Appendix C

Guideline for Management, Operation and Maintenance of Irrigation System by Water Users' Association

Contents

1. Background

The Project on Irrigation Scheme Development in Central and Eastern Uganda (PISD) is a study project on large- and medium-scale irrigation in Uganda implemented under assistance of JICA (Japan International Cooperation Agency) and in coordination with MAAIF (Ministry of Agriculture, Animal Industries and Fisheries) and MWE (Ministry of Water and Environment). The purpose of the project is to improve livelihood of regional farmers cultivating lowland and proximity fields through the development of sustainable irrigated agriculture for the rice production to build capacity for irrigation and natural resource management among different stakeholder categories.

In the second phase of the project (June 2015 – December 2016), the JICA Study Team (JST) decided to develop this guideline to enhance capacity of farmers for proper management and O&M (Operation and Maintenance) in the future irrigation project. The following three priority groups in the Namatala River basin were selected for the sample training.

- Kakoli Akuseka Takuwa Reflect Association (Kakoli Village, Nangeye Parish, Naboa S/C, Budaka District)
- Nahamya Rice Grower's Association (Nahamya 'A' Village, Kaiti Parish, Naweyo S/C, Butaleja District)
- Kibiniko Y'etana Farmers' Group (Kibiniko Village, Tsabanyanya Parish, Bukasakya S/C, Mbale District)

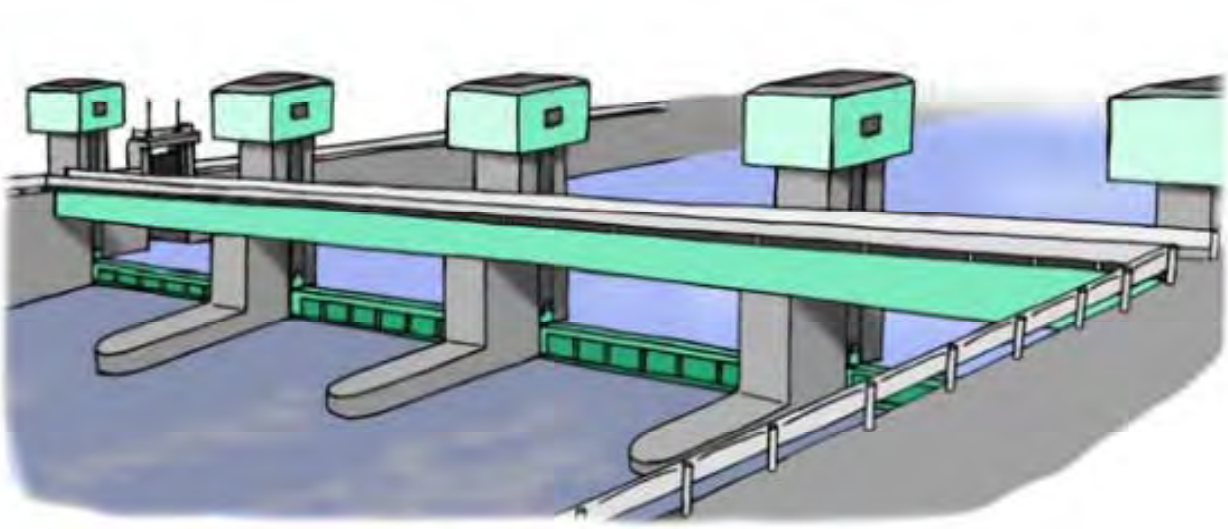
The JST provided the sample training on irrigation management to the selected groups. The sample training focused on organizational management of Water Users' Association (WUA), not on facility construction or farming technologies. The result of sample training was reflected to this guideline. The JST expresses our deep appreciation to the selected three groups for their kind cooperation.

Expected reader of this Guideline:

- Farmers groups preparing for the future large-scale irrigation project
- National government or local government officers in charge of organizing WUAs

2. Facilities: Type of modern irrigation facilities

Modern irrigation facilities can provide stable water supply to the field, which enables farmers to increase production. On the contrary, the modern facilities require high-skilled management organization and high cost to maintain. That is why we need to establish a solid Water Users' Association (WUA).



Headwork

Main water gate and Main canal

Water gate at secondary canal to tertiary canal (Doho Irrigation Scheme)

Figures from "PARTICIPATORY IRRIGATION MANAGEMENT ORGANIZATIONS IN JAPAN", February 2011, JICA-Tsukuba International Centre

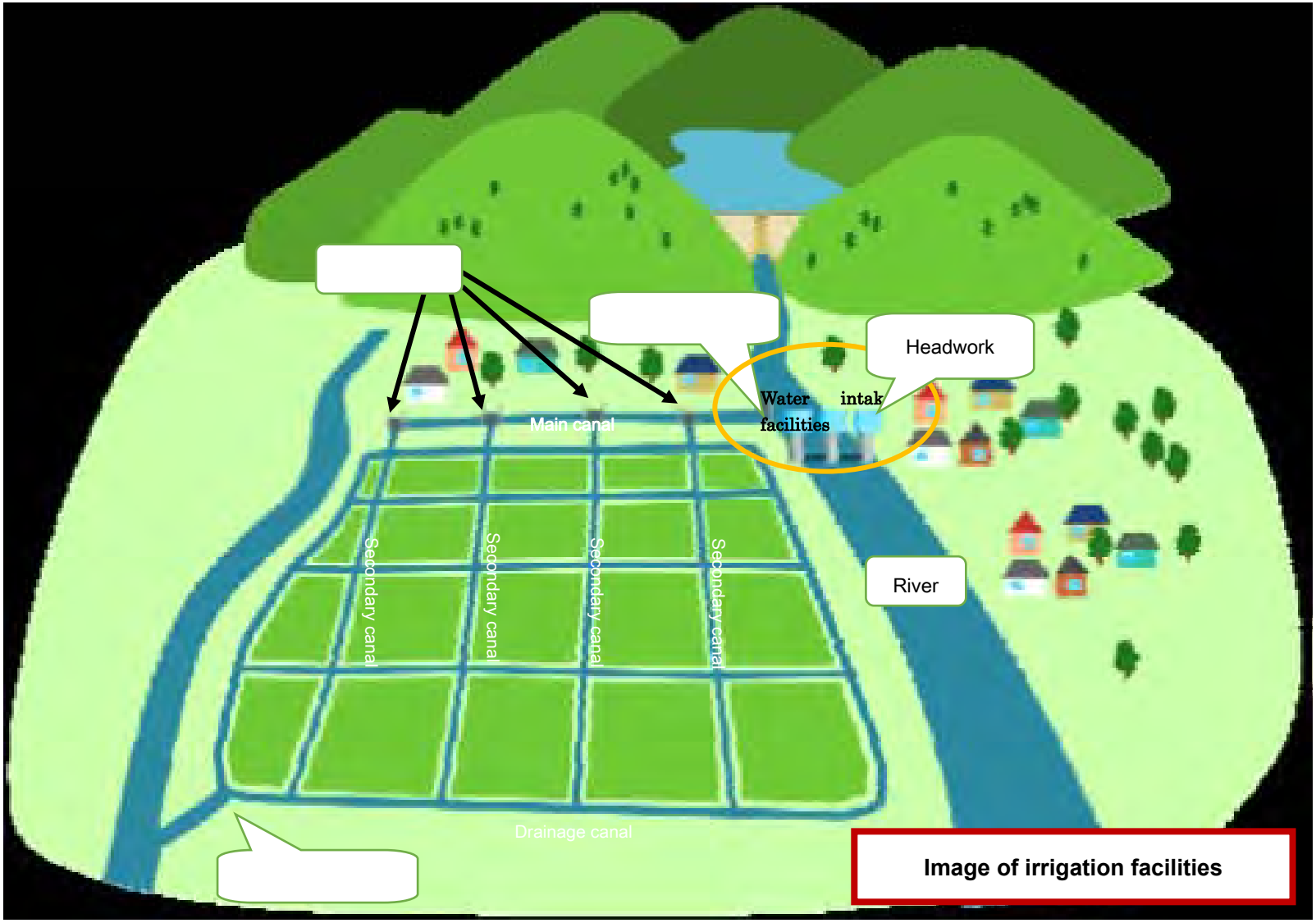


Image of irrigation facilities

Main canal (Doho Irrigation Scheme)

Water gate at the main canal　(Doho Irrigation Scheme)

Diversion of water and water gate at the secondary canal　(Doho Irrigation Scheme)

Secondary canal　(Doho Irrigation Scheme)

3. Organization: Water Users' Association (WUA)

(1) Role of Irrigation Water Users' Association (WUA)

The main purpose of establishing an Irrigation Water Users' Association (WUA) is *to ensure efficient andequal water distribution tomembers*. In order to accomplish this purpose, WUA is usually established as *autonomous, non-profit, self-fundingorganization with a certain legal status*.

Main role of WUA is *Operation and Maintenance (O&M) of irrigation facilities* (water intake, canals, water gate, drainage, etc.) and *Management of whole irrigation systems*.

Specific roles of WUA are;

a) O&M: prepare and implement O&M plans, ensure efficient supply of water, and mobilize resources for O&M (fund, labour, material, etc.)

b) Financing: collect annual fee from members (registration fee, water users fee, etc.), manage association's fund and allocate budget

WUA also plays an ordinary role of farmers association such as:

a) Coordination: involve all beneficiaries and facilitate communication between members
b) Representative: negotiate and collaborate with concerned government department and agencies
c) Conflict resolution: mediate conflict among beneficiaries over irrigation systems

WUA must be organized as soon as the irrigation area is identified and confirmed so that they can appraise their needs for water and participate in construction works. This process is critical in nurturing the sense of ownership among the intended irrigation users.

The persons who have control over the farmlands are farmers (or owners). In addition, the persons who pay the cost of irrigation management are farmers (or owners).

(2) Members

One of the specific characteristics of WUA is that *membership in WUA is **compulsory*** to the all resource (land and water) users within the irrigation area that is legally determined by WUA and related authority. The members democratically control WUA, share risks and benefit from irrigation system, and accept corresponding responsibilities. Farmers using water from the irrigation system obligatorily become a member of WUA.

General qualification of membership is as follow;

a) The person is a citizen of the country
b) The person is of the age of xx years and above
c) The person is a farmer conducting farming within the irrigation area. The persons who have control over the farmlands are farmers (or owners).

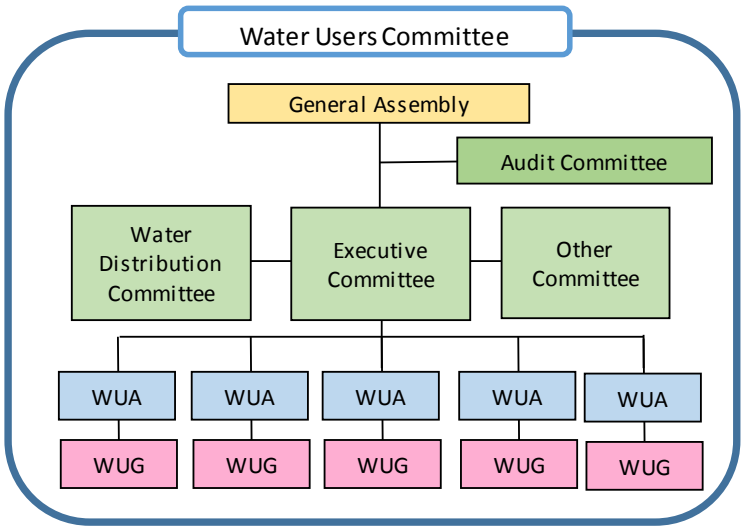
Members' Rights	Members' Obligation
◆ To get irrigation water supply in accordance with the rules of water distribution ◆ To be elected for or elect the committee and other positions ◆ To attend the general meeting and provide constructive idea and to freely express opinions or ideas ◆ To exercise the right to vote on all matters affecting to the Association.	◆ To use irrigation system properly ◆ To work jointly with other members in proper management, operation, use and maintenance of the irrigation system. ◆ To pay water users fee and other agreed contributions on time ◆ To attend the general meeting ◆ To obey and comply with the regulations

(3) Structure of WUA

Internal Structure of WUA:

The basic functional bodies of WUA are General Assembly, Management Committee, and Water Users' Group (WUG).

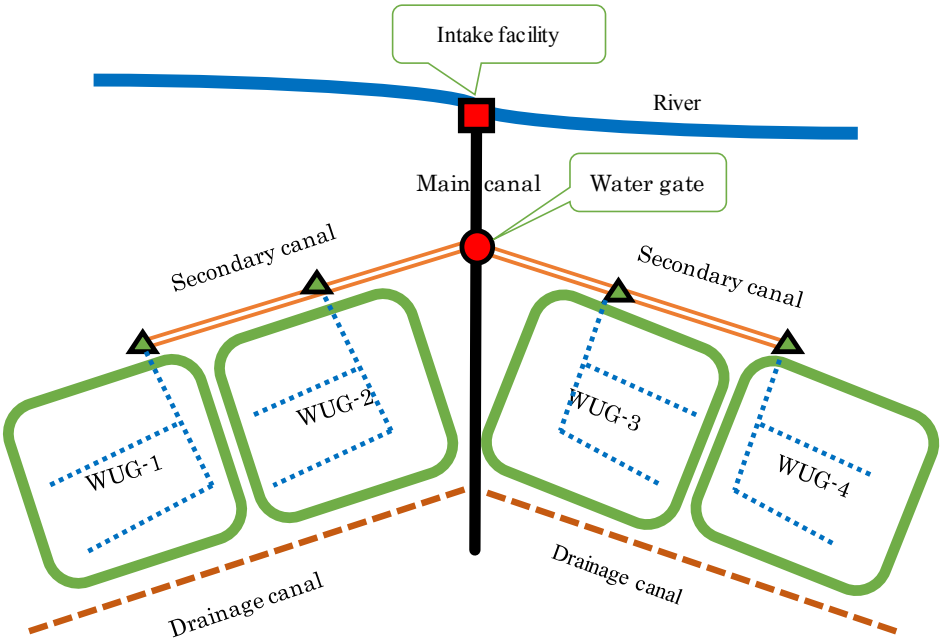
Name of functional bodies	Function, duty and responsibility
General Assembly	General Assembly is the highest authority and the highest decision making body of WUA, being composed *of all the members* of WUA. ◆ elect members of management committee, ◆ decide on proposals presented by the Management Committee, ◆ approve laws and regulation of the association, and ◆ approve annual plan, budget, and financial statement.
Executive Committee (Management Committee)	Executive Committee members are elected by general assembly. The Committee shall consist at least: a) Chairperson, b) Vice chairperson, c) Secretary, and d) Treasurer. They are responsible to management and administration of overall irrigation system such as; ◆ To plan and budget for operation and maintenance ◆ To manage irrigation system operation, monitor and evaluate its status (e.g. procurements of service/works/good, supervise gate operator, modification of facilities, etc.) ◆ To collect water users fee and other contribution, exercise expenditure and keep financial record ◆ To prepare official record on performance and financial situation of irrigation system ◆ To resolve conflict among beneficiaries. ◆ To assist other committee's activities
Other Committees	General Assembly will also elect other committees as necessary such as; Audit Committee, Water Distribution Committee, Marketing Committee, Loan and Saving Committee, and so on.
Water Users' Group (WUG)	All members shall belong to Water Users' Group (WUG) consisting of *members who receive water from the same tertiary/terminal canal*. WUG is the body that operate and maintain their tertiary canals under technical support of Management Committee or Water Distribution Committee.



Sample Internal Structure of WUAs

In the middle and large-scale irrigation project, Water Users' Group (WUG) is formed as a subordinate organization within the WUA. WUG consists of 15-20 *members who receive water from the same tertiary/terminal canal*. The WUG is responsible in maintaining canals in their area. In this way, farmers become more responsible for maintain activities because they take care the facilities that they use.

WUG leaders were elected by their members. The leader is in charge of consensus building of his/her WUG members and participating in the WUA meeting on behalf of his/her WUG. In principle, WUA members are beneficiaries who receive water from the irrigation system. WUA can, however, involve a local government officer who helps to solve problems between people.



Formation of WUGs

Practice:
Calculate the number of WUGs under the following situation.

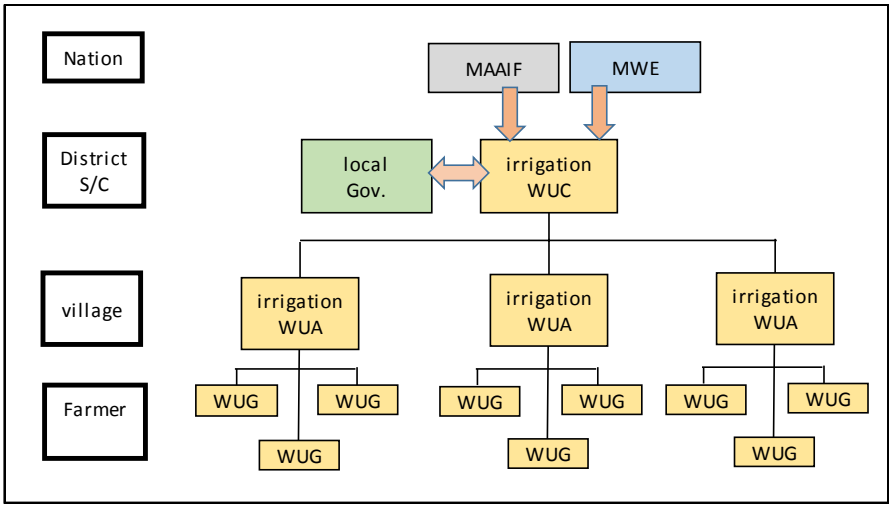
- Irrigated area: 4500ha
- Average farmland size per farmer in the irrigated area: 1ha
- Number of members for a WUG: 20 persons

A. 225 WUAs

Vertical Structure of WUA:

As the scale of irrigation becomes large, the multilayered structure is more suitable for O&M in terms of efficiency of members management. In the large scale irrigation project, several Water Users' Group (WUG) with 15-20 members are formed at lower level of WUA and Water Users' Committee (WUC) is formed at upper level of WUA.

In the large-scale irrigation system, involvement of national and local government is a key for proper management. O&M of modern irrigation structure requires high skills, which often go beyond farmer's ability. District government would be direct counterpart of WUC under the supervision of national government.

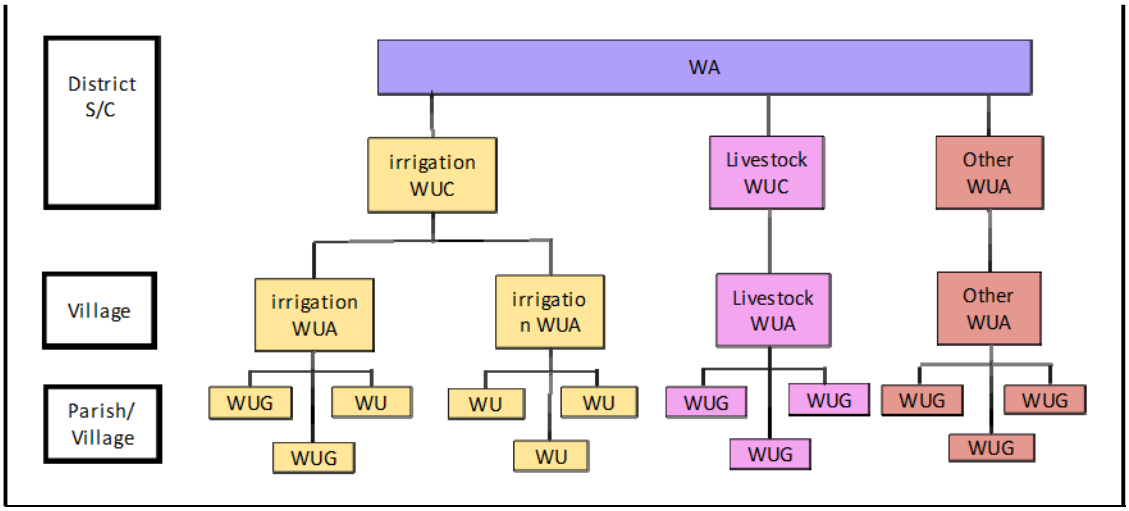


Sample Vertical Structure of WUAs

Generally, Water Users' Organization (WUOs; including WUC, WUA, and WUG) holds an annual general assembly and several executive and other committee meetings on demand. Young WUOs are, however, recommended to hold more general assembly due to its inexperience in organizational management. Frequent communication between executive members and farmers helps them to understand what problem farmers have and what executive and other committees decided. Especially WUOs at the initial stage need constant general assembly to discuss and decide the regulation (bylaws or constitution) of WUO. Formation of new regulations requires trial and error process to develop the final version so members have to gather frequently (e.g. once a week) to plan, do and check the new rules.

Horizontal Structure of WUA

Water resource is used by various users such as fisherman, livestock holder, drinking water user andso on. To avoid conflict between various water users, the communication chanel should be open to all stakeholders. An umbrella organization such as Water Resource Association (WRA) is often recommended to be formed over WUC in order to build consensus on water use in the area.



(4) Records

WUOs are managed and operated democratically. It means that WUOs ensure accountability and transparency of management policy and budget to all the members who give approval to the decision. Generating members, trusts to WUAs encourage them to pay the fee and to participate in O&M work.

To ensure accountability and transparency the written form of meeting and financial records are important. All members have access to this official record. The document is also useful for the third party to check the situation when some conflicts require outsiders to solve them.

All WUOs shall keep records on:

- Plan of the service area
- List of members, containing the size and location of each members' land
- Size of land that receives water in each irrigation period
- Schedule (Calendar) of water distribution
- O&M activity including detail of labour contribution by members
- Minutes of the meeting of the general assembly and committees
- List of assets owned by WUO
- Financial accounts and records, etc.

Box: WUA in Japan

WUA in Japan is called *LID (Land Improvement District Organization)*.

- LID is a farmers organization established with the approval of Prefecture Governor under the Land Improvement Act (1949)
- Establishment of LID requires the consent of two third farmers in the area.
- General assembly and General meeting of representatives are decision-making bodies.
- There are over 5,000 LIDs in Japan. Majority of LIDs cover less than 100ha and average size is 600ha with 900 members.
- Half of LIDs employ several permanent staffs.

- Some LIDs implement forestation project to ensure stable water resource and others provide technical service on irrigation skill and farm management to improve efficiency of water use.

Tips: Speedy decision making -Janken (Scissors, Paper and Stone)

Decision-making is one of the important role of all organization and it is, however, time-consuming and irritating work. Even after long discussion, sometimes members cannot find the point of compromise.

An old Japanese game called "Janken" is played when you want to decide the winner quickly. The game uses the following three types of hand signs.

Scissors

Paper

Stone

[Rules]

- Scissors cut Paper: Scissors win to Paper.
- Paper wraps Stone: Paper wins to Stone.
- Stone cracks Scissors: Stone wins to scissors.

[Process of the game]

The two opponents hammer their closed fist twice in the air simultaneously and at the third stroke, they reveal the chosen hand sign. You have to guess which hand sign the opponent will choose, and which hand sign you will choose to defeat him/her. It is a game to test your luck.

(5) Bylaws (Constitution/Charter)

WUA's bylaws are recommended to be developed on the member's consensus. The process of generating bylaws helps memebers to understand and fosters sense of ownership.

Contents of the by-laws:

a) Name, location, address and working area of the association
b) Objectives and activities of the association
c) Membership requirements of the association, and conditions for withdrawal and dismissal

from membership

d) Right and duties of members of the association
e) Power, responsibilities and duties of management committee and other committee
f) Conditions, rules, regulations and requirements for irrigation water acquiring, allocation, distribution and drains
g) Conditions for fixations of water rates, recovery and other resource mobilization
h) Conditions for re-election, appointment, terms of office and suspension or dismissal of the members of the management committee or other committees.
i) Conditions for calling of meeting and voting
j) Conditions for conflict management
k) Penalty/Sanctions
l) Conditions for amendments of the by-laws

The articles on "Conditions for conflict management" and "Penalty/Sanctions" are difficult to determine when WUA has little experience of these issues. These articles should be continuously amended through trial and error until the effective way of conflict management or punishment is found.

Generally, WUA penalizes the following actions;

a) Default of water users fee
b) Non participation of communal work
c) Take (steal) water by damaging irrigation facilities
d) Damage caused by livestock
e) Theft of parts of the facility
f) Violation of water distribution schedule

Practice:

1. Discuss which content is missing in the bylaws of your group
2. Create a new article of bylaws regarding to penalty on the member who are not willing to pay water users fee. Please remind that the WUA membership is compulsory. You cannot chase away members so easily.

Box: Example of articles on Penalty/Sanctions

[Model Charter for WUAs in Afghanistan]

Article 45: Offences and Penalties

Whoever, without any lawful authority:

(a) refuses to pay service or other charges levied by the Association;

(b) refuses to fulfil obligations in the hasher (community work);

(c) damages, alters, enlarge or obstructs any part of the irrigation and drainage system,

equipment, or facilities of the Association;

(d) interferes with, increases, or diminishes the water supply in, or the flow of water from, through, over or under any irrigation and drainage system;

(e) opens, shuts or obstructs or attempt to open, shut or obstruct any sluice or outlet or any other similar facility in any irrigation system; or

(f) corrupts water of any irrigation system as to render it less fit for the purpose for which it is ordinarily used;

commits an offence against the Association and its members.

Article 46:Non-Payment of Service Charge

In the event of non-payment of a service charge, the Association may take the following series of actions:

1. A warning to the delinquent water user from the Treasurer
2. A fine upon the delinquent water user established by the Treasurer (or Accountant) and Mirab (traditional water gate keeper), to be collected by the Treasurer (or Accountant)
3. A cut-off of water supply to the user, by order of the Management Board, until the delinquent amount is paid and/or termination of the water users' membership

Article 47: Refusal to Participate in Collective Work

In the event of refusal of a water user to perform hashar duties, the Association may take the following series of actions:

(1) A warning to the delinquent water user from the Mirab

(2) Termination of the users' water right for the upcoming season, by order of the Management Board.

If within one week of termination of the water right a water user pays compensation for delinquency in hashar duties in labour, in kind, or in cash, the Association shall restore the water right for the upcoming season.

Article 48: Damages

In the event that a water user in any manner illegally alters or damages the irrigation and drainage system or other equipment and facilities that belong to the Association or another water user, the Association may levy a fine of up to 1,000 Afghanis, plus the cost of the repair or replacement of the altered or damaged irrigation and drainage system or other equipment and facilities.

Article 49: Interference

In the event that a water user interferes with, increases, or diminishes the water supply in, or the flow of water from, through, over or under any irrigation and drainage system, the Association may takes the following series of actions:

(1) A warning to the delinquent water user from the Treasurer

(2) A fine upon the delinquent water user of up to 1,000 Afghanis plus the cost of damages to other

water users, to be established by the Treasurer (or Accountant) and Mirab, and to be collected by the Treasurer (or Accountant)

(3) A cut-off of water supply to the user, by order of the Management Board, until the fine is paid and/or termination of the water users' membership

Article 50: Delinquency

Non-payment, delinquency of payment, or failure to abide by the established penalties shall constitute grounds for the following:

(1) The Association may terminate the membership of the offender.

(2) The Association may lay a claim suits in local courts.

(3) The Association may put a lien against the property of the offender.

4. O&M: Operation and Maintenance of Irrigation System

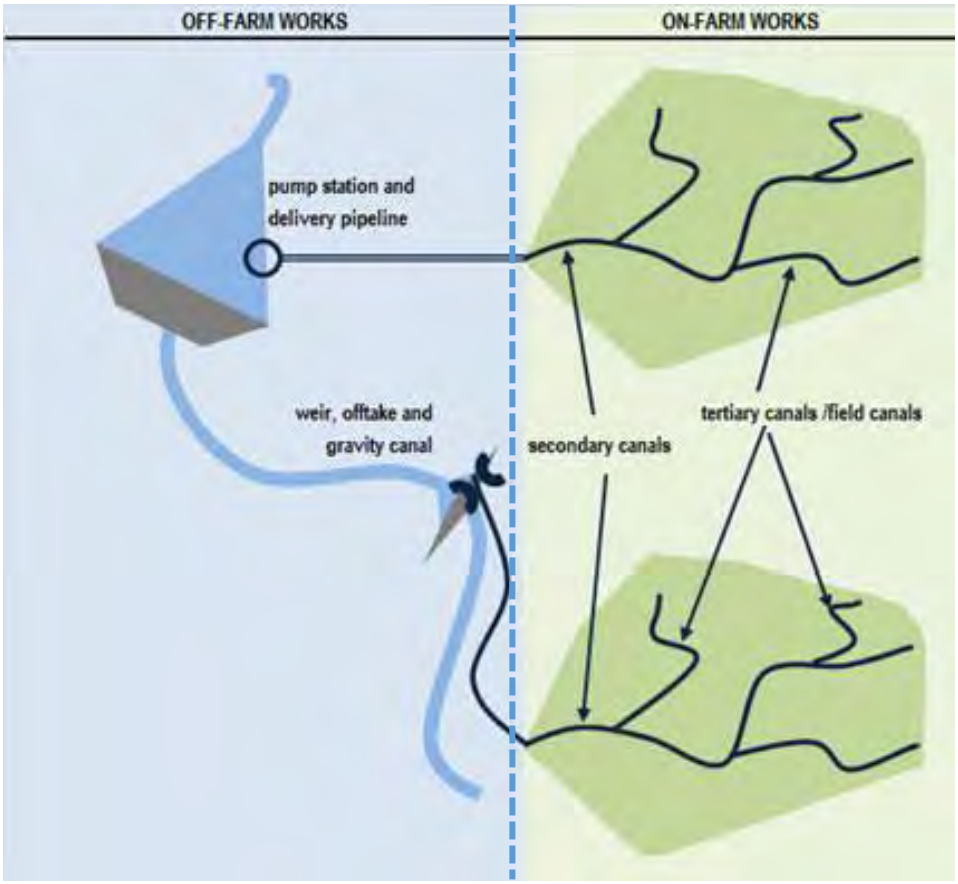
(1) Project Body

In the concept of "*Participatory Irrigation Management (PIM)*", the beneficiaries (users of irrigation system) organize the WUAs to participate positively into O&M activities. WUAs/WUGs are considered as a main body for O&M of irrigation facilities. PIM is very popular concept for irrigation project worldwide. The advantage of PIM is; to reduce O&M cost, and to foster a sense of ownership of users.

In PIM, the beneficiary farmers are involved into the planning and design of facilities such as canal allocation or facility structure so that the farmers give advice to the plan/design and gain a better understanding of facilities that they are going take care of. The farmers are recommended to be organized as WUAs and WUGs at the planning stage of irrigation project.

Irrigation development project is implemented by a combination of several project bodies such as government, District and farmers organization. According to the National Irrigation Master Plan for Uganda (2010-2035), responsibility of each body is as follow;

MWE: Ministry of Water and Environment	◆ Assessment of water resources availability and economic analysis of water usage, ◆ Design/construction of **off-farm** infrastructure (dams, pump station, delivery canal, etc.) ◆ Support to the O&M of **off-farm** hydraulic works, major water infrastructure and reservoirs
MAAIF: Ministry of Agriculture, Animal industry and Fisheries	◆ The provision of technical assistance with respect to the design and construction of **on-farm** irrigation system (including distribution/field canals, control structure, drainage canals, etc.) ◆ the promotion of appropriate technologies for efficient and effective use in irrigation ◆ support to the O&M of the **on-farm** systems, ◆ the provision of extension services and provision of advice to farmers on irrigation systems and promotion of efficient water use, ◆ the provision of support to /for the supervision and monitoring of water use and management
Local Government	◆ project planning and site selection ◆ project monitoring ◆ establishment of appropriate management structure ◆ providing availing land and facilities ◆ participating in capacity building related activities
Farmers Organization	◆ forming, joining and participating in WUA ◆ contributing capital costs of the on-farm works ◆ O&M of the on-farm work ◆ Payment of the recurring costs, including the water service tariff



(2) Organizational Structure for O&M

Operation and maintenance is a key action to secure the sustainability of irrigation facilities. When O&M activities are not properly done, the facilities degrade immediately and lose their function of water supply. If you operate the facilities properly and maintain them periodically, you can utilize facilities more sustainably. Of course, additional investment is necessary to rehabilitate or reconstruct the facilities for long-term (e.g. the water gate need to be repaired at least every 20 years). This additional cost put pressure on the project budget. A proper O&M activity requires a proper O&M organization.

In the past irrigation project in Uganda, the government hands over facilities to WUOs to fully operate and maintain the facilities. In many cases, however, farmers were not well-capacitized and they did not know their roles or responsibility in irrigation O&M, which resulted in poor O&M of facilities, improper distribution of water and poor collection of water users' fee.

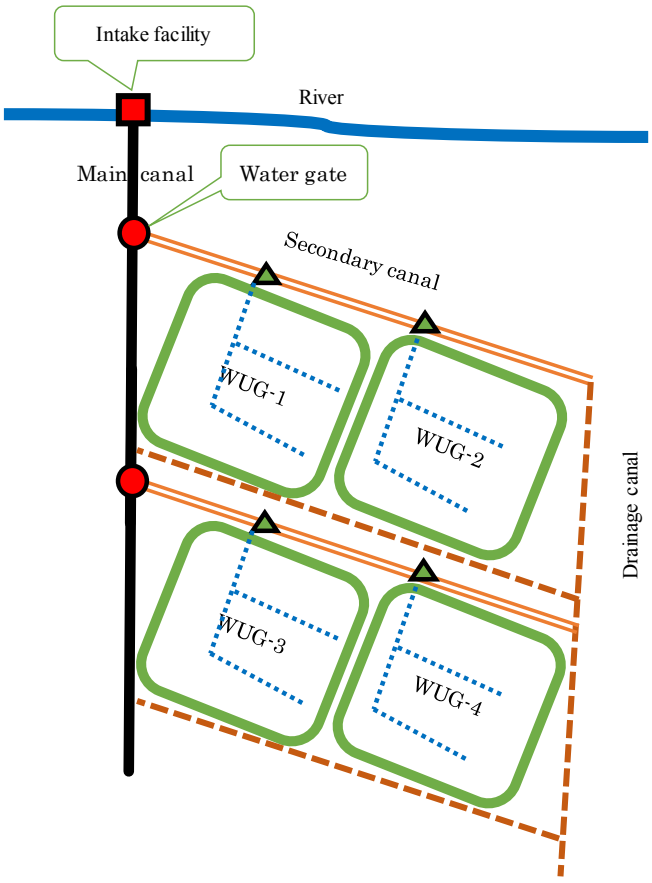
To avoid the above mentioned situation, national government and local government are expected to be involved into O&M so that farmers' organization receives necessary supports.

- National government has the primary responsibility to repair/rehabilitation of large facilities and they also give technical advice and training to other parties which manage the lower facilities.

- District government is responsible to O&M of the secondary facilities. Local government also plays a role of hub between farmers and national government.
- Farmers organization is responsible in ordinary O&M of the whole facilities with support of national and local government and also functions as a channel of tariff collection and labor supply for maintenance.

Expected role of division

Name of facility	Icon	Operation & ordinary maintenance	Large maintenance
Intake facilities (Headwork, main water gate)		Farmers Organization (WUC)	National government
Main canal		Farmers Organization (WUC)	National government
Water gate (From main canal to secondary canal)		Farmers Organization (WUC)	National government
Secondary canal		Farmers Organization (WUA)	Local government
Water gate (from secondary canal to tertiary canal)		Farmers Organization (WUA & WUG)	Local government
Tertiary canal		Farmers Organization (WUG)	Farmers Organization
Drainage canal		Farmers Organization (WUG)	Local government



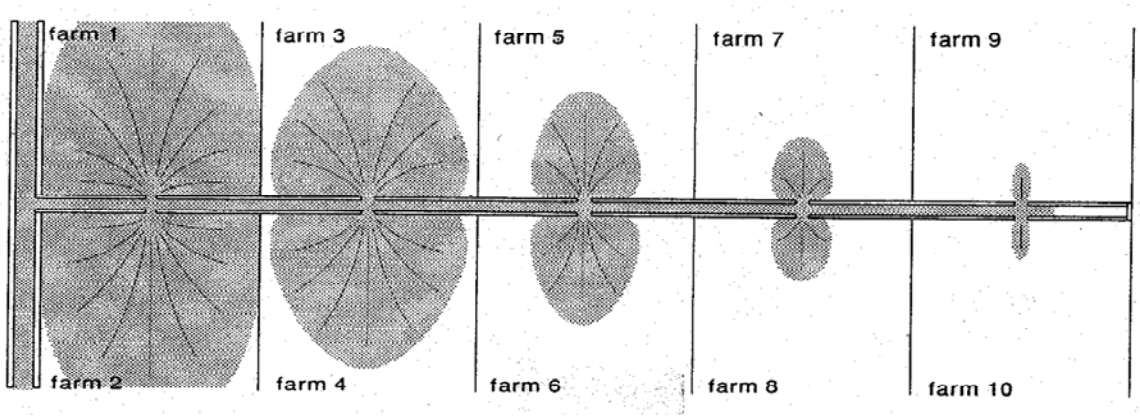
(3) Operation of water delivery

WUOs have to secure equal water distribution to member's field. Also, WUA have to utilize water resources in the most efficient way. The term "equal" in this case does not always mean that all farmers receive the same quantity of water. It means that water is distributed according to the cropping stage of each field so that the production volume of the area increases. The farmlands in downstream tend to receive less water than ones in upstream. These inequalities should be adjusted through WUOs activities.

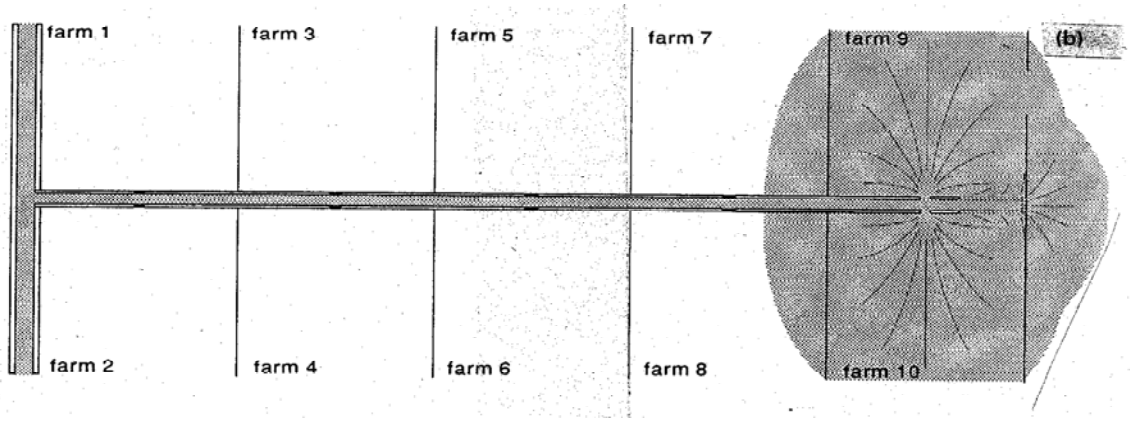
One of the important factors of irrigation operation is to make **the water distribution calendar** determining when to irrigate to which farmland and how much water to be applied. Usually water quantity is not enough to deliver at the same time to all the farmlands in the area, **rotation** distribution method is often applied so that all the farmlands receive water equally.

The figures below are bad examples of water distribution. In Example (a), all water gates to the 10 farmlands are opened and most of farmland at downstream gets less waters. In Example (b), only two Watergates are open and water overflows. You should make rotation considering quantity of water and water pressure.

Example (a): all gates to farmlands open at the same time



Example (b): a few gates are open and the canal overflows. The water is wasted.



FAO: Irrigation Scheme Operation and Maintenance

BOX: Process for making Water distribution calendar

a) WUGs collect information on water demand of members and inform it to WUA and WUC.
b) WUC makes the annual calendar of water distribution to the secondary canals. The calendar is discussed and approved in the general meeting.
c) WUA makes the annual calendar of water distribution to the tertiary canals. The calendar is discussed and approved in the WUA meeting.
d) WUG makes the annual calendar of water distribution to the farmland from the tertiary canal. WUG also make consensus between members on the rule of water distribution from the tertiary canal.

When you make the water distribution calendar, never forget to secure **equality** and to make **consensus** among all the members. All members should participate in making the calendar on the equal ground. All calendars should be approved formally in the general meeting or other official meetings.

Types of water distribution calendar;

a) irrigating on fixed intervals
b) irrigating on member's water demand;
c) observation of visual plant stress

The calendar on fixed interval is the most easy to make. However, the calendar on member's water demand is more adequate when farmers needs control the harvest timing in accordance with the market situation.

Operation of water gate

Executive Committee meeting

Example of Water distribution calendar (Monthly): **irrigating on fixed intervals**

* x=opening gate

	day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	total
Water availability	Water availability	high												moderate						low													
	Number of water gate to be opened	6												4						2													
Opening gate	Farm 1	x	x	x		x	x	x		x	x	x		x		x		x		x				x				x				x	16
	Farm 2	x	x	x		x	x	x		x	x	x		x		x		x		x				x				x				x	16
	Farm 3	x	x		x	x	x		x	x	x		x	x		x		x			x				x				x				15
	Farm 4	x	x		x	x	x		x	x	x		x	x		x		x			x				x				x				15
	Farm 5	x		x	x	x		x	x	x		x	x		x		x		x			x				x				x			15
	Farm 6	x		x	x	x		x	x	x		x	x		x		x		x			x				x				x			15
	Farm 7		x	x	x		x	x	x		x	x	x		x		x		x				x				x				x		15
	Farm 8		x	x	x		x	x	x		x	x	x		x		x		x				x				x				x		15

From day1 – day12, water availability is high and you can open 6 water gates a day. In this case, each farm can receive water for 3 days of every 4 days.

From day 13 to day 18, water availability is moderate and you can open 4 water gates a day. In this case, each farm can receive water every other day.

From day 19 to day 31, water availability is low. In this case, each farm receive water only once in every 4 days

In this month, Farm 1 & 2 receives more water than other farms. The difference should be adjusted in the next month.

Example of Water distribution calendar (Monthly): **irrigating on member's water demand** (■ farm requesting water, x=opening gate)

	day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	total
Water demand	Farm 1											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	Farm 2						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
	Farm 3	■	■	■	■	■	■	■	■	■	■	■		Water demand				■	■	■	■												
	Farm 4			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■					
	Farm 5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■												
	Farm 6								■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Farm 7										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Farm 8	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
Water availability	Water availability	high												moderate								low											
	Number of water gate to be opened	6												4								2											
Opening gate	Farm 1											x	x																				
	Farm 2						x	x	x	x	x	x	x																				
	Farm 3	x	x	x	x	x	x	x	x	x		x																					
	Farm 4			x	x	x	x	x	x	x	x	x																					
	Farm 5	x	x	x	x	x	x	x	x	x	x		x																				
	Farm 6								x	x	x	x	x																				
	Farm 7										x	x	x																				
	Farm 8	x	x	x	x	x	x	x	x	x	x		x																				

Practice: make the water distribution calendar from day 12 to day 31

(4) Monitoring of water distribution

The monitoring system is necessary to watch;

- The water is distributed in accordance with water distribution calendar,
- The water gates are opened and closed as scheduled,
- The water is distributed properly into farmlands, etc.

Farmers need to gain a habit to inform WUA/ WUC what they notice in their farming practice. On the other hand, *WUA/WUC has to response properly* to the issues that they are informed. This interaction creates a relationship of confidence between farmers and WUA/WUC. Emergency response system is also necessary to arrange emergent water distribution in case of sudden draught.

The people or WUGs that solves problems over O&M by surveillance should be awarded and their **good practices** should be shared between members. This process promotes participation of farmers to monitoring activities.

(5) Maintenance of irrigation facilities

Routine maintenance activities have to be repeated throughout the lifetime of an irrigation project to keep it functioning. There are several types of maintenance work; simple routine maintenance, skilled routine maintenance, long term maintenance and emergency maintenance.

i) Simple routine maintenance is daily routines which do not require special skills. Whenever possible, these daily routines should be done by the water users themselves. Large-scale routine is usually scheduled in the off-season, when both farmers and operators are not busy with irrigation and can therefore more easily be engaged in maintenance work.

- greasing of gates;
- removing vegetation from weir/embankments, canals and drains;
- removing silt from canals, drains and structures.

ii) Skilled routine maintenance is maintenance activities require skilled technician (mechanic, carpenter, etc.).

- repairs to gates;
- repainting of steel structures;

iii) Long term maintenance (repair): irrigation facilities such as concrete structure, steel gate and bridges have limited life. Therefore, after certain years, these facilities must be replaced with the new facilities before the existing facilities worn out and unable to function.

Durability of the facilities depends on the material; Concrete structure-5-20 years. Wooden structure-several years.

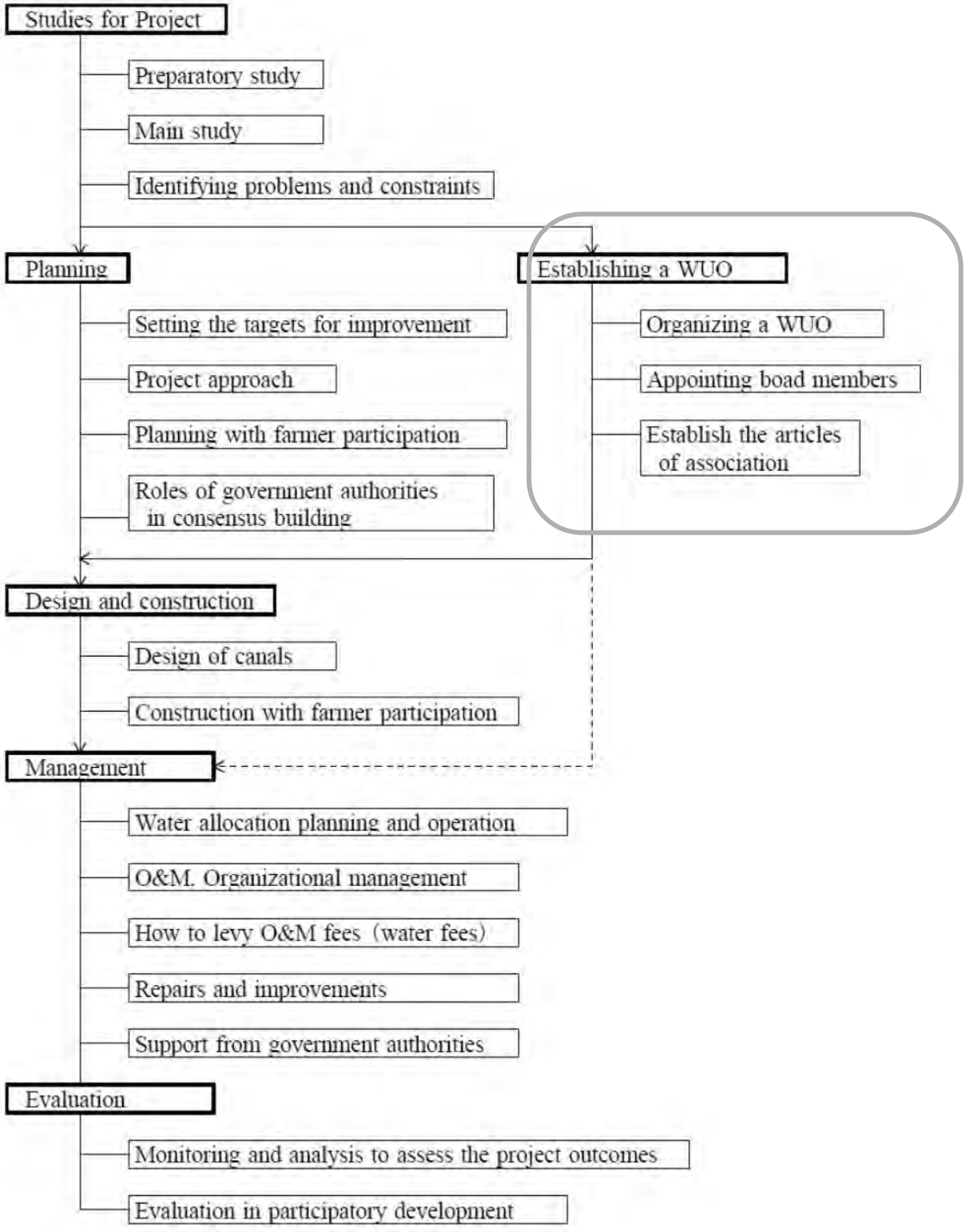
iv) Emergency works: Emergency works require immediate and joint action by all stakeholders, to prevent or reduce the effects of unexpected events such as:

- breach or overtopping of canal embankment or river dike, causing flooding;
- critical failure of head works, causing interruption of irrigation water supply;
- natural disasters such as floods, earthquakes or storms.

Operational staff must be trained so that they know what to do as soon as they arrive on the scene, such as closing the head works in case of a canal breach. A good communication system can do much to reduce the damage.

Maintenance of canal by members

Role of WUA starts at Planning Stage in PIM (Participatory Irrigation Management)

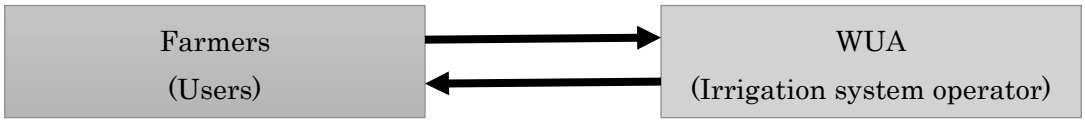


Source: JIID

5. Financial Management of Irrigation System

(1) Revenue and Expenditure of WUA

One of the main characteristics of WUA is ***self-funding***, which means that *WUA should operate and maintain the irrigation system solely based on contributions in cash or kind from the beneficiaries*. Thus, WUA must secure funding source, manage fund and allocate fund properly.



Exchange of water and money

Irrigation system is sustained by regularly maintenance by WUAs (the irrigation system operator) and the cost should be borne by farmers (the irrigation system users). Thus, the irrigation system is the exchange relation of money and water between users and operator.

i. Revenue of WUA

Main source of income for WUA is derived from contribution from beneficiaries, such as registration fee, water users' fee, and so on. In principle, the payment from users is the single income for WUA. Thus, stable charging system to members is a lifeline for WUA management. The fees are charged to *all users of water in the irrigation area*.

Box: Example of charging system for Water Users Fee

There are various methods for charging users, based on;

- the size of the irrigated area;
- the irrigation volume;
- a share of the harvested crop.

Area Based Fee Collection (most simple and clear charging method)

- Fixed rate per hectare (acre) of irrigated farm
- Charge is not related to type of crop grown or actual volume of water received
- Net irrigated farm size assessments will be made per each farmland before pricing.

Water charge shall be collected *at the end of the harvest season* in cash. When the WUA members is unable to pay in cash, the water charge may be in kind (unmilled rice, etc.) or in labour force. In this case, WUA shall determine the value of in kind payment in terms of cash.

ii. Expenditure

The fund of WUA is derived from Water Users Fee or other contribution from members. Most part of this fund shall be used for ordinary expenditure. The rest shall be reserved for the emergency expenditure or cost to renewal facilities in the future.

General contents of ordinary expenditure are;

a) Cost of operation and maintenance of the irrigation facilities including head works, canals, other structures and equipment;
b) Purchase and replacement of parts of equipment;
c) Funding of relevant training for members of the Association;
d) Payment of employees and contractors engaged by WUA;
e) Payment of other administrative costs.

Emergency expenditure

The cost of first aid in case of;

- breach or overtopping of canal embankment or river dike, causing flooding;
- critical failure of head works, causing interruption of irrigation water supply;
- natural disasters such as floods, earthquakes or typhoons.

Cost to renewal of facilities in the future

- The cost to replace water gate and other facilities (every 5-20 years).
- The cost to repair large structures such as headwork, main canal, etc.

Although the financial principle of WUA is self-funding by members, in case of repair of large facilities such as headwork or main water gate, WUA possibly gets financial support from national government due to its high cost.

Practice: List up all expected activities of O&M and estimate the cost for each activity.

(2) Pricing Water Users Fee

Pricing of Water Users Fee should be calculated carefully. The members might reject to pay the fee when pricing method is not clear or they are not satisfied with the price itself. General process of pricing is *accumulating all expected expenditure* as follow:

a) List up all expected expenditure including ordinary expenditure, emergency expenditure and cost to renewal (see the former section);

b) Estimate *annual cost* for each expenditure;

c) Sum up all the costs;

d) Divide the sum by size of irrigation area, then you will get water users fee per acre per year.

After you get the price of Water Users Fee, you have to consider if the price is "*affordable*" to members. If not, you have to change the way of activity to more economical way or to give up some activities. The charging timing could be both yearly or seasonally considering seasonal affordability of members.

Practice:

Calculate O&M cost per acre by using the List of expected activities of O&M and estimation in the previous Practice.

Box: Example of pricing water users fee in Japan

Breakdown of Levy (Water Users Fee) *3000Ush =1 US$ = 100 Yen, 10a=0.25 acre

[Revenue]

1. Ordinary Levy
   (1) Block expecting irrigation and drainage (BLOCK A)
   4,200 Yen/10a = 42US$/10a
   (2) Block expecting only drainage (BLOCK B)
   2,520 Yen/10a = 25.2US$/10a

2. Operation and Maintenance Levy
   The levy charge varies from 3,100Yen/10a to 5,000Yen/10a, depend on the condition of blocks.
   No charge for the blocks with drainage only (Block B).

3. Special Levy (Repayment/Redemption for loan amount for construction cost)
   Farmers burden cost for project construction cost

[Expenditure]

4. Utilization of the Ordinary Levy
   (1) Management Fee ; 250Yen/10a (BLOCK A), 150Yen/10a (BLOCK B)
   (2) Deposit for repairing facilities; 350 Yen/10a (BLOCK A), 210 Yen/10a (BLOCK B)
   (3) Organizational fee for several types of meetings such as Representative members committee meeting, Board meeting etc.
   (4) Wages for Staff
   (5) Office operation fee; repairing office, water & electricity charges etc.
   (6) Collection for levy from the members
   (7) Common expenditure
   (8) Contingency

5. Utilization of Operation and Maintenance Levy
   (1) Repairing Cost for facilities
   (2) Construction fee
   (3) Electric charge for operation of pumps and gates
   (4) Subcontract fee for inspection of high voltage facilities
   (5) Management cost for slashing, removal of waste.
   (6) Share expense and burden
   (7) Rehabilitation of facilities
   (8) Contingency

(3) Financial Record of WUA

All kind of organization must be accompanied by accountability. Especially financial accountability attracts member's attention so the organization should keep clear and evident financial group. The following table is a sample of financial record. It is a simple format with only five columns – Date, Item, In (revenue), Out (expenditure) and Total.

[Book keeping rules]

- Date: date that your group receives or spends money.
- Item: name of item that the group receives or spends. Do not forget to put unit price and quantity of item.
- IN (revenue): amount (USh) that the group receives. Revenue is income of the group. You can put only numbers in this column.
- Out (expenditure): amount (USh) that the group pays. Expenditure is money spent by the group. You can put only numbers in this column.
- Total: sum of money remained to the group. It is also called "balance". Total amount is calculated by; (in case of "IN") Total = Total in the previous row plus amount of In, or
  (in case of "Out") Total = Total in the previous row minus amount of Out

All financial documents should be kept with financial record.

Financial Record (Simple format)

Date	Item	IN (Revenue)	OUT (Expenditure)	Total

Practice: Simulation of financial record

Fill in the financial record sheet according to the following events.

Event 1	January 5th. The first meeting of this year was held. The financial balance is 24,500Ush. All 16 members paid membership fee. Membership fee is 5000Ush per person.
Event 2	January 18th. Today is maintenance day of canals. The chairperson purchased some maintenance tools at 40,000Ush. 12 members participated. All participating members were provided soda. Unit price of soda is 1000Ush.
Event 3	February 2nd. One of the members requested the support to his children's school fee. The members agreed to support member with 15,000Ush.
Event 4	February 5th. Flood destroyed the canals of field. It costs 65,500Ush to repair the damage canals but financial balance was not enough for that. Kindly, Mr. Jacob lent 30,000Ush to the group. The repair work was done.
Event 5	February 10th. At the meeting, 15 members paid membership fee. Membership fee is 5000Ush per person. 30,000Ush was returned to Mr. Jacob.
Event 6	February 14th. A member paid membership fee. He also paid penalty of 1000Ush because he delayed to pay.

6. Environment and Agriculture

(1) Multifunctionality of Agriculture

Intensive agricultural practice often causes environment destruction such as soil infertility, soil erosion, and unavailability of water and so on. These events resulted in failure of farming in long term. For sustainable agriculture, some rules and regulation on farming are needed to prevent overuse of natural resources. The most popular rule concerning agriculture and environment is "*sustainability*". Sustainability of agriculture is the condition where natural resources are used in renewable way and no pollution is created by farmers.

The concept of "*Multifunctionality of agriculture*" shows us an example of sustainable agriculture. In this concept, agriculture has various roles other than food production. Other roles played by agriculture are as follows;

- Conservation of Land
- Fostering Water Resources
- Preservation of the Natural Environment
- Development of Favourable Landscapes, and provide space for Recreation/Relaxation
- Protection of Cultural Asset
- Viability of Rural Community (job creation)

Especially paddy rice field contributes to environmental issues such as land conservation, and water resource fostering. The followings are some example of roles of paddy field.

- Paddy fields prevent flood in surrounding areas by storing rainwater temporarily.
- Water stored in paddy fields sinks into soil gradually and becomes groundwater, which will help to ensure stable river flows.
- Embankment/weir/ridge of paddy field prevents soil erosion
- Water drained from paddy is reusable for other purpose such as livestock grazing, fishing and industrial use.

Paddy rice cultivation is one of the environment-friendly methods of agricultural practice.

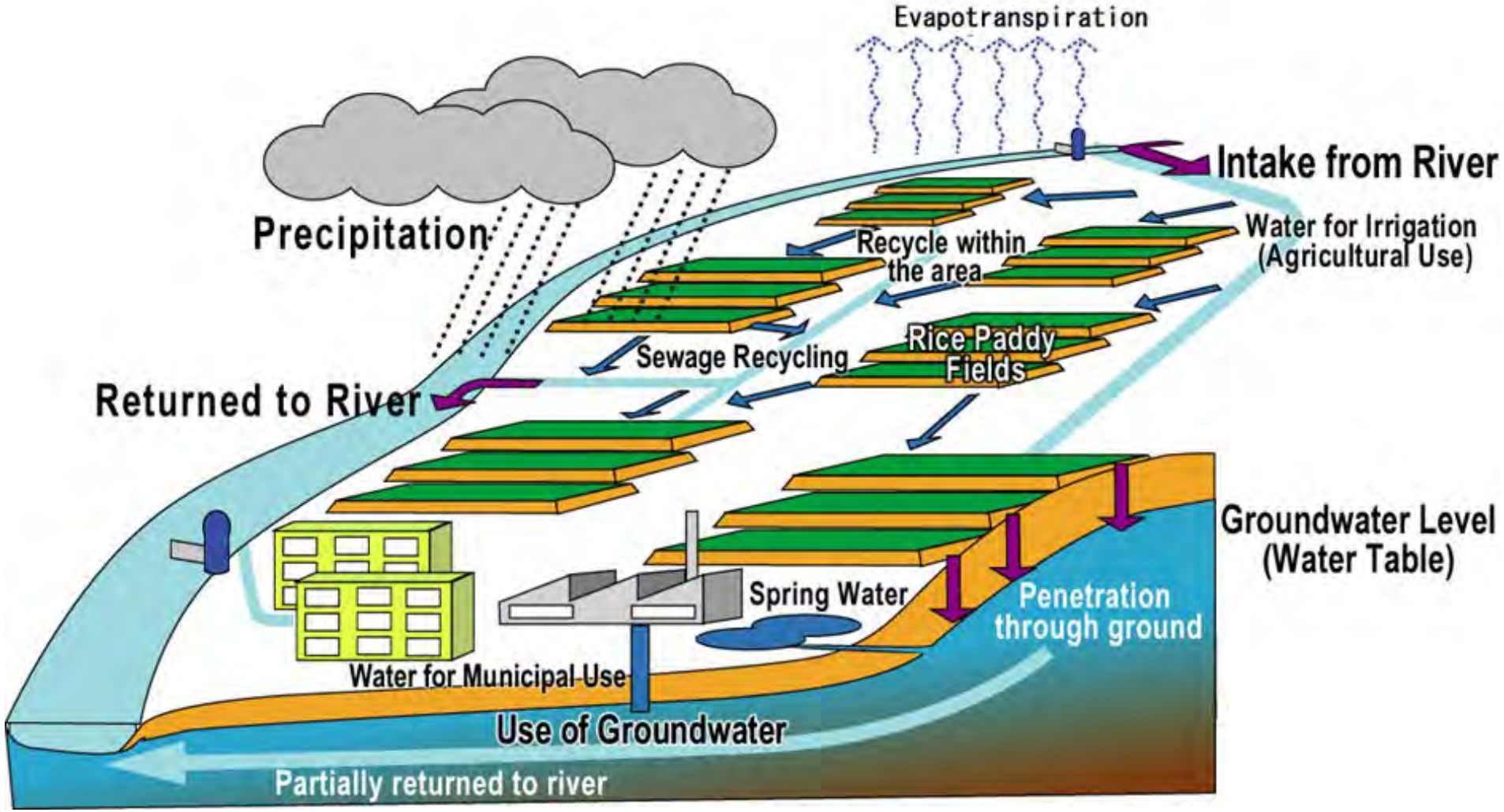


Figure: MAFF Japan HP

Image of Multifunctionality of paddy field

(2) Wise use: Ramsar Convention and Agriculture

Most of rice cultivation is practiced in the low land, where water stays for a certain period of a year. There is an international treaty on use of this type of land – Ramsar Convention. Ramsar convention is a legal agreement regulating use of land with water such as lake, river, wet grassland, coastal area and so on. These areas are defined as "*wetland*" by Ramsar Convention.

Ramsar Convention requests people to utilize wetland in accordance with "***Wise Use***" concept. "Wise Use" is defined as the maintenance of ecological character of wetland within the context of sustainable development. In wise use of wetland, people have to use natural resources at the same level that can be maintained for the near future. Meaning resources should not be overused, soil degraded or the water spoiled.

Ramsar Convention *does not prevent irrigation users in wetlands to stop cultivation.* What is rather promoted is to use the wetland resources ***wisely***. As they depend on their livelihoods on wetland resources, the exploitation of the resources shall threaten their livelihood.

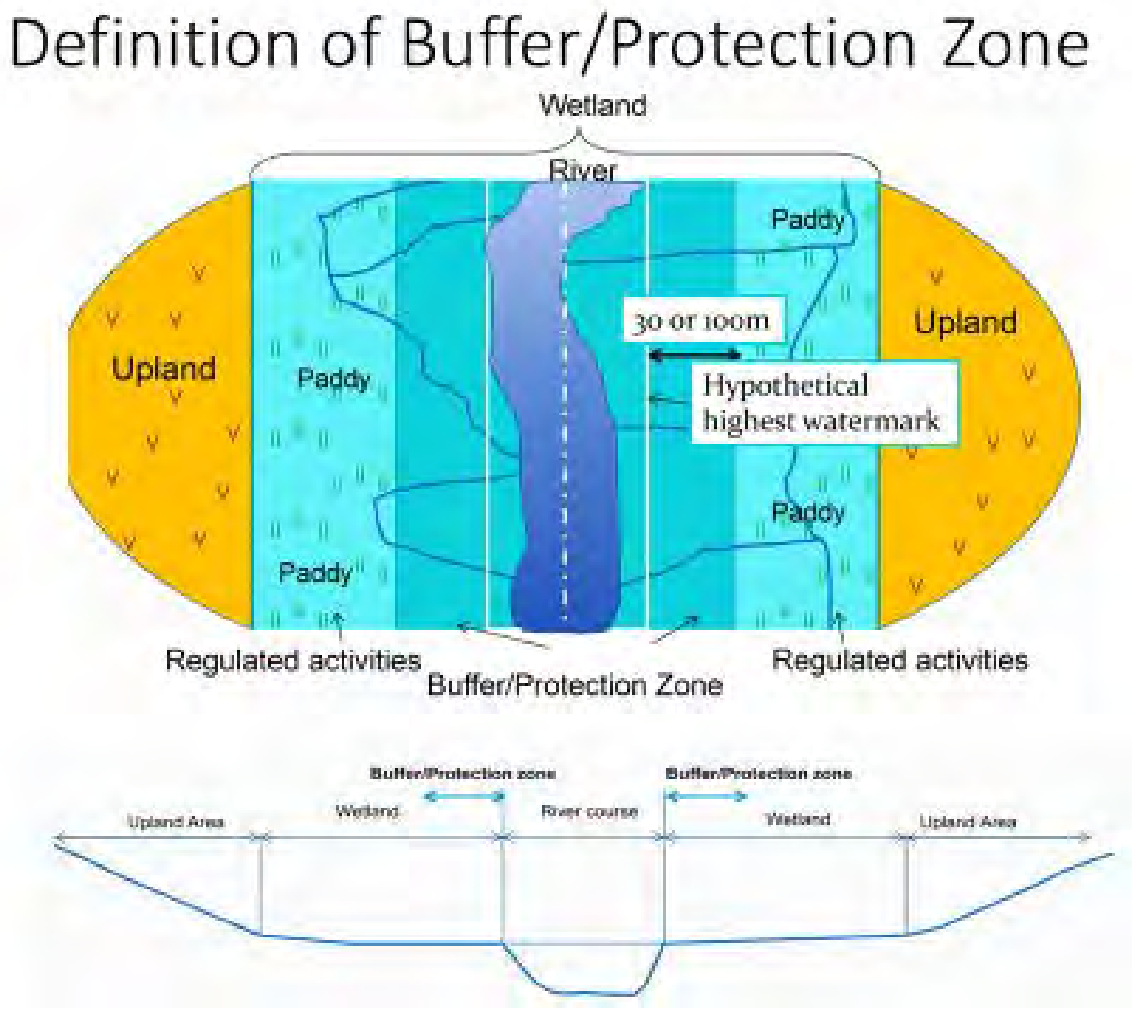
The 10th Ramsar Convention agreed to recognize paddy fields as wetland, which serves to rural livelihood, resident's health, and conservation of environment for animals. It means that it is approved to use wetland for rice production. Sustainable rice cultivation does not compete with wetland conservation. Multifunctionality of paddy field is one of methods, which enable us wise use of wetland. The Ramsar Convention, however, does not justify the new development of artificial wetland (e.g. paddy) in the natural wetland area.

(3) Community Wetland Management Plan

In Uganda, how to use wetland is determined by Community-based regulations. The Strategy 7 of Wetland Sector Strategic Plan 2001-2010 (WSSP) states that Community-based regulation and administration of wetlands resource use established and strengthened through central and district administrations. The rules over wetland use are formed through interaction between community and national government.

Where is wetland?: there are two types of boundary – Ecological and legal boundary. Ecological boundary is established based on water level, soil type, vegetation, topography (shape of land) and so on. Legally agreed boundary is established to fix the boundary because the ecological wetland boundary is mobile; moving in and out from the wetland centre seasonally and inter-annually.

Zones in wetland: Wetland area is classified in to three zones; r*iver course, buffer zone (Protection zone), and other zone with regulated activities*. Buffer zones is located along river course and more strictly protected due to its strong impact to ecological environment. Section 30 (3) of the NES Regulations (2000) states that "No activity shall be permitted within the protected zones without written authority of the Executive Director of **NEMA** (National Environmental Management Authority)". Buffer zone functions as "buffer" to reduce risks as it is named. Buffer zone serves habitat environment, purification of water quality, flood alleviation, and so on.



Ownership of wetland: Wetlands area not and cannot be owned by any person or individuals. However, lack of ownership *does not* mean lack of access or right to use wetland for income generating activities.

Box: Examples of rules for regulated activities in wetland
[Guidelines for Wetland Edge Gardening, MWE, November 2005 (revised February 2009)]

- The headwaters (upper area) of wetland catchment area should not be cultivated. How much area should be left uncultivated depends on the slope (Please consult with relevant technical officers, MWE or MAAIF)
- Before wetlands are converted for agriculture use, the development must seek appropriate technical advice from the relevant authorities.
- A single type of development (e.g. monoculture) should not dominate a wetland or wetland sections.
- Conversion of wetland for cultivation should not be carried out by individuals. Association should be formed to undertake development.

- Drainage of the central core of the wetland by cutting channels or by other means (e.g. infilling) is strictly forbidden.
- The cutting of channels more than 30cm below the ground level to drain water from edge of seasonal wetlands is also forbidden by law.
- Irrigation channels designed to redistribute water within and between the garden plots are permitted.

- Some artificial fertilizers may be used either to reduce soil acidity or to restore lost fertility on the advice of the Agricultural officers. MAAIF List of approved fertilizers: Single Super Phosphate (SSP), Nitrogen-Phosphate-Potassium (NPK), Calcium ammonium nitrate (CAN)
- Herbicides and pesticides may be permitted in wetland cultivation only after consultation with Agricultural officers. MAAIF List of Approved agro chemicals: Herbicide-Basagran, Insecticide-Dusban, Furadan, Fungicide-Diathane

- Fallowing (resting farmland) or crop rotation during the dry season is recommended.
- Controlled grazing of cattle in the post-harvest period is permitted during fallow in order to restore soil fertility. In the same reason, the cultivation of green manure crops such as such as *Sesbania, Leucaena, Crotolaria, Mucuna utilis* and beans is recommended.

Box: Importance of legal status of WUA

The farmlands of rice producers are often found at riverside or lowland where water covers a certain period of a year. Some parts of these lands are possibly classified as wetland. Individual is not allowed to convert wetland into cultivation area. Only association can develop this area under consultation of relevant authorities.

One merit of forming legal WUA is that the farmers in the association get official right to develop wetland into paddy field. This right justifies the rice cultivation in wetland. Another merit is that WUA enhance farmers to work jointly, to have sense of responsibility on Wise Use, and to utilize wetland in sustainable way through trainings given to the association.

The National Water Policy 1999 discusses the need to establish irrigation WUAs but it does not bring a concrete measure for that. Currently there is no law in Uganda to regulate irrigation WUA, however MAAIF and MWE is preparing Irrigation Policy. It is expected to determine the right and obligation of irrigation WUA in Uganda.

As of 2015, no official acknowledgement is given to irrigation WUA. Instead, it is recommended to get the status of CBO (Community based organization) or Cooperatives (Ministry of Tourism, Trade, and Industry through District Cooperative officer). CBO is a formal group with registration at District office. By acquiring legal status, the group will be publicly recognized entity, which gives it foundations for further development of group and establishing the cooperatives or more profit-oriented enterprises.

Box: With environmental regulation or without regulation?

Alal Sea (66,000km2) is a lake in Uzbekistan, Central Asia. Its size was almost same with Lake Victoria (68,800 km²) in Uganda and Tanzania. The lake, however, quickly get dried up after the government started to use lake water for cotton production.

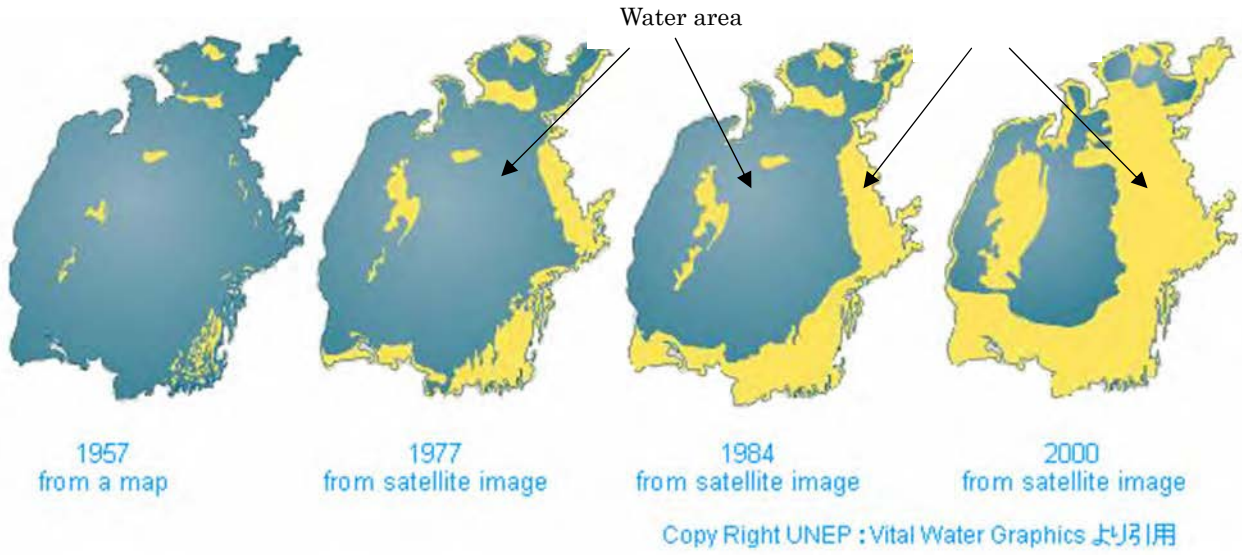


Photo:farm1.static.flickr.com

Ships abandoned on the dried land

Appendix D

Guideline for Irrigation Development Procedure in the Wetland in Uganda

Guideline for Irrigation Project Procedure in the Wetland in Uganda

Table of Contents

Glossary of Acronyms

List of Tables

List of Figures

Attachment:

Glossary of Acronyms

ALC	Area Land Committee
BZ	Buffer Zone
CWMP	Community-based Wetland Management Plan
CDO	Community Development Officer
CGV	Chief Government Valuer
C/P	Counterpart
DAO	District Agriculture Officer
DCDO	District Community Development Officer
DEO	District Environment Officer
DISO	District Security Officer
DWO	District Wetland Officer
EIA	Environmental Impact Assessment
EMA	External Monitoring Agent
EMP	Environmental Management Plan
F/S	Feasibility Study
GoU	Government of Uganda
JICA	Japan International Cooperation Agency
JST	JICA Study Team
LABOS	Landowner Boundary Survey
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoGLSD	Ministry of Gender, Labour and Social Development
MoLHUD	Ministry of Lands, Housing and Urban Development
MWE	Ministry of Water and Environment
NEA	National Environment Act
NEMA	National Environment Management Authority
NGO	Non Governmental Organization
O/D	Overall Design
O&M	Operation and Maintenance
PACC	PISD Area Coordination Committee
PAP	Project Affected Person
PDCC	PISD District Coordination Committee
PTAF	PISD Task Force Team
PISD	Project on Irrigation Scheme Development in Central and Eastern Uganda
RAP	Resettlement Action Plan
RIC	Resettlement Implementation Committee
ATF	RAP Task Force
WB	World Bank
WB OP	World Bank Operation Manual
WMD	Wetland Management Department

Chapter 1 Introduction

1.1 Background

Wetland resources represent one of Uganda's vital ecological and economic natural resources. In addition to their direct use values such as crop cultivation, fishing and extraction of useful materials, wetlands are essential for life support processes such as stabilization of the hydrological cycle and micro climate regulation, protection of riverbanks, nutrient and toxin retention, and sewerage treatment among other uses. Despite these values of natural resources, wetlands in Uganda are now degrading and its underlying cause is being encroachment for agricultural expansion and industrial development.

Although at the surface wetlands seem to be excellent agricultural land, wetland conversion for agriculture has in some cases led to serious problems. These problems not only affect farmers who, after securing and cultivation a wetland plot at the great cost, are flooded out, or see their yields diminishing rapidly. More importantly, many other Ugandans experience problems, like reduced water availability, floods, changes in microclimate, and reduced fish stocks, due to wetland conversion for agricultural purposes. Many of these problems can be avoided if wetland agriculture is done at the right place and in the right manner.

1.2 Objective

Recognizing the situation described above, PISD has conducted F/S to promote the 'wise use' of wetlands for irrigation agriculture and to bring to an end the present unplanned, uncoordinated and piecemeal conversion of wetlands in the area. During the F/S, PISD team encountered constraints and challenges that attributed from the legal grounds. The Objective of this guideline is to extract lessons learnt from PISD experiences and provide suggestive procedures that other project can take to proceed the middle-large scale irrigation project in Uganda.

1.3 Structure of the Guideline

This guideline consists of two parts. Firstly, the legal grounds that are challenges for PISD to conduct F/S and further stages of the Project are described in Chapter 2. Secondly, procedures that PISD took to conduct the field survey that are indispensable for F/S are described in Chapter 3. These are extracting of PISD experience that should be useful information for other similar projects.

Chapter 2 Legal Grounds for Irrigation Project

Legal grounds that are contradicted and unclear are the main constraints for PISD to proceed the F/S. They are divided into three aspects; i) environment, ii) wetland, and iii) land issues. Points and PISD policy taken on these aspects are described in following sections;

2.1 Legal Grounds on Environment

(1)Securing Protection Zone for River Banks

Legal ground in Uganda	PISD Policy
1) The Sironko River shall have a protection zone of one hundred meters (100m) from the highest watermark of the river. [29 in B] [1] 2) The Atari River shall have a protected zone of thirty meters (30m) from highest watermark of the river [29 in B].	1) In Sironko site, more than a 100m-wide protection zone is set from the centre of the river by the construction of protection dyke. 2) In Atari site, a 30m-wide protection zone is set from the centre of the river. Note: The protection dyke secures the protection zone as a retarding basin to mitigate flood damages and to protect natural environment.

(2)Securing Protection Zone for Lake Shores

Legal ground in Uganda	PISD Policy
1) Lake Bisina and Lake Opeta shall have a protected zone of two hundred meters (**200m**) measured from the low water mark. [30 in B].	1) In Atari site, more than 500 m-wide protection zones are set from the edge of the nearest Ramsar wetland system by the construction of protection dyke.

(3)Environmental Consideration Including EIA

Legal ground in Uganda	PISD Policy
1) Only those uses that have been proved to be non-destructive to wetlands and their surroundings will be allowed and/or encouraged. [7.2 in A] 2) All proposed modifications and restorations on wetlands be subject to an EIA, …… All planned new wetland developments will be subjected to an EIA process …. Those which have been subjected to EIAs will continuously be monitored to assess their impact on the environment …[7.8 in A] 3) A developer desiring to conduct a project	1) PISD is NOT destructive following the current and traditional production manners, promoting eco-friendly production and community-based wetland management forming the CbWMP. 2)3)4) PISD is classified as Category A by JICA Guidelines which has to mitigate the adverse impacts caused by the project. EIA study has been conducted by JST in accordance with Ugandan relating laws and JICA/WB guidelines in order to acquire an environmental certificate from NEMA. Further,

[1] Legislations cited:
A: National Policy for the Conservation and Management of Wetland Resources (1995)
B: The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, No. 3/2000 (2000)

which may have a significant impact on a wetland, river bank or lake shore, shall be required to carry out EIA [34 in B] 4) (b) EIA … is mandatory for all activities in wetlands likely to have an adverse impact on the wetland [5 in B]	the environmental management plan (EMP) has been made to monitor and manage the impact of the PISD. JST also examined impacts on the Ramsar wetland system (Lake Opeta and Bisina).

2.2 Legal Grounds on Wetland

(1)Communal Use of Wetland

Legal ground in Uganda	PISD Policy
1) Any **cultivation** where the cultivated area is **not more than 25 %** of the total area of the wetland shall not be subject to the application to carry out the activity…. [11 in B] 2) Communal use will be permitted, only if environmental conservation and sustainable use principles and strategies … are adhered to. [7.6 in A]	1) Land area for PISD (Sironko: 1,480ha, Atari: 680 ha) shall be not more than 25% of the total wetland.(See Figure 1 and Figure 2 in Atachment-2) 2) Community-based Wetland Management Plan (CbWMP) has been made and approved by the District.

(2)Wise-use of Wetland

Legal ground in Uganda	PISD Policy
1) Wise-use of wetlands shall be interpreted into the national and local approaches to the management of their resources through awareness campaigns and dissemination of information [5 in B] 2) promote the integration of **wise-use** of resources in river and lakes into the local and national management of natural resources for socioeconomic development [19 in B]	1) 2) Rice fields including irrigation channels are recognized as a human-made wetland that play important ecological roles and support a range of biodiversity, ……some sites associated with rice paddies promotes the dynamic conservation of areas that is important for indigenous techniques and cultural and biodiversity values, and such sites could provide examples of wetland **wise-use**.*) *) Resolution X.31: Enhancing biodiversity in rice paddies as wetland systems (Ramsar convention)

(3)Permission to Use Wetland Resource

Legal ground in Uganda	PISD Policy
1) A person shall not carry out any activity in a wetland without a permit issued by the Executive Director (of NEMA). Any person intending to carry out an activity (such as cultivation) shall apply to the Executive Director for a permit. [12 in B]	1) Conducting the EIA study and developing the environmental management plan (EMP) becomes a proof that the PISD fully takes into account to follow Uganda's regulations as well as international guidelines.

2.3 Legal Grounds on Land Issue

(1)Those without Formal Legal Rights or Claims

Legal ground in Uganda	PISD Policy
1) Those without formal legal rights or claims to lands are not entitled to be resettled or compensated. Ugandan law does not make specific provision for squatters or illegal settlers and compensation is given to only legal occupants. The Land Act treats lawful occupants and bona fide occupants as statutory tenants of the registered owner.	1) A Project Affected Person (PAP) is one who, as a consequence of the project, sustains losses as a result of impact on a) land, b) structure, c) immovable asset and/or d) livelihood/incomes. The PAPs will be identified through census and detailed land survey in O/D stage. Eligibility of benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets, and the PAPs who have no recognizable legal right to the land they are occupying. Further, according to WB OP4.12, a customary land owner who does not have a certificate can be recognized as a land owner who has legal rights of land.

Table 1 Shows the PISD eligibility criteria that accords to WB OP 4.12. PAP's eligibility will be categorized according this eligibility Criteria. Basically PAPs in all categories will be able to obtain support to some extent for their loss.

Table 1 Eligibility Criteria

Category of affected persons	Assets	Type of compensation
Those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country)	Physical and non-physical assets such as - residential structures - economic trees - crops - land - commercial/business properties - tenancy - income earning opportunities	Compensation at full replacement cost for losses of assets. Assistance (moving allowances during relocation, residential housing or housing sites. support for restoration of livelihood
Those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets; provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan.		Compensation at full replacement cost for losses of assets. Assistance (moving allowances during relocation, residential housing or housing sites. Support for restoration of livelihood
Those who have no recognizable legal right or claim to the land they are occupying (squatters and		Assistance (moving allowances during relocation, residential housing or housing sites.

encroachers)		Support for restoration of livelihood

(2)Policy on Buffer Zone area

Although PISD has been examining the legal ground related to river bank environment, wetlands, and the land issue, it is still unclear how to deal with farmers who are doing cultivation within the buffer zone that will be established ager the construction of protection dyke along the river. Table 2 shows cases of how to deal with these farmers.

Case 1 is the case where farmers will be permitted to continue cultivating within the buffer zone, because their activities are not illegal on the condition that PISD acquires the EIA certificate for the Project, and it automatically satisfies the condition of NER 23. Adding to this reason, the resolution X.31 of the Ramsar Convention states that rice paddy is the artificial wetland that enhances biodiversity. However, in this case farmers cannot be compensated in any way.

Case 2 is the case where farmers will not be permitted to continue cultivating within the buffer zone, because their activity is considered being against to the article 29 of NER, even though PISD shall acquire the EIA certificate. However, as for the eligibility criteria, they can be considered the rightful customary land owner so as to acquire the full fledged compensation.

Case 3 is the case where farmers will not be permitted to continue cultivating within the buffer zone, because their activity is considered being against to the article 29 of NER as same as Case 2. Therefore, they cannot get the compensation for the land even though they claim they are the costmary owner of the land. However, attributing to the safeguarded policy of WB, they can be compensated for crops and relocation support and disturbance allowance.

Case 4 is the case where farmers will not be permitted to continue cultivating within the buffer zone, because their activity is considered being against to the article 29 of NER as same as Case 2. And because they are not the landowner they cannot get the compensation for the land. However, attributing to the safeguarded policy of WB, they can be compensated for crops and support for their livelihood, e.g. Introducing land owner to employ them.

Case 5 shows that all resident land and housing structures will be compensated if they have to relocate from the buffer zone. Compensation will be for the resident land if he/she is a land owner, and for housing structures and shifting cost regardless of their tenure.

PISD is going to take Case 2 for land owners and Case 4 for other than the land owners, and Case 5 for the any homestead land and structures.

Table 2 How to deal with farmers cultivating within Buffer Zone area

Target	Cultivation After dyke construction	Legal Ground	Eligibility	Compensation
Case 1	Permitted	EIA certificate NER 23** Rice resolution***	all farmers	No compensation
Case 2	Prohibited	NER 29*	Considering they are the rightful customary land owner	Compensation for land and crops (Cash/in kind compensation + relocation support cost)
Case 3	Prohibited	NER 29* WB safeguard policy	Considering they are the customary land owner, but doing illegal activity	Compensation for crops + relocation support cost
Case 4	Prohibited	NER 29* WB safeguard policy	Tenant, lessee, squatter illegal activity	Compensation for crops Support for the livelihood
Case 5		WB safeguard policy	All resident land and housing structures	Compensation for structures and resident land (Cash/in kind compensation + relocation support cost)

*: The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, No. 3/2000 (2000), 29 (3) No activity shall be permitted within protected zones without the written authority of the Executive Director.

**: EIA certificate or NER 23. Application for a person to use a river banks or lake shore.

*** Resolution X.31: Enhancing biodiversity in rice paddies as wetland systems (Ramsar convention)

Chapter 3 Irrigation Project Procedure in the Wetland

PISD has conducted four study activities that need field survey in the target area. They are; 1) EIA, 2) RAP, 3) CWMP, and 4) LABOS. These activities were indispensable for F/S and to conduct these activities in the community, community people's consent towards the PISD was essential.

In the beginning of field surveys of these activities there were suspicious consciousness on PISD among community people, which GoU, NEMA or JST would take their land or chase them from wetlands away, and they were not cooperative to PISD. To solve their ungrateful recognition on PISD, JST and C/P elaborate the way of approach carefully to explain about PISD to District officials and formed PDCC. Then together with PDCC, C/P and JST formed PACC whose members are representatives of community people. With the cooperation and function of PDCC and PACC, PISD began to be able to gain community people's consent on above activities.

In this chapter procedures for above four survey activities and functions of PDCC and PACC are described. Figure 1shows the procedure to proceed these four survey activity.

Firstly, Stakeholder meeting with officials of District and Sub-county is very important. C/P from central government and JST explained about PISD to these local government officials and acquired their commitment towards PISD and formed PDCC as the function among the local government officials and the focal point for the community representatives.

Secondly, with the cooperation of PDCC, PISD hold the sensitization meeting with community people and explain about PISD and formed PACC consists of representatives of community people. Since then these PACC has been acting vital roles for PISD.

After forming PACC, JST was able to enter the community and started field survey of each activity with the help of PACC members.

During the survey, four each activity firstly did the introducing meeting with community people and did the explanative meeting to explain the result after the field survey. CbWMP and LABOS have finished their activity during F/S stage, and EIA is now submitting ESIA report and will wait for NEMA's approval. For the RAP process, abbreviate RAP report is going to finish and during the O/D stage detailed survey will be started and complete the RAP report. After acquiring EIA certificate from NEMA and approval of RAP from CGV and completion of compensation payment, the construction work of PISD can commence.

Procedures of specific each activity are described in following sections

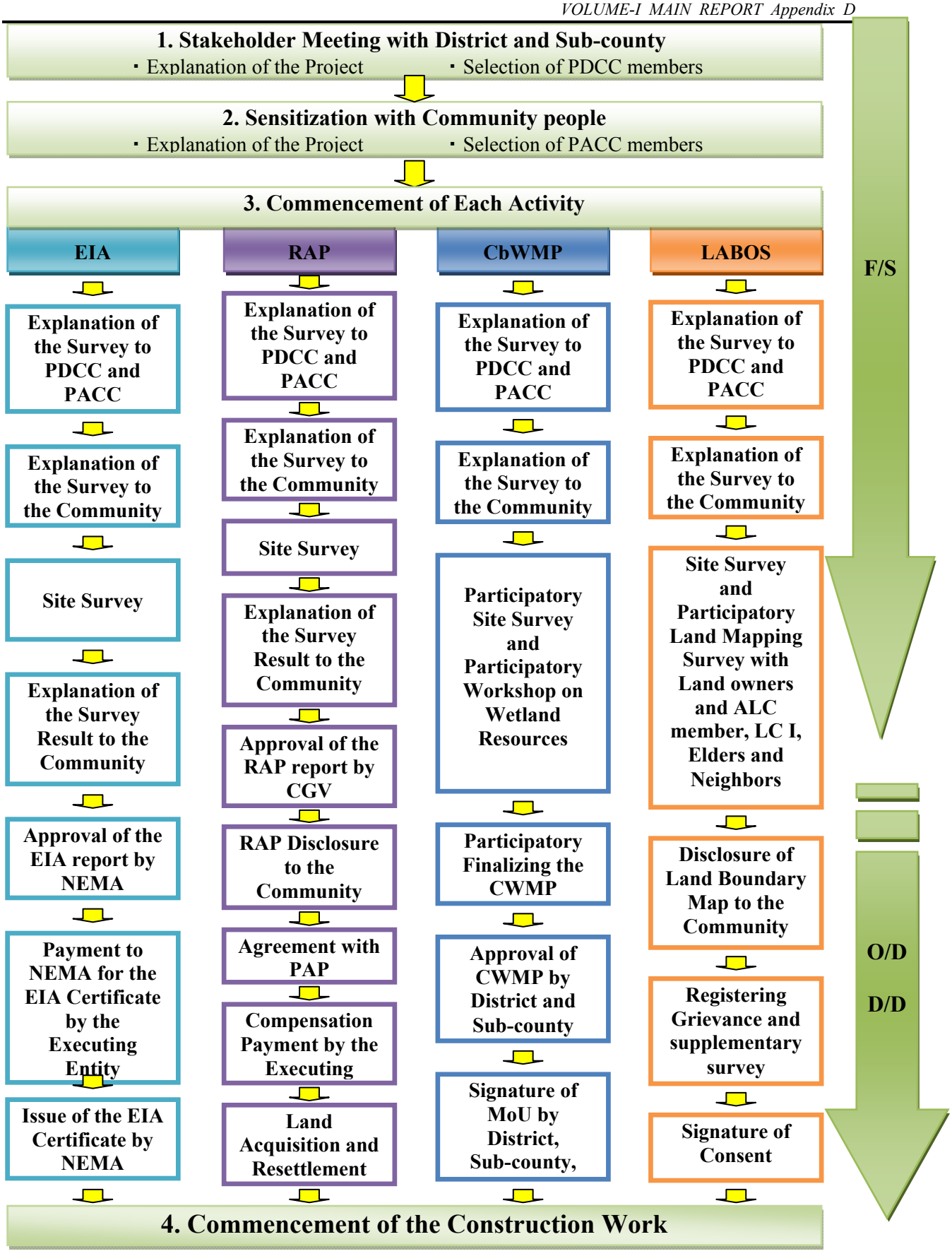


Figure 1 Procedures of Irrigation Project Taken by PISD

3.1 Procedure of EIA

(1)The EIA Process in Uganda

The EIA process is as follows:

a) Project brief preparation (for projects that may not require full/ detained EIA) ;
b) Screening;
c) Detailed environmental impact study;
d) Decision making by NEMA (and lead agencies).

These processes are shown in Fig. 2-5 and described in detail below:

(2)Preparation of Project Brief

A project brief is necessary for some development projects that are listed in the Third Schedule of the National Environment Act (NEA) Cap 153, for NEMA to determine the category of the project. This arises out of the screening process which assesses the cost or benefit of the particular project. The developer has the responsibility to prepare a project brief which must provide the required information given in below.

Name and address of the developer

Name, purpose, objectives and nature of the water project in accordance with the categories identified in the Third Schedule of the NEA;

Description of the project site and its surroundings where the project is to be located (including Global Positioning System (GPS) coordinates, village, parish, Sub County, County, and District).

Site location map;

Policies, laws, regulations governing such project;

Description of project design and activities that shall be undertaken during and after the development of the project;

Description of equipment to be installed and any buildings or related facilities;

Description of the materials and input that the project shall use;

Description of the products and by-products, including waste to be generated;

Description of any likely environmental impacts of the project, and how they will be eliminated or mitigated during the implementation of various phases/stages of the project;

Description of any other alternatives, which are being considered (e.g. setting, technology, construction and operation procedures, sources of raw materials, handling of wastes etc.); and

Any other information that may be useful in determining the level of EIA required by NEMA, and Decommissioning and restoration plans for closure and restoration of the site to productive post-closure use.

(3)Environmental Screening

It is a requirement that any developer intending to develop a project submits a project brief to NEMA, containing a prescription of the activity being considered. The project brief shall be screened by NEMA in consultation with DWRM. The review process shall remain the same as stated in the National Environment Act Cap 153 and EIA regulations 1998. After the review, NEMA shall make a decision whether:

- ✓ the project is exempt from any further assessment through EIR or EIA and consequently;
- ✓ a conditional or unconditional approval for the project shall be granted; or
- ✓ where it is envisaged that the project is likely to lead to significant impact on the environment, it shall require that an EIR or a full EIS study be carried out.

Water resources related projects have four screening categories namely:

Category 1: Small projects which do not have potential significant impacts and for which separate EIAs are not required, as the environment is the major focus of project preparation. These could include borehole drilling, hand augured shallow wells, protected springs and earth reservoir construction.

Category 2: Environmental analysis is normally unnecessary, as the project is unlikely to have significant environmental impacts. A project brief is enough. This could include project location in less sensitive areas or where many such schemes are in the same locality and their synergetic effects have potential impacts.

Category 3: A limited environmental analysis is appropriate, as the project impacts can be easily identified, and for which mitigation measures can be easily prescribed and included in the design and implementation of the project. Projects in this category could include:

i. rural water supply,
ii. large earth reservoirs, but not located in very sensitive areas
iii. big gravity flow schemes
iv. all category one projects located in sensitive areas.
v. aquaculture,
vi. small industries, and

Category 4: An EIA is normally required because the project may have diverse significant impacts. Projects in this category could include:

i. water projects requiring water to a level more than $400m^3$ in any period of twenty four hours, or projects requiring to use motorized pumps;
ii. storage dams, barrages, weirs, valley tanks and dams;
iii. river diversions and inter-basin water transfer;
iv. flood control schemes, drilling e.g. for geothermal;
v. large reservoirs;
vi. irrigation and drainage schemes;

vii. water use industries e.g. pulp and paper, Breweries, etc.
viii. mining industry;
ix. sewage treatment plants;
x. small and large hydro power projects;
xi. urban water supply projects, and
xii. small to large gravity flow schemes.

xiii. irrigation and drainage schemes;
xiv. water use industries e.g. pulp and paper, Breweries, etc.
xv. mining industry;
xvi. sewage treatment plants;
xvii. small and large hydro power projects;
xviii. urban water supply projects, and
xix. small to large gravity flow schemes.

According to NEMA's EIA guideline, the irrigation and drainage scheme is categorized as "Category 4" which needs to conduct an EIA. EIA procedure is as shown in Figure 2 and details are described in 3.1.2 Process of Environmental Impact Assessment (EIA) and in Appendix- D.

The EIA process is concluded when NEMA issues an EIA Certificate of Approval to the developer after paying an appropriate fee.

(4)Environmental Impact Study (EIS)

According to the EIA Regulations 1998, EIS refers to the detailed study conducted to determine the possible environmental impacts of a proposed project and measures to mitigate their effects. The EIS process contains the following key stages:

- ✓ Scoping and TOR;
- ✓ Preparation of the EIS;
- ✓ Review of EIS and Decision on project; and

i. Scoping and TOR

Scoping is the initial step in the EIS. Its purpose is to determine the scope of work to be undertaken in assessing the environmental impacts of the proposed project. It identifies the critical environmental impacts of the project for which in-depth studies are required, and elimination of the insignificant ones. The scoping exercise should involve all the project stakeholders so that consensus is reached on what to include or exclude from the scope of work. It is also at this stage that project alternatives are identified and taken into consideration. The contents of the scoping report are the same as the project brief however more detail is likely to be needed. This may involve some preliminary data collection and field work.

The Developer takes the responsibility for scoping and prepares the scoping report after consultation with NEMA, Lead Agencies and other stakeholders. The developer with assistance from technical consultants will draw up the TOR for the EIS and submit a copy to

NEMA that shall in turn be forwarded to Lead Agencies for comments (including the District Local Government or District Environment Officer).

ii. Preparation of the EIS

In preparing an EIS, relevant information is collected on issues of real significance and sensitivity. These are then analyzed, mitigation measures developed for the adverse impacts and compensatory measures recommended for unmitigated environmental impacts. Measures aimed at enhancing beneficial or positive impacts are also given. An EIS documents the findings and is submitted to NEMA by the developer.

iii. Review of EIS and Decision on Project

The Developer is required to submit ten (10) copies of the EIS to NEMA for review and approval. NEMA then forwards a copy to the Lead Agencies for comments. NEMA in consultation with the Lead Agencies (including the District Local Governments or District Environment Officer) shall review the contents of the EIS, paying particular attention to the identified environmental impacts and their mitigation measures, as well as the level of consultation and involvement of the affected stakeholders in the EIS process. In this review, the level to which the TOR set out for the study is addressed shall be considered. In making a decision about the adequacy of the EIS, NEMA shall take into account the comments and observations made by the Lead Agencies, other stakeholders and the general public. NEMA may grant permission for the project with or without conditions, or refuse permission. If the project is approved, the Developer will be issued a Certificate of Approval.

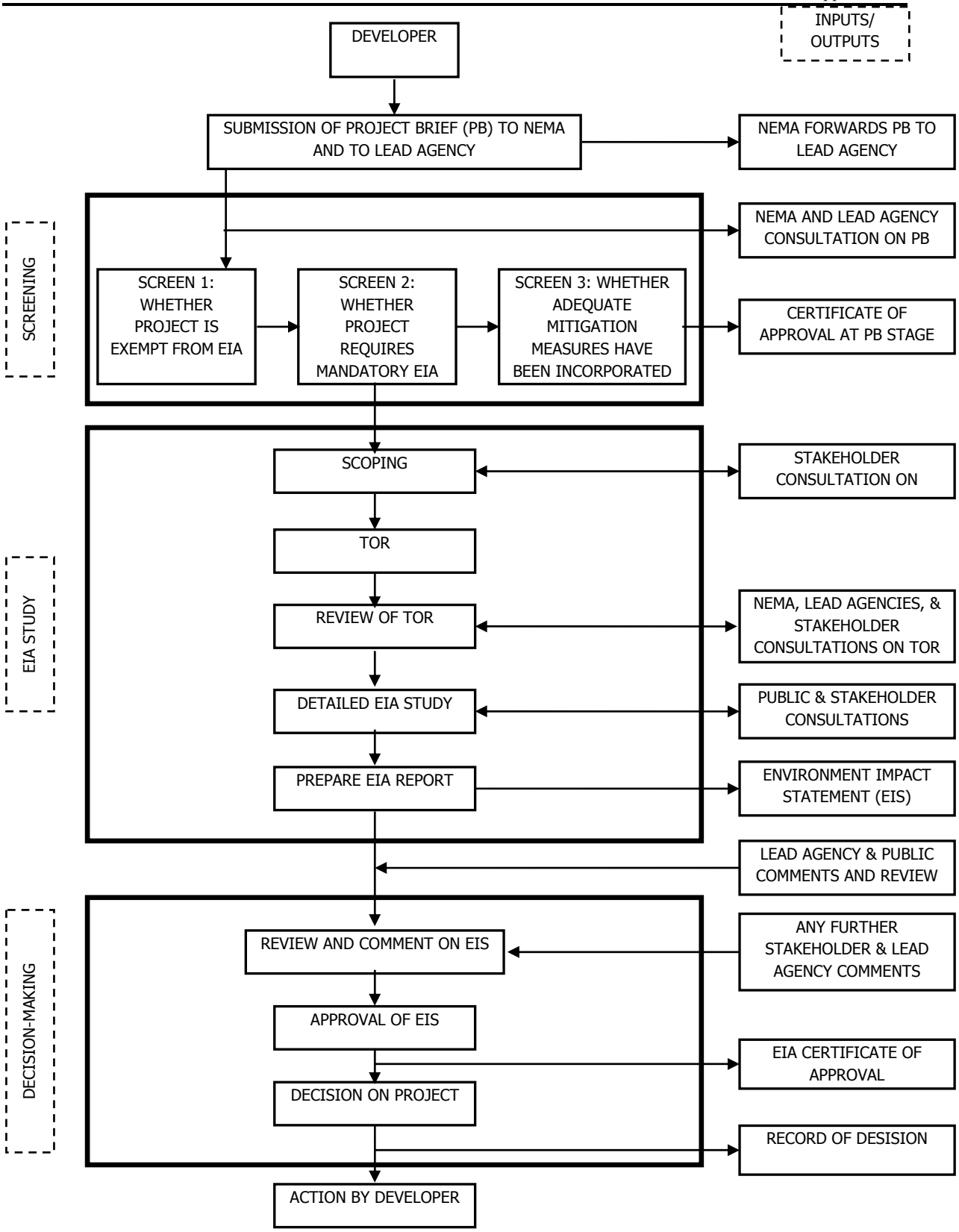
iv. Environmental Monitoring and Management Plan

Monitoring is the continuous and systematic collection of data in order to assess whether the environmental objectives of the project have been achieved. Good practice demands that procedures for monitoring the environmental performance of proposed projects are incorporated in the EIS.

To assist in implementation of identified mitigation and monitoring strategies, an environmental monitoring plan will be developed. It will describe the various environmental management strategies and programmes to be implemented. It will also identify the management roles and responsibilities for ensuring that monitoring is undertaken, results are analyzed and any necessary amendments to practices are identified and implemented in a timely manner. The monitoring plan shall provide for monitoring of both project implementation and environmental quality. It shall contain a schedule for inspecting and reporting upon the implementation of the project and associated mitigation measures identified in the EIS. The monitoring plan shall also identify the key indicators of environmental impact. Further, the plan shall provide a schedule for monitoring each indicator and for reporting the monitoring results to NEMA or the Local Authority.

v. Public Consultation

The environmental impacts or effects of a project will often differ depending on the area in which it is located. Such impacts may directly or indirectly affect different categories of social groups, agencies, communities, and individuals. These are collectively referred to as project stakeholders or the public. It is crucial that during the EIA process, appropriate mechanisms for ensuring the fullest participation and involvement of the public are taken by the developer in order to minimize social and environmental impacts and enhance stakeholder acceptance.



Source: NEMA

Figure 2 Summary of EIA Process in Uganda.

3.2 Procedure of Resettlement Action Plan

3.2.1 Need for a RAP

The proposed PISD will involve land acquisition specifically where the irrigation facility and protection dyke will be constructed; currently the proposed site is utilised for mainly farming activities that will require PISD to compensate those affected and ensure that the project does not impact those affected negatively as a result of land acquisition. PISD is preparing RAP report to ensure that land acquisition is undertaken as per the JICA/WB standards of involuntary resettlement as well as those of the Government of Uganda.

3.2.2 Objectives of the Resettlement Action Plan

The main objective of Resettlement Action Plan (RAP) is to provide an agreed plan for the resettlement and compensation of Project Affected Persons (PAPs) affected by the proposed project to be implemented. The plan provides a road map for resolving displacement, resettlement and compensation issues.

The PISD RAP has been prepared in consistent with the applicable policy provisions of the Government of Uganda (GoU) and those of JICA/WB. The RAP has been prepared as the PISD will involve land acquisition and displacement affecting shelter, livelihood and other associated impacts. The RAP presents an inventory of people likely to be affected by the project, and the proposed compensation and resettlement packages.

3.2.3 Methodology and Approaches

A combination of deskwork review and field visit and stakeholder participation formed the basis of the RAP. The approaches normally include:

i) Review of available data

ii) Site Verification and assessment

iii) Undertaking PAP Census and Socio-economic Profile

iv) Valuing Affected Assets

v) Conducting Spot Valuation

vi) Disclosure of the Resettlement Action Plan

vii) Compensation payment

viii) Vacation or relocation

Figure 3 shows items that RAP report has to include. Details are described in Volume II and III 7.2 “Land Acquisition and Resettlement” of each site.

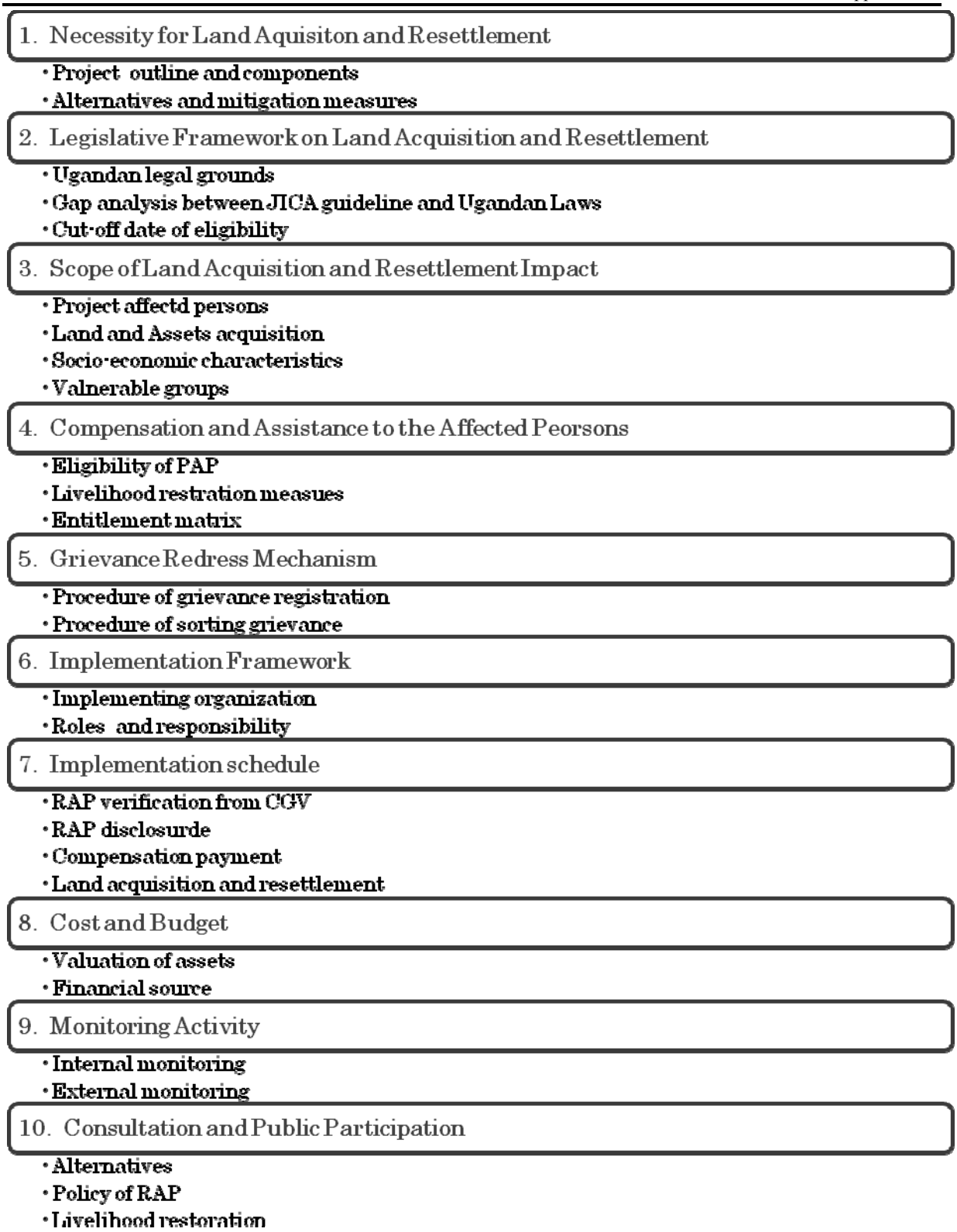


Figure 3 Items RAP Report has to Include

Establishing RAP Task Force is not mandatory in normal RAP process. PISD has made RTF to examine RAP items that are shown in Figure 2. Exchanging opinions and specific knowledge on RAP from related agencies. TOR of RTF is described in Attachment-3. This RTF is for only F/S stage, however, members of RTF will consist of the Resettlement Implementation Committee in O/D stage to succeed

the task of RAP.

3.3 Procedure of CWMP

3.3.1 Goal and objectives of management planning

(1)Overall goal

The overall goal of wetland management planning is to: Achieve optimal utilisation of the wetland resources, while providing continued benefits to the immediate and distant communities both now and in the future.

(2)Long term objectives

The long-term objectives of the management planning exercise include to:

1. Optimise the use and management of wetlands based on the views of local users, and within the framework of the National Wetlands Policy, and other relevant legislation, with a view to improving management practices within the whole catchment area;

2. Optimise the benefits from wetland services and functions, notably the hydrological functions like water retention and flood control, as well as wetland products;

3. Contribute to the well-being of all on- and off-site community members;

4. Enhance the equitable distribution of wetland benefits to as many potential users as possible;

5. Provide the basis for monitoring and evaluating wetland resource use, the fair distribution of wetland resources and wetland ecological stability;

6. Generally improve management practices within the whole catchment area; and

7. Develop effective tools for the management planning of natural resources, for use in other areas and regions.

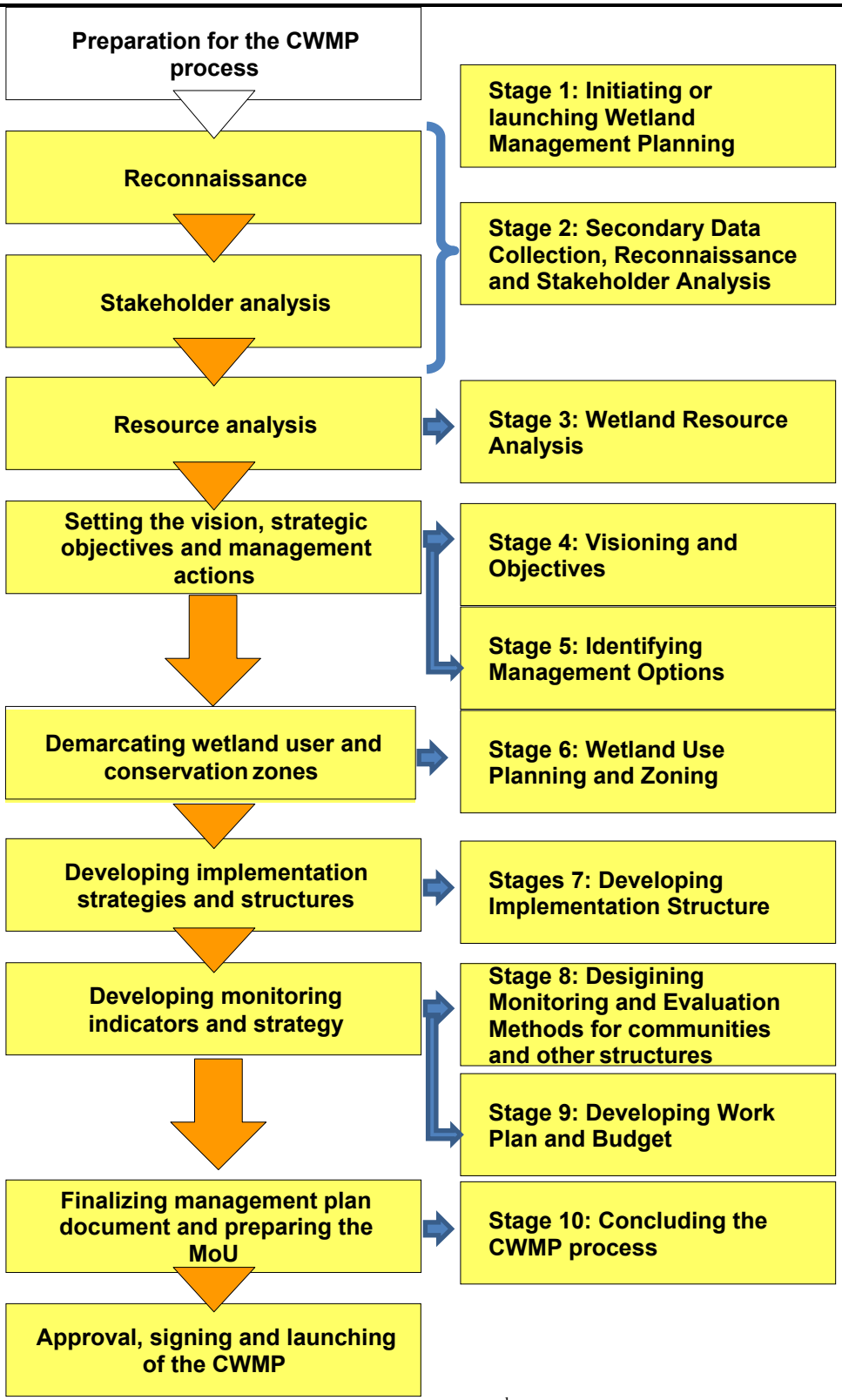
3.3.2 Outcome

Sustainable practise, and positive behaviour towards wetlands and the resources they provide; this is with a view to enhancing livelihoods and promoting ecological integrity.

3.3.3 Key Steps to Develop CWMP and FMP

Figure 4 provides a schematic series of key steps to develop a CWMP and FMP[2]. These steps can be sub-divided further, at the convenience of the WMP Technical Backstopping Team[3]. Throughout the process of developing a CWMP, feedback should be given to the PWMPT[4]. The Technical Backstopping Team should always prepare detailed reports and drawings of outputs of every stage, and report back at the next meeting. The reporting should serve as a validation so as to cultivate consensus and ownership of the result. It should also be used as an opportunity to make clarifications as well as raise awareness as need arises to.

[2] Framework Management Plan
[3] Comprise of district technical officers and/or WMD staffs
[4] Participatory Wetland Management Planning Team



Source: Wetland Management Planning Process Manual 2nd Edition, 2015, WMD/MWE

Figure 4 Basic Steps in the Community Wetland Management Planning Process

3.4 Procedure of LABOS

Identifying the land owner and his/her boundary is very important for the land acquisition for the construction of the irrigation facility. During O/D and D/D stage, detailed confirmation of PAP will be conducted to examine his/her assets and value for paying compensation based on this boundary map as shown in Figure 6.

3.4.1 The Main Objective of the LABOS[5]

- ✓ To identify and confirm the landownership.
- ✓ To prepare landownership boundary map.
- ✓ To prepare the database that covers information such as: the list of landowners/tenants, the size of their land and the land use pattern of the particular plot.

3.4.2 Key Steps to Take

1. Explanation of the survey purpose and methods to PDCC and PACC
2. Explanation of the survey purpose and methods to the community people
3. Field survey to recognize the site
4. Participatory land mapping survey
   - ➢ With landowners to determine the boundary and witnesses to confirm the boundary
   - ➢ Witnesses are: a member from Area Land Committee, LC 1, elders and Neighbours
5. Data processing and preparing the land boundary map
6. Disclosure of the land boundary map to the community
   - ➢ Displaying the map. Figure 5 is the map for the public disclosure
   - ➢ e.g. the wall of the Health Centre, School, or elder's house where people can access easily.
7. Receiving complaints and supplementary survey
8. Signature of the consent on the boundary from each landowners

Figure 5 Detailed Land Ownership Map for display

[5] Land Boundary Survey

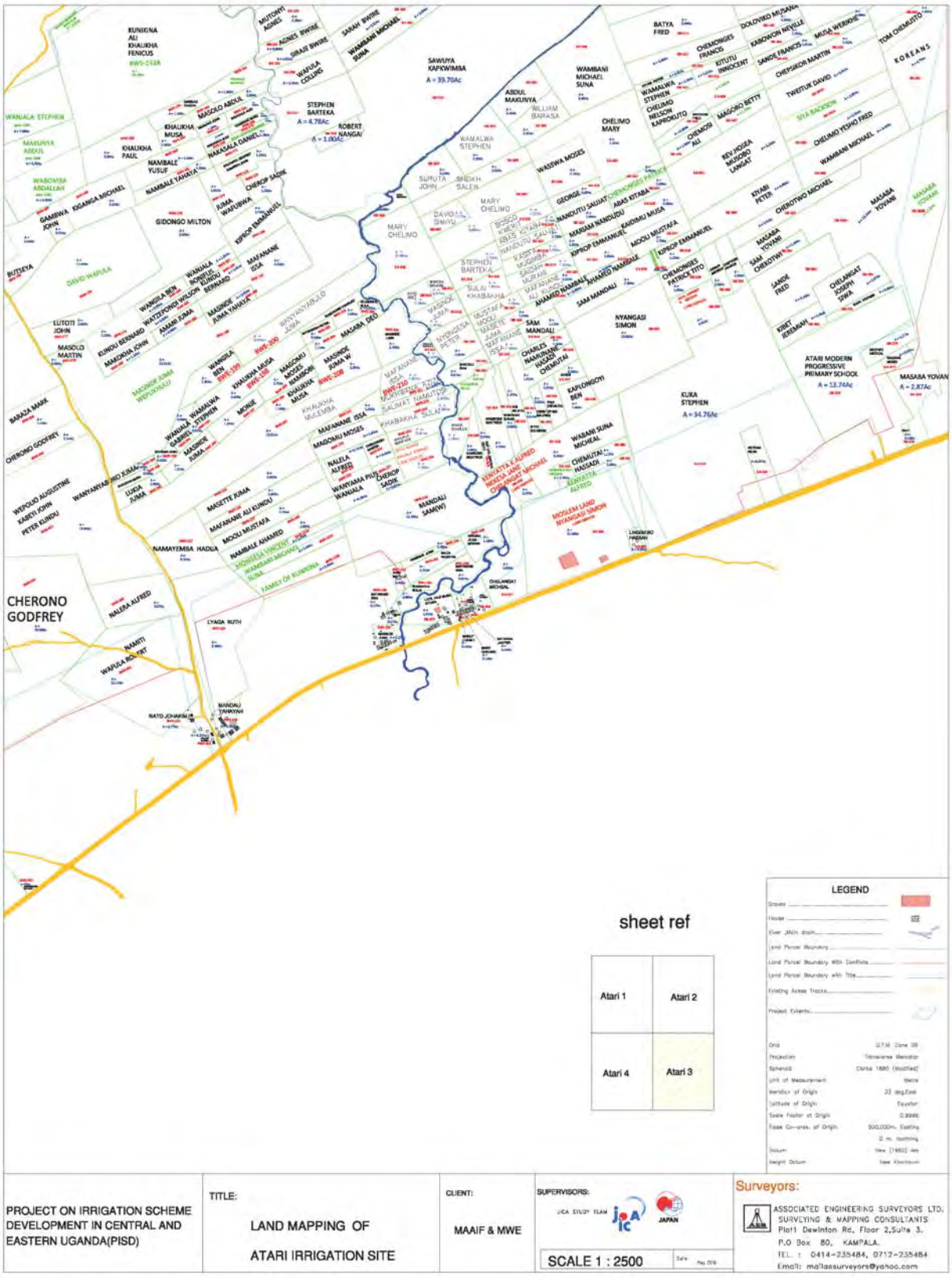


Figure 6 Sections of Final Land Ownership Map

3.5 Procedure of Coordination with Local Government and Community People

3.5.1 Framework of Coordination

PISD Task Force Team (PTAF) was 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 formulated PISD District Coordination Committee (PDCC) within the three F/S Districts of Bukedea, Bulambuli and Kween, 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 workshops to educate community members through information materials such as project brief, project map, project benefits, FAQ, and so on. Later, PTAF together with JST and PDCC established a PISD Area Coordination Committee (PACC) by selection of representatives from among expected project beneficiaries and landowners in each parish within PISD project area. Figure 7 shows the steps to form the cooperation framework of PISD and their consisting members.

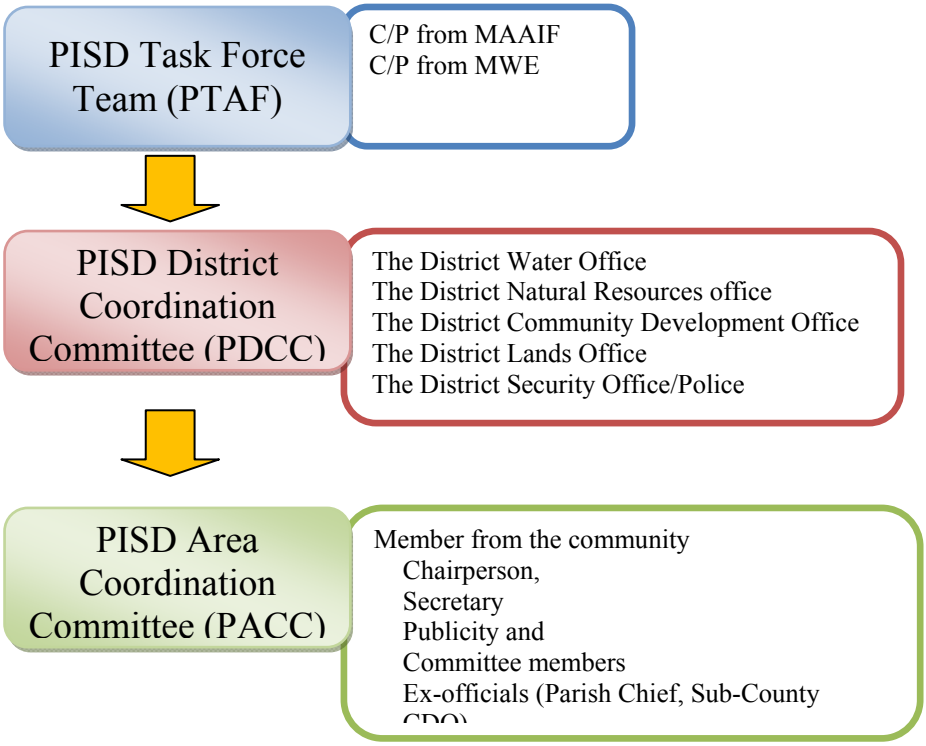


Figure 7 Forming Steps of Cooperation Framework and Consisting Members

Figure 8 shows the framework of coordination among PTAF, JST, PDCC and PACC. PDCC and PACC existence was approved by JCC members of PISD and they were to be supported by C/Ps and JTC for further activities and coordination among community in the study area for the smooth implementation of F/S. Since then F/S activities by C/Ps and JST have been conducted with mobilisation and liaison by PDCC and PACC under overall coordination and leadership of C/Ps and JST.

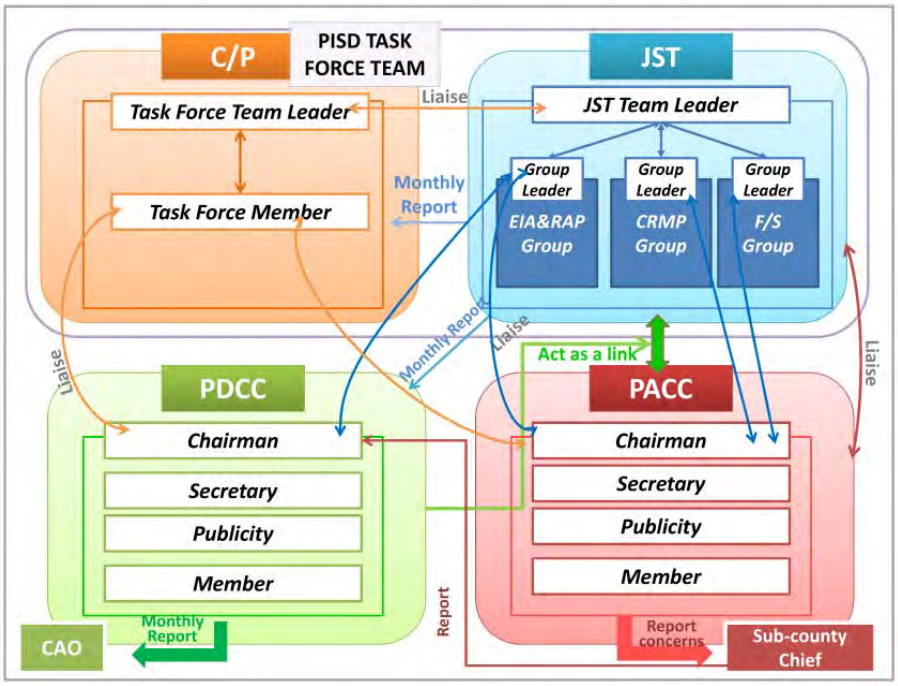


Figure 8 Framework of Coordination

3.5.2 Roles and Responsibilities

Main Roles and Responsibilities of PTAF, PDCC and PACC are shown in Table 3. Although these are extracted from the PISD experience, they can be adapted in the other similar irrigation projects that need to enter into the local community for the survey and study.

Details for PISD in particular is described in Volume I Main Report "5.4 Agreement Consensus from Community before the Study."

Table 3 Roles and Responsibilities of PTAF, PDCC, and PACC

Function	Main Roles and Responsibility
PTAF	− To be the direct link between the JST and MAAIF and MWE − To be the direct link between the JST and the PDCC and PACC − To keep track of the progress of the study and update MAAIF and MWE headquarters on time − To take care any other issues that will arise from PACC and PDCC that is above the jurisdiction of the JST
PDCC	− To monitor the study of PISD and provide monthly briefs to the District Leadership. − To act as a link between the PACC and the JST. − To support the JST in activities involved in the studies of EIA, RAP, CWMP and LABOS − To provide guidance to the PACC − To provides technical support and guidance to farmers during the study. − To coordinate and ensure security detail of the JST and farmers

PACC	− To liaise with the communities to provide security to JST during the survey. To help the JST in identifying land owners for the survey of LABOS − To liaise with the Sub-County Chief on any project related concerns and sentiments from the communities − To mobilize communities to actively participate during the study − To liaise with the Sub-County Chief on any security threats regarding PISD study. − To help for conflict resolution in close liaison with the LC1s and the Sub-Counties in the project area on any conflicts that may arise in the course of the studies. − To be a representative of all the interest groups including the marginalized and to conform to the gender representation requirements. − To monitor JST activity and report to PDCC.

Attachment-1:

Legal Framework on Environment, Wetland, and Lands

Table of Contents

1.1 Policy and Laws related to Environment and Social Consideration

The overarching legislation for environment and social consideration in Uganda is found in the country's Constitution (1995), National Environment Management Policy (1995), and National Environment Act (NEA 1995). The objectives and principle of these important laws and policy are shown below.

(1)Constitution of the Republic of Uganda (1995)

Environmental protection and management in Uganda starts in the Constitution as a basic human right to a clean and healthy environment. Article 237 (2) b under "Land and Environment" provides that the Government or Local Government as determined by parliament shall hold in trust for the people and protect natural lakes, rivers, wetlands, ground water, natural streams, forest reserves, game reserves, national parks and any other land reserves for ecological and touristic purposes for the common good of the citizens of Uganda.

The National Objectives and Directive Principles for environment indicate that:

Chapter XXVII: The Environment

(1) The State shall promote sustainable development and public awareness of the need to manage land, air, and water resources in a balanced and sustainable manner for the present and future generations.

(2) The utilization of the natural resources of Uganda shall be managed in such a way as to meet the development and environmental needs of present and future generations of Ugandans; and, in particular, the State shall take all possible measures to prevent or minimize damage and destruction to land, air, and water resources resulting from pollution or other causes.

(3) The State shall promote and implement energy policies that will ensure that people's basic needs and those of environmental preservation are met.

(4) The State, including LGs, shall -

(a) create and develop parks, reserves, and recreation areas and ensure the conservation of natural resources;

(b) promote the rational use of natural resources so as to safeguard and protect the biodiversity of Uganda.

(2)National Environment Management Policy (1995)

The overall policy goal is sustainable social and economic development which maintains or enhances environmental quality and resource productivity on a long-term basis that meets the needs of the present generations without compromising the ability of future generations to meet their own needs.

(3)National Environment Act Cap. 153 (NEA) (1995)

The NEA provides for the sustainable management of the environment and establishes an authority as a coordinating, monitoring, and supervisory body for that purpose the National Environmental Management Authority (NEMA). The general principles of the Act are to:

- Assure all people living in the country the fundamental right to an environment adequate for their health and well-being.
- Encourage the maximum participation by the people of Uganda in the development of policies, plans, and processes for the management of the environment.
- Use and conserve the environment and natural resources of Uganda equitably and for the benefit of both present and future generations, taking into account the rate of population growth and the productivity of the available resources.
- Conserve the cultural heritage and use the environment and natural resources of Uganda for the benefit of both present and future generations.
- Maintain stable functioning relations between the living and nonliving parts of the environment, through preserving biological diversity and respecting the principle of optimum sustainable yield in the use of natural resources.
- Reclaim lost ecosystems where possible and reverse the degradation of natural resources.
- Establish adequate environmental protection standards and monitor changes in environmental quality.
- Require prior environmental assessments of proposed projects that may significantly affect the environment or use of natural resources.

The NEA provides for the establishment of institutional structures right from national to village levels and clearly outlines their roles and responsibilities. The institutional structures include the National Environment Management Authority (NEMA), the Policy Committee on the environment, the Technical Committee on environment, the District Environment Office and the Local Environment Committees at sub county, parish and village levels. It also gives roles for each institution in environment and natural resources management as stated in the **Table 1.1.1** below:

Table 1.1.1 Roles for each institution in environment and natural resources management

Institution	Role
National Environment Management Authority (NEMA).	• To coordinate, monitor and supervise all activities in the field of environment in the country.
Policy Committee on the environment	• To formulate and provide national policy guidelines on environment management.
Technical Committee on environment	• To give advice on subjects to the environment such as soil conservation, licensing pollution, biodiversity conservation and environment impact assessment.
District Environment Committee	• To coordinate the activities of the district relating to the

	management of environment and natural resources. • To ensure all environment concerns are integrated in all plans and projects approved by the district council. • To assist in the development and formulation of byelaws relating to environment and natural resources management. • To promote the dissemination of information about the environment through education and outreach programmes. • To coordinate with NEMA on all issues relating to environment management. • To coordinate the activities of **local environment committees** in the management of the environment. • To receive reports from the **local environment committees** every year. • To prepare a District State of the Environment Report every year.

Other legislation and policies governing the environment and social consideration are;

- **The Land Act (1998),**
- **The Local Government Act (1997),**
- **The Water Act (1997),**
- **the Decentralization Policy (1993),**
- **The Water Act, Cap 152 (1997)**
- **The Fish Act, Cap 152 (1951)**
- **The Wildlife Act, Cap 200 (1996)**
- **Environment Impact Assessment Regulations (1998)**
- **The National Environment (Conduct and Certification of Environment Practitioners) Regulations (2003)**
- **Occupational safety and Health Act, (2006)**
- **The National environment (Audit) regulations (2006)**
- **The National Environment (Wetlands, River bank, and Lake Shores Management) Regulations (2000).**

(4)International Environmental instruments/obligations for Uganda

Uganda is a signatory to several international instruments on environmental management. These are summarized below. The Ramsar Convention will be described in 2.5.1 (3).

- **The African Convention on the Conservation of Nature (1968)**
- **The Ramsar Convention on wetlands of International Importance (1988)**
- **The Protection of World and Cultural Heritage convention (1972)**
- **The Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES, 1973)**
- **Convention on Biological Diversity- (CBD, 1992)**
- **United Nations Framework Convention on Climate Change (UNFCCC, 1992)**
- **Nile Basin Initiative (NBI, 1999)**

1.2 Policy and Laws related to Wetland

(1)National Policy for the Conservation and Management of Wetlands (1995)

This policy provides the basis for management and use of wetlands in Uganda. It promotes wetland

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

for the implementation of Uganda's Wetland Policy. The Wetlands Sector Strategic Plan 2001-2010 (WSSP) guides the activities of the WMD. The current WSSP (2011-20) is the latest version. Its goals are to increase knowledge and public and stakeholder awareness about wetlands, further develop the institution structure for wetland management, improve management and protection, establish, and strengthen community-based wetland management, and mobilize local and international financing mechanisms.

Districts are encouraged to designate a wetlands focal point to carry out wetland activities, and they can seek support from one of the three Regional Technical Support Units (RTSUs) established by WMD to provide technical backstopping to the field for wetland management. Districts are responsible for development of District Wetland Action Plans and their integration into District Development Plans (DDPs). They are also encouraged to formulate and implement district-level ordinances and local bylaws for wetland management. Community-Based Wetland Management Plans (CBWMPs) are to be prepared by community groups.

The effectiveness of these institutions is constrained by under staffing, inadequate funding and limited coordination among the different sectors involved in the management process.

1.3 Policy and Laws related to Resettlement and Land Expropriation

(1)Ugandan Laws

There are a number of national and local legal frameworks that regulate the land relations in Uganda. These frameworks define land rights, ownership, procedures, and requirements of transfer and acquisition of land between individuals and communities. They also provide procedures for the acquisition of land by the state or a public body for public projects. Among the most important legal instruments in this regard are the following:

- **The Constitution of Uganda (1995);**
- **The Land Act (1998);**
- **The National Land Policy 2011**
- **The Local Government Act (1992);**
- **The Land Acquisition Act (1965);**
- **The Physical Planning Act (2010)**

While all matters relating to land acquisition, compensation, and resettlement are managed within the provisions of the above legislation, the most decisive document in this regard is the Land Act of 1998, as amended.

(2)The Uganda Constitution (1995)

Article 237(1) of the Constitution vests all land of Uganda in the citizens of Uganda. However under Article 237(1) (a), the government or local government can acquire land in the public interest. Such acquisition is subject to the provisions of Article 26 of the Constitution, which gives every person in Uganda a right to own property.

The Constitution also prescribes the tenure regimes in accordance with which rights and interests in which land may be held namely; Customary, Freehold, Mailo and Leasehold. It introduces 'bonafide occupancy' as a form of tenure that gives the occupant some rights to the land occupied. According to the Constitution, all land belongs to the people of Uganda and is held in trust by the Government. Government is authorized to acquire land for a public purpose and compensate affected persons in accordance with the law. It provides procedures to follow during the acquisition of land for public interest and provides for the "prompt payment of fair and adequate compensation" prior to

taking possession of the land. The Constitution however, does not make resettlement a right.

(3)The Land Act (1998)

The 1998 Land Act addresses land holding, management control, and dispute processing. The Act creates a series of land administration institutions, namely, Uganda Land Commission (ULC), District Land Boards (DLB), Parish Land Committees (PLC), and District Land Tribunals (DLT). Section 78 of the Act gives valuation principles for compensation, i.e. compensation rates to be yearly approved by DLBs. The basis for compensation is depreciated replacement costs for rural properties and market values for urban properties.

Article 75 of the Land Act 1998 and Article 243 of the 1995 Constitution creates District Land Tribunals with jurisdiction to determine disputes relating to the grant, lease, repossession, transfer or acquisition of land by individuals, the ULC or other authority with responsibility relating to land; and the determination of any disputes relating to the amount of compensation to be paid for land acquired.

Article 77 (e) of the Land Act 1998 gives power to the DLTs to determine any other dispute relating to land under this act. Article 88 (1) of the act stipulates that an appeal shall lie from the decision of a DLT to the High Court. Key features of the recognized forms of land tenure in Uganda are:

Customary Tenure - is governed by rules generally accepted as binding and authoritative by the class of persons to which it applies. That is customary tenure is not governed by written law. Landowners do not have deeds recognizing their ownership rights and land is run according to rules and practices generally accepted as legitimate and binding by a particular community. Customary laws vary according to regions but most systems are based on the same general principles. Ownership rights are recognized by the community through inheritance, purchase, or by settling on a plot of land which was previously vacant. Under Ugandan customary legal systems, particularly in northern and eastern Uganda, land is usually communally owned by the clan but it can also be owned individually. Rights and responsibilities that derive from communal ownership are shared among various members of the clan according to traditional practices. Usually, the head of the clan or family, the "custodian," has the responsibility to look after each member's land rights and to allocate land fairly to all. Under this system, disputes are heard and settled by clan elders.

Leasehold Tenure - is created either by contract or by operation of the law and is a form under which the landlord of lessor grants the tenant or lessee exclusive possession of the land, usually for a period defined and in return for a rent. The tenant has security of tenure and a proprietary interest in the land.

Freehold Tenure - derives its legality from the constitution and its incidents from the written law. It involves the holding of land in perpetuity or a term fixed by a condition and also enables the holder to exercise, subject to the law, full powers of ownership.

Mailo Tenure - has roots in the allotment of land pursuant to the 1900 Uganda Agreement and derives its legality from the constitution and its incidents from written law. It involves the holding of land in perpetuity and permits the separation of ownership of land from the ownership of developments on land made by a lawful or bona fide occupant. The system enables the holder to exercise all powers of ownership, subject to the rights of those persons occupying the land at the time of the creation of the mailo title and their successors.

(4)National Land Policy 2013

This new land policy addresses the contemporary land issues and conflicts facing the Country. The vision of the policy is: "a transformed Ugandan society through optimal use and management of land resources for a prosperous and industrialized economy with a developed services sector" while the goal of the policy is: "to ensure an efficient, equitable, and optimal utilization and management of

Uganda's resources for poverty reduction, wealth creation, and overall socio-economic development."

Access to Land for Investment: Section 4.16 of the Policy (87 – b) states that government shall put in place measures to mitigate the negative impacts of investment on land so as to deliver equitable and sustainable development. While part 89 of the same section positions government to protect the land rights, including rights of citizens in the face of investments with measures for, but not limited to;

i) clear procedures and standards for local consultation;

ii) mechanisms for appeal and arbitration;

iii) facilitation of access to land by vulnerable groups, smaller-scale land owners and land users in the face of large scale farming interests; and

iv) protection against degradation of natural resources and sensitive eco-systems.

Measures for Protection and Promotion of Land Rights: Section 4.18 (93) of the Policy recognizes the inability of the majority of Ugandan to afford the cost of formally securing land rights and therefore government will put in place a framework that would ensure that land rights held by all Ugandans are fully and effectively enjoyed, even in the event of resettlement.

Land rights of Ethnic Minorities: As regards land rights of ethnic minorities, the Policy states in Section 4.8 (57) of the Policy that:

a) Government shall, in its use and management of natural resources, recognize and protect the right to ancestral lands of ethnic minority groups;

b) Government shall pay prompt, adequate, and fair compensation to ethnic minority groups that are displaced from their ancestral land by government action.

and in (58); to redress the rights of ethnic minorities in natural habitats, Government will take measures to:

i) establish regulations by Statutory Instrument to:

c) recognize land tenure rights of minorities in ancestral lands;

d) document and protect such de facto occupation rights against illegal evictions or displacements;

e) consider land swapping or resettlement or compensation in the event of expropriation of ancestral land of minorities for preservation or conservation purposes;

f) set terms and conditions for displacement of minorities from their ancestral lands in the interest of conservation or natural resources extraction;

ii) deliberate and specify benefit-sharing measures to ensure that minority groups benefit from resources on their ancestral lands rendered to extractive or other industry;

iii) educate and create public awareness on the benefits of conservation and protected areas for national development; and

iv) Recognize the vital role of natural resources and habitats in the livelihood of minority groups

in the gazettement or degazettement of conservation and protected areas.

(5)Land Acquisition Act (1965)

This Act makes provision for the procedures and method of compulsory acquisition of land for public purposes whether for temporary or permanent use. The Minister responsible for land may authorize any person to enter upon the land and survey the land, dig or bore the subsoil or any other thing necessary for ascertaining whether the land is suitable for a public purpose. The Government of Uganda is supposed to pay compensation to any person who suffers damage as a result of any action. Any dispute as to the compensation payable is to be referred to the Attorney General or court for decision.

The Land Acquisition Act stops at payment of compensation. It is not a legal requirement to purchase alternative land for the affected people by the project. Once they are promptly and adequately compensated, then the obligations stop there. The Government through the Ministry of Lands, Housing, and Urban development will pay the compensation to the affected persons. There is no requirement or provision in the law that people need to be moved or that alternative land be made available or bought. Each affected person entitled to be compensated; on receipt of his/her compensation is expected to move and has no further claim.

(6)The Physical Planning Act; (2010)

The Physical Planning Act 2010 (the " new Act") a new law that commenced in April 2011 repeals the 1964 Town and Country Planning Act (Cap 246) (the "old Act") and brings with it significant changes that are of particular importance to real estate developers.

Under the old Act, the obligation to obtain development permission in order to develop structures for land use was restricted to developments in urban areas. The new Act makes it mandatory for a person carrying out a development within a planning area to obtain development permission from a physical planning committee at the district, urban and local levels.

The new Act regulates control of developments, approval of physical development plans and applications for development permission. The physical planning committees set up under the new Act are tasked with preparing physical development plans, recommending plans for change of land use and approving development applications relating to housing estates, industrial locations, schools, petrol stations, dumping sites and sewerage works.

(7)Obtaining development permission

Under the new Act, an application for development permission is made to the relevant local government which then forwards the application to the relevant physical planning committee. The new Act sets up planning committees at local levels to consider special development needs in these areas. The physical planning committee is required to notify the applicant of its decision within thirty (30) days and attach this notice to the development permission granted. A physical planning committee may, if it thinks expedient, by notice of deferment served on the applicant, defer consideration of the application for development permission for a given period and for reasons specified in the deferment notice. When considering a development application, the physical planning committee is required to take into consideration the regard for the health, amenities and conveniences of the community generally and the proper planning and density of development and land use in the area.

(8) Ensuring compliance

In the absence of development permission, the new Act requires demolition of the structure and restoration of the land on which the development is made, as much as possible to its original

condition. The new Act also prohibits the Registrar of Documents from registering a document relating to the development of land under the Registration of Documents Act, unless development permission, in respect of the development, has been granted. The new Act also provides for the establishment of a National Physical Planning Board to advise the government on all matters relating to physical planning.

The functions of the Board include:

- Hearing and determining appeals lodged by persons or local governments aggrieved by the decision of any physical planning committees;
- Determining and resolving physical planning matters referred to it by physical planning committees;
- Advising the government on broad physical planning policies, planning standards and the viability of any proposed subdivision of urban or agricultural land;
- Approving regional, urban or district physical development plans, recommending to the Minister national plans for approval and monitoring implementation of the plans;
- Advising the Minister responsible for local government on the declaration of town councils, town boards or upgrading of urban authorities;
- Formulating draft planning policies, standards, guidelines and manuals for consideration by the Minister;
- Exercising general supervisory powers over all lower planning committees such that they can seek guidance, set standards and take control; and
- Fostering co-ordination of physical planning related or interdisciplinary activities in the country in order to promote orderly and sustainable development of human settlements in rural and urban areas.

(9)The Local Government Act (1997)

The Local Government Act (LGA) was enacted to give effect to the policy of decentralisation and devolution of functions, powers and services; and to provide for decentralisation at all levels of local government to ensure good governance and democratic participation in, and control of decision making by the people. The Local Government Act provides for the system of Local Governments, which is based on the district. Under the district there are lower Local Governments and administrative units. This system provides for elected Councils. The chairman nominates the executive committee of each council. The functions of this committee include:

- Initiating and formulating policy for approval of council;
- Overseeing the implementation of the Government and Councils' policies, and monitor and coordinate activities of Non-Government Organizations in the district; and
- Receiving and solving disputes forwarded to it from lower local governments.

According to the second schedule to the LGA, the Central Government is responsible for water resources and the environment (Part I, Second Schedule of the Local Government Act). The Lower Local Government Councils (sub-county or division) are responsible for the protection and maintenance of local water resources (Part 4). It is the function of the various executive committees, including the parish or village executive committees, to generally monitor projects and other activities undertaken by government, local governments, and non-governmental organisations in their area (Section 50(8)).

(10)World Bank Policies

World Bank policy requires "screening" of all projects proposed for Bank financing to help ensure that they take social concerns into account with respect to adverse impacts on project affected people (PAP's) and to appropriately plan for and respond to these impacts, and thus improve decision making about resettlement, options, alternatives, participation of PAP's and compensation. The

World Bank's safeguard policy on involuntary resettlement, OP 4.12 is to be complied with where involuntary resettlement, impacts on livelihoods, acquisition of land or restrictions to access to natural resources, may take place as a result of the project. It includes requirements that:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable persons physically displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by the involuntary taking of land resulting in:

i) relocation or loss of shelter;

ii) loss of assets or access to assets; or

iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location

(11)Comparison between Land Law in Uganda and World Bank OP 4.12

Although the Ugandan Constitution requires that prompt, fair, and adequate compensation be paid prior to displacement, this is not on par with OP 4.12, as there is no requirement that states that the government should provide alternative land or assist with resettlement. Additionally it is unclear how to interpret "prompt, fair, and adequate" compensation. OP 4.12 states that displaced persons should be compensated at full replacement cost.

Ugandan law does not make any specific accommodation for squatters or illegal settlers, and reimbursement is based on legal occupancy. There is also no provision in the law that the state should attempt to minimize involuntary resettlement.

Furthermore, the GOU has recently prepared the National Land Policy (2013) aimed at consolidating a number of scattered policies, which exist on various aspects of the land question, but are diverse, sectoral and inconclusive in many respects. Uganda has never had a clearly defined and / or consolidated National Land Policy since the advent of colonialism in the nineteenth century. Post-independence and recent attempts to settle the land question by the Land Reform Decree 1975, the 1995 Constitution of Uganda, and the Land Act 1998 failed to deal with the fundamental issues in land tenure due to absence of clear policy principles to inform the enactment of legislation that offers politically and socially acceptable and technically feasible solutions. The key policy issues touch on (1) historical injustices and colonial legacies, (2) contemporary issues, mainly arising from such legacies; and (3) land use and land management issues.

1.4 Procedure of Environmental Impact Assessment

(1)Responsible Organization

EIA responsible institution is the National Environment Management Authority (NEMA). The National Environment Act (NEA), Cap. 153, stipulates the Mandate of NEMA as the principal

Agency in Uganda responsible for the management of the environment by coordinating, monitoring, regulating, and supervising all activities in the field of environment. Its organogram is shown in **Figure 1.4.1**.

(2)The EIA process in Uganda

EIA process to follow is shown below:

a) Project brief preparation (for projects that may not require full/ detained EIA) ;

b) Screening;

c) Detailed environmental impact study;

d) Decision making by NEMA (and lead agencies).

These processes are shown in **Figure 1.4.2** Summary of EIA process in Uganda.

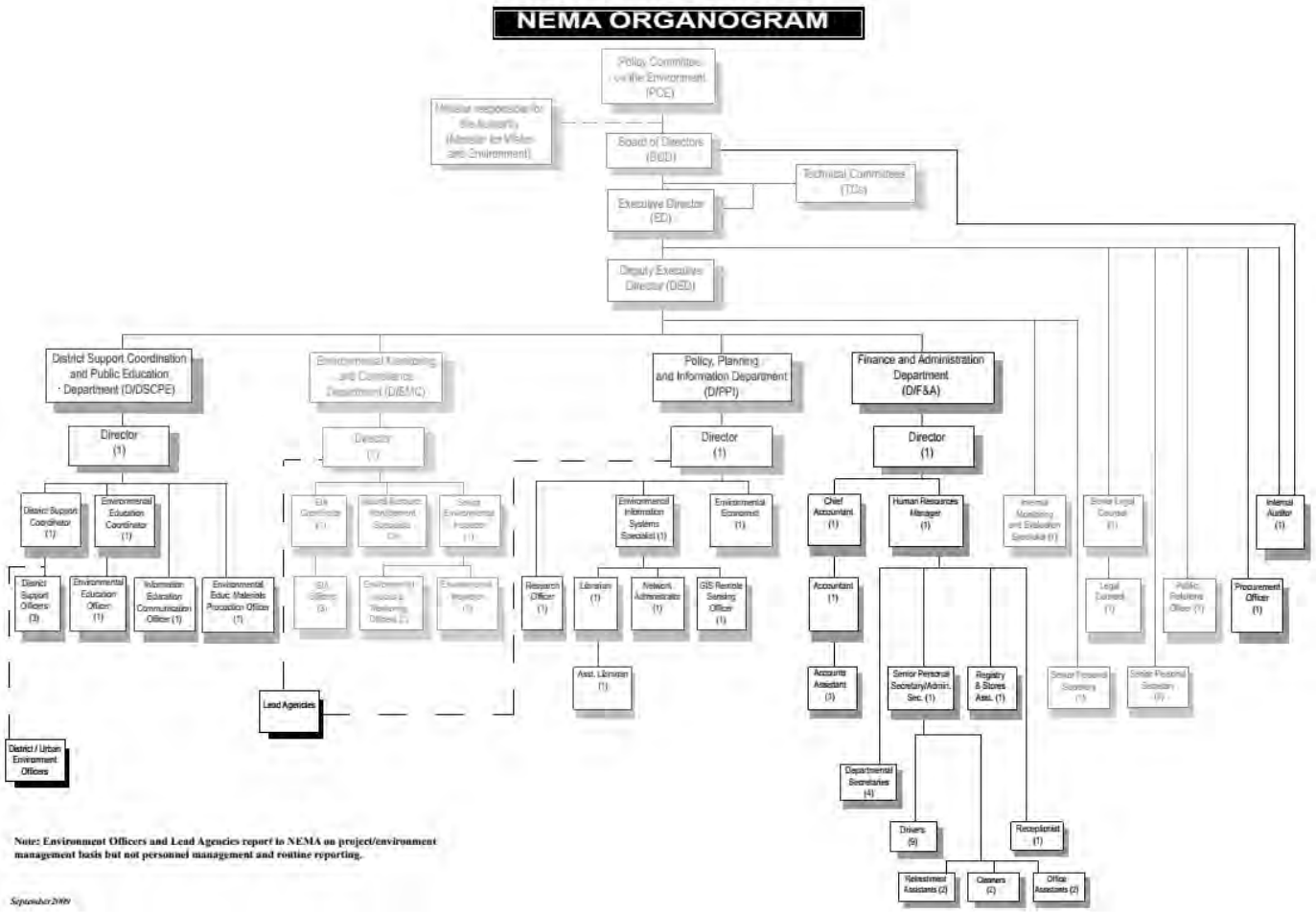


Figure 1.4.1 NEMA Organogram

Source: NEMA

1)Preparation of Project Brief

A project brief is necessary for some development projects that are listed in the Third Schedule of the National Environment Act (NEA) Cap 153, for NEMA to determine the category of the project. This arises out of the screening process which assesses the cost or benefit of the particular project. The developer has the responsibility to prepare a project brief which must provide the required information given in below.

i) Name and address of the developer
ii) Name, purpose, objectives and nature of the water project in accordance with the categories identified in the Third Schedule of the NEA;
iii) Description of the project site and its surroundings where the project is to be located (including Global Positioning System (GPS) coordinates, village, parish, Sub County, County, and District).
iv) Site location map;
v) Policies, laws, regulations governing such project;
vi) Description of project design and activities that shall be undertaken during and after the development of the project;
vii) Description of equipment to be installed and any buildings or related facilities;
viii) Description of the materials and input that the project shall use;
ix) Description of the products and by-products, including waste to be generated;
x) Description of any likely environmental impacts of the project, and how they will be eliminated or mitigated during the implementation of various phases/stages of the project;
xi) Description of any other alternatives, which are being considered (e.g. siting, technology, construction and operation procedures, sources of raw materials, handling of wastes etc.); and
xii) Any other information that may be useful in determining the level of EIA required by NEMA, and Decommissioning and restoration plans for closure and restoration of the site to productive post-closure use.

2)Environmental Screening

It is a requirement that any developer intending to develop a project submits a project brief to NEMA, containing a prescription of the activity being considered. The project brief shall be screened by NEMA in consultation with DWRM. The review process shall remain the same as stated in the National Environment Act Cap 153 and EIA regulations 1998. After the review, NEMA shall make a decision whether:

i) the project is exempt from any further assessment through EIR or EIA and consequently;
ii) a conditional or unconditional approval for the project shall be granted; or
iii) where it is envisaged that the project is likely to lead to significant impact on the environment, it shall require that an EIR or a full EIStudy be carried out.

Water resources related projects have four screening categories namely:

Category 1: Small projects which do not have potential significant impacts and for which separate EIAs are not required, as the environment is the major focus of project preparation. These could include borehole drilling, hand augured shallow wells, protected springs and earth reservoir construction.

Category 2: Environmental analysis is normally unnecessary, as the project is unlikely to have significant environmental impacts. A project brief is enough. This could include project location in less sensitive areas or where many such schemes are in the same locality and their synergetic effects have potential impacts.

Category 3: A limited environmental analysis is appropriate, as the project impacts can be easily identified, and for which mitigation measures can be easily prescribed and included in the design and implementation of the project. Projects in this category could include:

i. rural water supply,
ii. large earth reservoirs, but not located in very sensitive areas
iii. big gravity flow schemes
iv. all category one projects located in sensitive areas.
v. aquaculture,
vi. small industries, and

Category 4: An EIA is normally required because the project may have diverse significant impacts. Projects in this category could include:

i. water projects requiring water to a level more than $400m^3$ in any period of twenty four hours, or projects requiring to use motorized pumps;
ii. storage dams, barrages, weirs, valley tanks and dams;
iii. river diversions and inter-basin water transfer;
iv. flood control schemes, drilling e.g. for geothermal;
v. large reservoirs;
vi. irrigation and drainage schemes;
vii. water use industries e.g. pulp and paper, Breweries, etc.
viii. mining industry;
ix. sewage treatment plants;
x. small and large hydro power projects;
xi. urban water supply projects, and
xii. small to large gravity flow schemes.

The EIA process is concluded when NEMA issues an EIA Certificate of Approval to the developer after paying an appropriate fee.

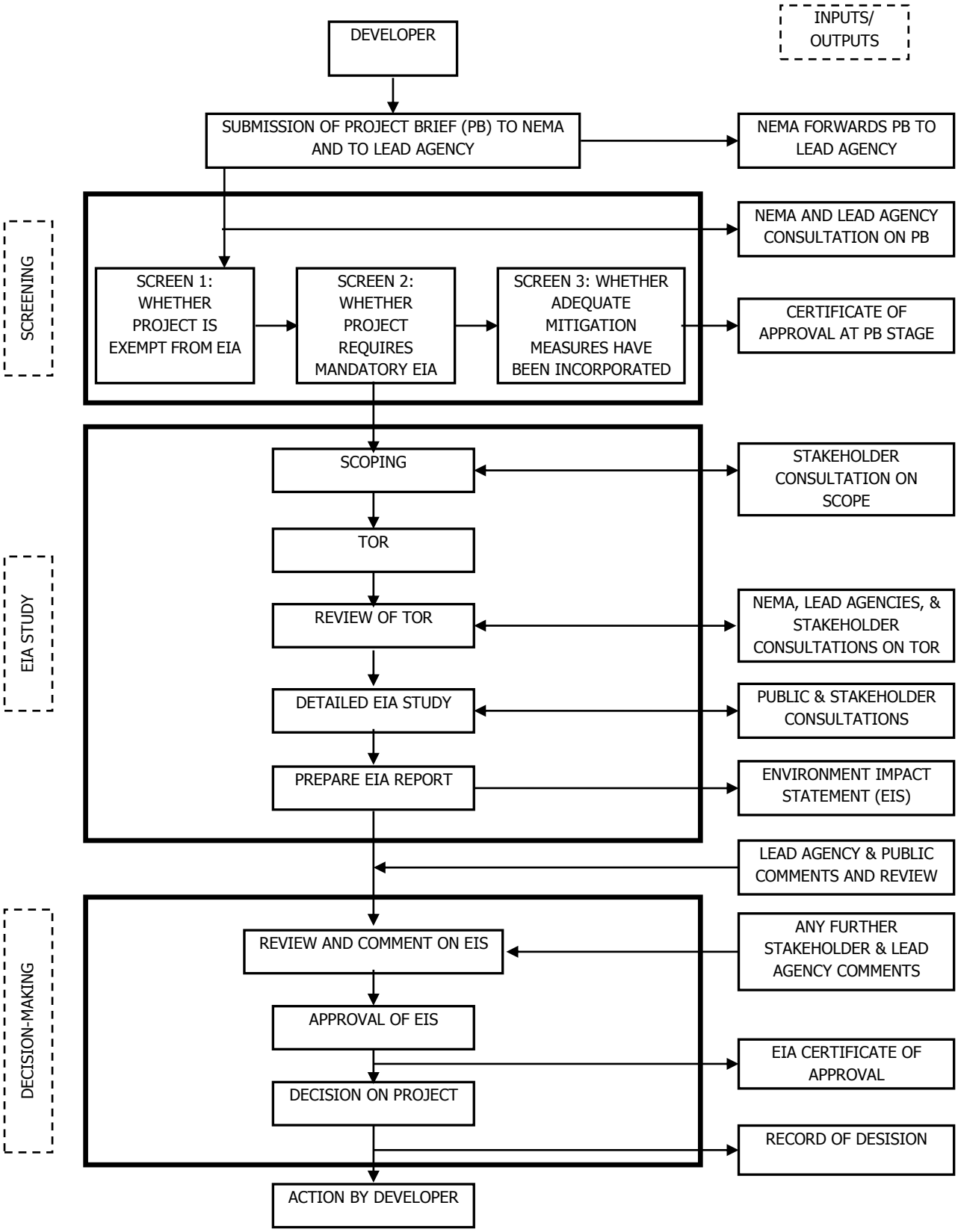


Figure 1.4.2 Summary of EIA process in Uganda.

3)Environmental Impact Study (EIS)

According to the EIA Regulations 1998, EIS refers to the detailed study conducted to determine the possible environmental impacts of a proposed project and measures to mitigate their effects. The EIS process contains the following key stages:

i) Scoping and TOR;
ii) Preparation of the EIS;
iii) Review of EIS and Decision on project; and
iv) Environmental Monitoring.

i)Scoping and TOR

Scoping is the initial step in the EIS. Its purpose is to determine the scope of work to be undertaken in assessing the environmental impacts of the proposed project. It identifies the critical environmental impacts of the project for which in-depth studies are required, and elimination of the insignificant ones. The scoping exercise should involve all the project stakeholders so that consensus is reached on what to include or exclude from the scope of work. It is also at this stage that project alternatives are identified and taken into consideration. The contents of the scoping report are the same as the project brief however more detail is likely to be needed. This may involve some preliminary data collection and field work.

The Developer takes the responsibility for scoping and prepares the scoping report after consultation with NEMA, Lead Agencies and other stakeholders. The developer with assistance from technical consultants will draw up the TOR for the EIS and submit a copy to NEMA that shall in turn be forwarded to Lead Agencies for comments (including the District Local Government or District Environment Officer).

ii) Preparation of the EIS

In preparing an EIS, relevant information is collected on issues of real significance and sensitivity. These are then analyzed, mitigation measures developed for the adverse impacts and compensatory measures recommended for unmitigated environmental impacts. Measures aimed at enhancing beneficial or positive impacts are also given. An EIS documents the findings and is submitted to NEMA by the developer.

iii) Review of EIS and Decision on Project

The Developer is required to submit ten (10) copies of the EIS to NEMA for review and approval. NEMA then forwards a copy to the Lead Agencies for comments. NEMA in consultation with the Lead Agencies (including the District Local Governments or District Environment Officer) shall review the contents of the EIS, paying particular attention to the identified environmental impacts and their mitigation measures, as well as the level of consultation and involvement of the affected stakeholders in the EIS process. In this review, the level to which the TOR set out for the study is addressed shall be considered. In making a decision about the adequacy of the EIS, NEMA shall take into account the comments and observations made by the Lead Agencies, other stakeholders and the general public. NEMA may grant permission for the project with or without conditions, or refuse permission. If the project is approved, the Developer will be issued a Certificate of Approval.

iv)Environmental Monitoring and Management Plan

Monitoring is the continuous and systematic collection of data in order to assess whether the environmental objectives of the project have been achieved. Good practice demands that procedures for monitoring the environmental performance of proposed projects are incorporated in the EIS.

To assist in implementation of identified mitigation and monitoring strategies, an environmental monitoring plan will be developed. It will describe the various environmental management strategies and programmes to be implemented. It will also identify the management roles and responsibilities for ensuring that monitoring is undertaken, results are analyzed and any necessary amendments to practices are identified and implemented in a timely manner. The monitoring plan shall provide for monitoring of both project implementation and environmental quality. It shall contain a schedule for inspecting and reporting upon the implementation of the project and associated mitigation measures identified in the EIS. The monitoring plan shall also identify the key indicators of environmental impact. Further, the plan shall provide a schedule for monitoring each indicator and for reporting the monitoring results to NEMA or the Local Authority.

4)Public Consultation

The environmental impacts or effects of a project will often differ depending on the area in which it is located. Such impacts may directly or indirectly affect different categories of social groups, agencies, communities, and individuals. These are collectively referred to as project stakeholders or the public. It is crucial that during the EIA process, appropriate mechanisms for ensuring the fullest participation and involvement of the public are taken by the developer in order to minimize social and environmental impacts and enhance stakeholder acceptance.

Attachment-2 : Figure of Wetland

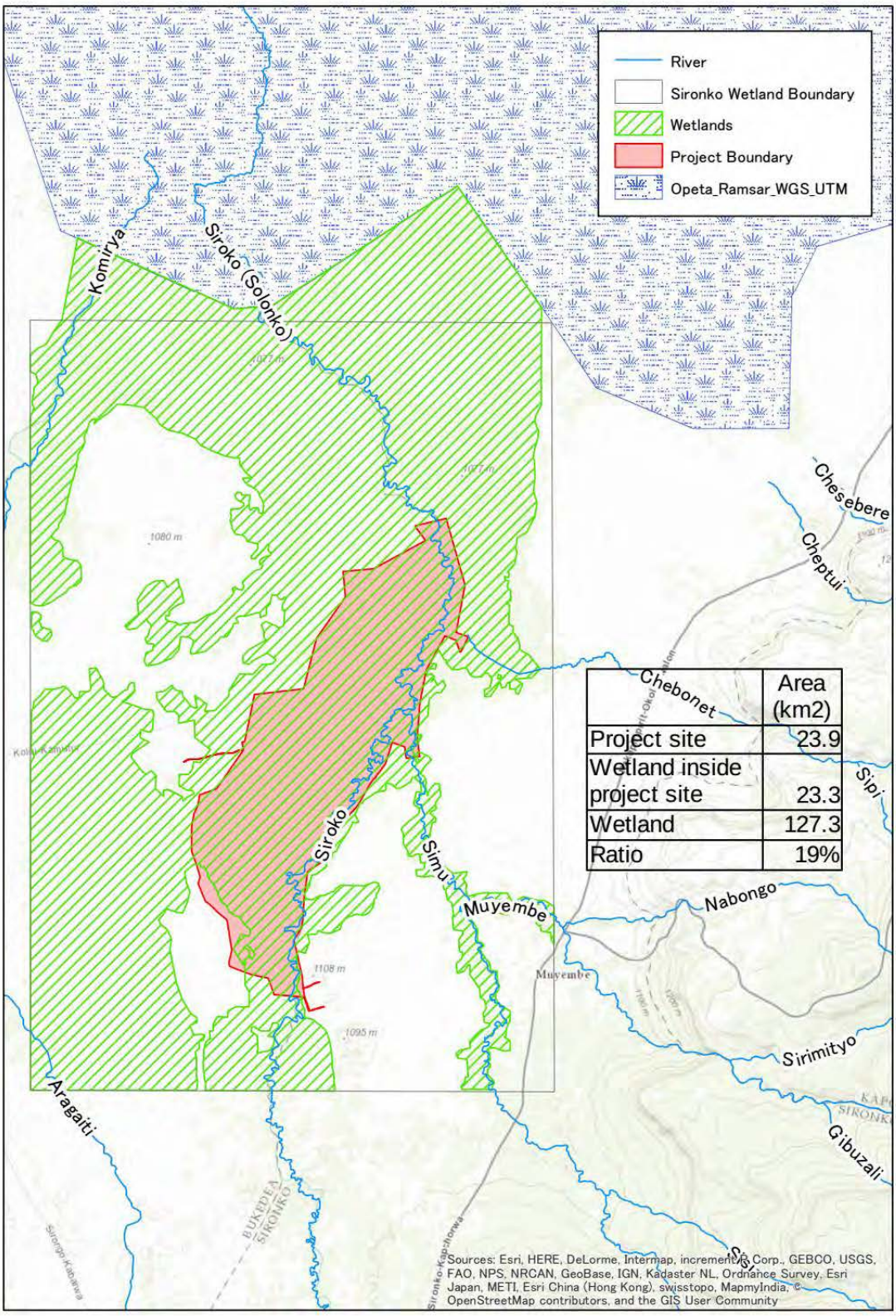


Figure 1 Percentage of the total area of the wetland (Sironko)

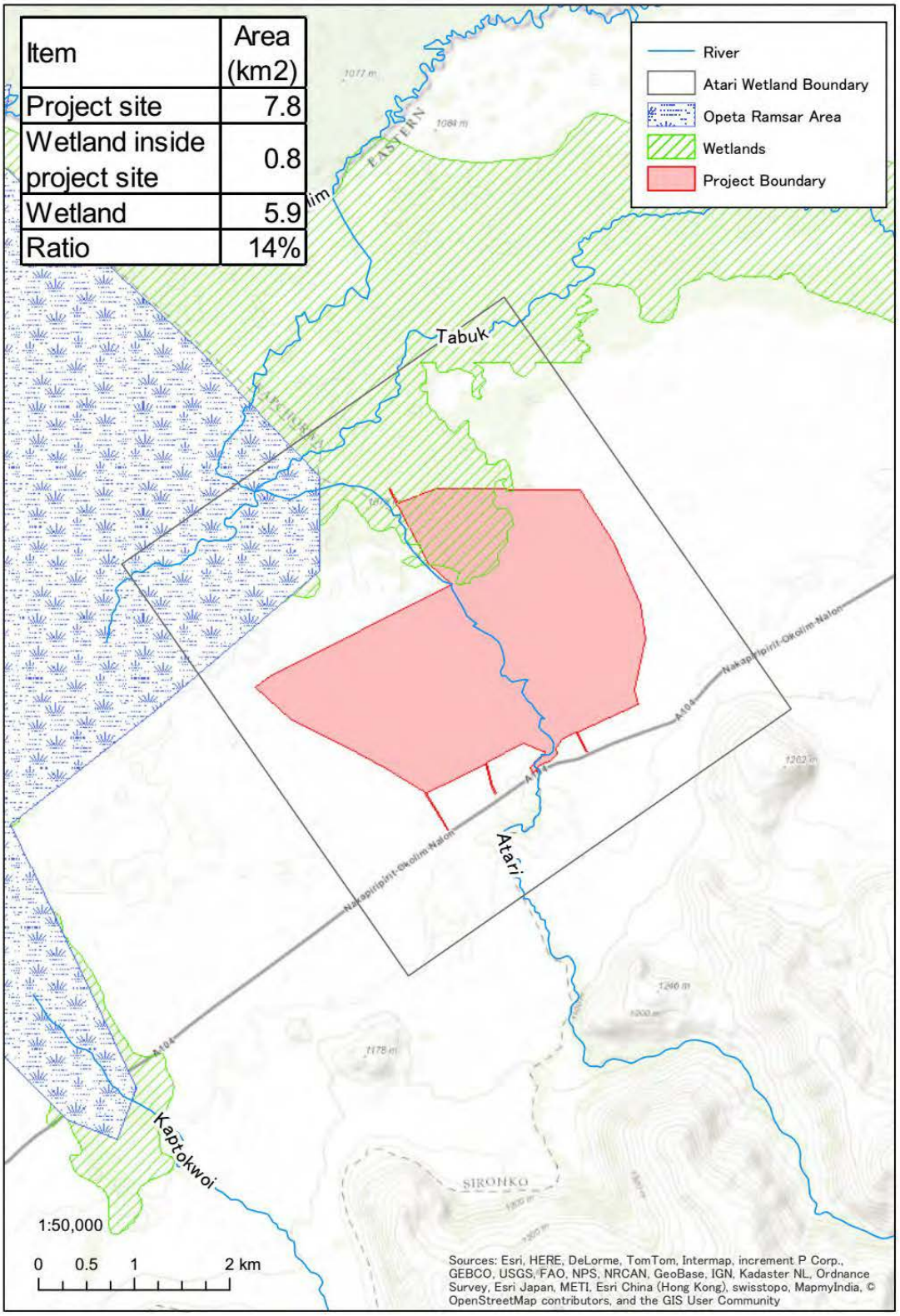


Figure 2 Percentage of the total area of the wetland (Atari)

Attachment-3

Draft TOR of RAP Task Force during F/S

(1) Background for Establishing RAP Task Force

Because the acquisition of land for irrigation facilities and the resettlement are expected to occur for the project, PISD must devise RAP (Resettlement Action Plan). To effectively implement the RAP, Task Force (TF) which consists of members from MAAIF, MWE and MLHUD has to be established.

(2) Objectives of TF

Objectives of TF is to develop the framework of RAP for PISD, such as policy of RAP, range of compensation, range of PAPs (Project affected people), and implementation method.

(3) Output

Results of discussion on items in the table below will be reflected in Draft RAP. Discussion will be based on the draft material which JST (JICA Study Team) will make.

Items	Definition / Confirmation & Discussion point
Policy of RAP	To ensure that the social and economic well-being of PAP will not be worsened as a result of the project. To abide with JICA guideline, WBOP4.12, and Ugandan laws and regulations.
Gap Analysis	To analyze gaps between JICA guidelines, WBOP4.12 and Ugandan laws and regulations, and to discuss and devise measures to fill the gaps.
Cut-off Date	Possible cut-off date is the beginning or the ending day of the Land owner survey, however it is to be discussed.
Eligibility	To define PAPs (Project Affected Persons) based on the types of loss, such as; Land acquisition/ structure acquisition/ Farmland acquisition/ Physical resettlement/ structure relocation / crops loss, income means loss, etc.
Entitlement Matrix	To determine types of compensation for deferent types of impacts on PAPs. How to deal with different scales of land loss.
Policy of voluntary donation	JICA and WB allow voluntary land donation, on condition that impacts must be minor, that is, involve no more than 10 % of the area of any holding, and require no physical relocation.
Grievance Mechanism	Organization that deals with grievance from PAPs concerning RAP. To determine members, roles, responsibility and duration.
RAP Institutional Framework	Institutions that have roles and Responsibilities to PISD RAP · MAAIF, MWE, MLHUD, MGLSD[1),] · Local Governments, · Uganda Land Commission, · Local Consultant (will be hired by MAAIF/MWE for verification and actual payment of compensation to PAPs)
RAP Implement Schedule	Compensation Schedule, Resettlement Schedule
Cost Estimation of RAP	Loss of land, structures, crops, restoration support, Compensation implement consultant, M & E,

Items	Definition / Confirmation & Discussion point
	Finance source
Monitoring & Evaluation system	Budget should be prepared for M & E activity. MAAIF, MWE, NGO, PDCC, PACC, NGO, university, etc. Verifying RAP completion.
Draft RAP	Compiled in F/S Draft Final Report.
Public Consultation Meeting	14 -19 March: General explanation of RAP, Hearing opinions and questions from residents. Completed. 23 - 28 May: Explanation of Draft RAP, policy of compensation
Approval of Final RAP	Approval from Chief Government Valuar (and JICA) before OD Report submission (Aug-Oct., 2017)
RAP implementation Committee (RIC)	Control and supervise organization on resettlement and compensation payment. Should be established before RAP implementation in 2018.

[1)] Ministry of Gender, Labour & Social Development (To cooperate about support for vulnerable PAP)

(4) Activity Period

Activity period is from April 2016 when TF is established and until September 2016 when the last JCC is held. Meeting will be held basically once in two/three weeks.

(5) Completion condition

TF activity during F/S will be completed after getting approval of RAP part compiled in Draft Final Report of JST from JICA in August –September 2016. Subsequently, this TF will consist of RAP Implementation Committee (RIC) that will be formed in O/D stage in 2017.

(6) Responsibility of TF team leader

An official from MAAIF or MWE will be appointed. TF leader is responsible to hold the meeting, facilitate the discussion, and prepare the minute of discussion.

(7) Task Force members

TF permanent members consist of officers from MAAIF, MWE, MoLHUD, Officers of MoGLSD, Local Governments, and Uganda Land Commission will be invited to participate when needs

(8) Communication

TF shall report the progress of discussions to commissioners of MAAIF and MWE and relevant JCC members.

Appendix E

Materials Used for Capacity Development Training

Content

1 Outline of the Capacity Development Workshop

The capacity development workshop for Phase 1 and Phase 2 is listed in Table 1.1. In total, seven training were conducted during the Study, namely, three training in Phase 1 and four training in Phase 2.

Table 1.1 Conducted Training

Date	Name	Participant	Contents
Phase 1			
23-24/9/2014	Basic Geographic Information System (GIS) Training	MWE, MAAIF NARO, NAADS Uganda National Meteorology Authority (UNMA), District officers Busitema University Total:14	Basic ArcGIS operation Collecting geographic information by GPS Satellite image analysis Google earth operation
23-24/10/2014	Lecture for Project Implementation	MAAIF MWE District officer Total:14	Demarcation of irrigation development in Wetland area Agriculture in Japan and type of project management system Land Improvement Law and roles of WUA and establishment and registration of WUA O&M of irrigation systems in Tanzania
8-13/2/2015	Training in Tanzania	MAAIF MWE Busitema University Farmer's representative Total:14	Study about improved irrigation scheme, especially from the aspect of O&M and strengthening farmers' organisations. Exchange and share experiences at irrigation schemes. Assess the training resources and the educational institutes
Phase 2			
25-26/8/2015	Advance GIS Training	MAAIF MWE Total: 10	Making contour map Land classification analysis Analyzing watershed
10-11/3/2016	Hydrology and Design Lecture	MAAIF MWE Total:8	Hydrological analysis Calculation of crop evapotranspiration Calculation of irrigation water Irrigation and drainage facilities design
5-6/5/2016	Training for Design of Irrigation Facilities	MAAIF MWE Total:16	Explanation of facility composition, summary and some case of main canal and irrigation facilities in a model country ・Scale of design and hydrogy
11/7/2016	Introduction to Method of Project Evaluation for Irrigation Project	MAAIF MWE Total:11	Project cost & benefit Opportunity cost, shadow price Cash flow Indicators (IRR, NPV, B/C) Cost component and project life etc Benefit component and development period etc

2 Activities of the Training

2.1 Training in Phase 1

(1) Basic GIS Training

1) Summary of Basic GIS Training

This training was held because of the counterparts (C/Ps) request. Its objective is to enable the participants understand the general information of GIS and learn basic operation of GIS software for application on their jobs and utilize technology of GIS for agriculture and water resources development and management. The target participants are beginners in the use of the GIS software and the total number of participants was 14; drawn from Ministry of Water and Environment (MWE), Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), National Agricultural Research Organization (NARO), National Agriculture Advisory Service (NAADS), Uganda National Meteorology Authority (UNMA), Luwero District Local Government (DLG), Mbale DLG and Busitema University attended the training. The training was conducted between 23rd and 24th of September 2014, for the total number of two days. The first day's program focused on the introduction of basic knowledge and operation of GIS, and field practice of collecting location information using Global Positioning System (GPS). The second day's program was more technical, providing lesson such as how to download satellite images, satellite image analysis, and the basic operation and utilize of Google Earth.

The lesson of first day（23rd of September）

Practice of ArcGIS activation
（24th of September）

Collecting location information using GPS
（23rd of September）

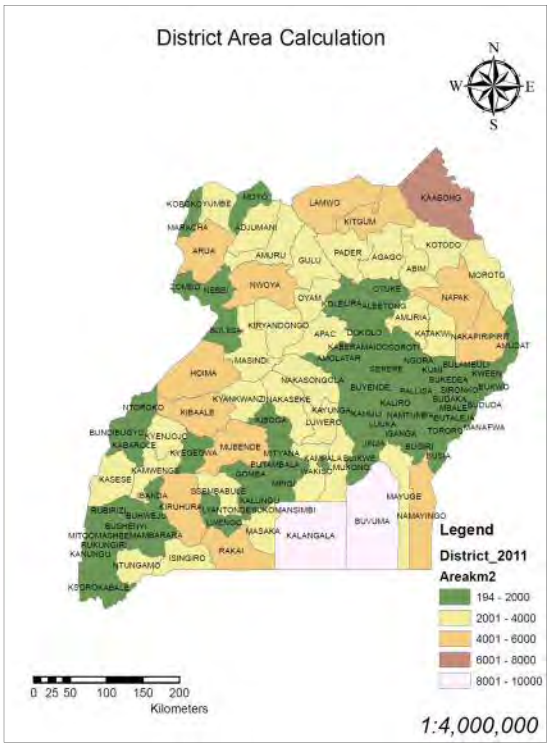
The discussion with participants
（24th of September）

Figure 2.1 Picture of Basic GIS Training

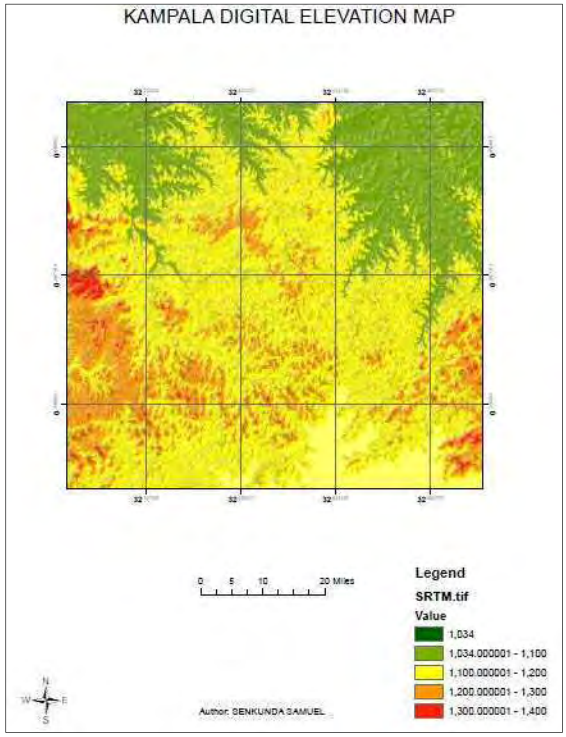
At the end of the lessons, a discussion was conducted about opinions of the training and application for agricultural production and water resources management using GIS in Uganda. Participants had high motivation and followed lessons with keen interest, and participants gave a lot of opinions and questions.

2) The Results of Workshop

Calculation of district area in Uganda and elevation map using Shuttle Radar Topographic Mission (SRTM) image were taught in the lesson. Samples, which were made by participants, are shown below.



Calculation area of district
by the Assistant Commissioner of
WfAP/MAAIF



Elevation map
by the Senior Meteorologist of UNMA/MWE

Figure 2.2 Picture Made by the Participants

3) Results of Questionnaire

A questionnaire was collected from participants after the lessons. The results show that the training satisfied the needs and expectation of the participants. However, the training period was too short for getting advanced knowledge of GIS such as delineation of watershed, ArcGIS was also used in the training, but it is too expensive for the participants, hence recommended use of GIS lesson with free software.

(2) Lecture for Project Implementation

The lecture has done with the aim of capacity building for irrigation scheme project implementation, operation, and maintenance for irrigation facilities targeting C/Ps including central and local government for two days. The participants are from MAAIF, MWE, and district engineer from Mbale District with total number of 14 persons. The subject was as following: i) Presentation of irrigation development plan and concept of zoning for 10 candidate sites which was proposed in joint workshop with wetland management project, ii) Introduction of land improvement law and roles of Water Users' Association （WUA） and establishment and registration of WUA through Japanese case, and iii) Introduction of Operation and Maintenance (O&M) system in Tanzania by irrigation development advisor, MAAIF. The participants had raised awareness of the issue and strengthened their knowledge through open discussion and exchanging views after and during presentation. The contents are show as below and presentation documents are attached in Page E-48.

- Proposed Demarcation of Irrigation Development in Wetland Area
- Agriculture in Japan and Type of Project Management System
- World Atlas of Irrigated Agriculture for Sustainability Science (WAIASS)
- Land Improvement Law and Roles of WUA and Establishment and Registration of WUA
- O&M of irrigation systems in Tanzania

(3) Training in Tanzania

1) Summary of Training

The purpose of workshop was that strengthening of farmers' organization for sustainable O&M of irrigation scheme and the government supporting system. Participants inspected irrigations scheme, training centre and college, which produce positive result for irrigation. The workshop was conducted by JICA expert of irrigation advisor form MAAIF and JST for the training period of six days including two days trip. A Total of participants were 14 people who are from MAAIF, MWE, and Busitema University.

Purpose of training

1) To capacitate the government staff and farmers at irrigation schemes in order to improve irrigation scheme, especially from the aspect of O&M and strengthening farmers' organizations.
2) To exchange and share experiences between Ugandan and Tanzanian government staff and farmers at irrigation schemes.
3) To assess the training resources including the educational institutes on the irrigation sector in Tanzania.

2) Training Contents

The training components consist of lecture to get necessary information, site visit to know actual situation and activities, exchanging opinions to learn experiences from each other and action plan making to take quick actions to address challenges. Each training site, participants, and staff of Tanzania made a presentation about their water management, O&M plan and farmer organization system. Discussions were conducted after the presentation.

Table 2.1: Training Contents

No.	Training site	Contents
1	JICA Tanzania Office	Technical cooperation in the field of irrigation by JICA Tanzania Office.
2	Department of Irrigation Technology and Services, Ministry of Agriculture, Food Security and Cooperatives (MAFC)	General information of Tanzanian irrigation sector and supporting system to irrigation schemes and the comprehensive guidelines
3	Kilimanjaro Irrigation Zone Office (ZITSU)	Outline of zone office activity and supporting system to irrigation schemes
4	Mombo and Ndungu irrigation schemes	Farmers' organization, O&M plan and record, financial management, water management, farmers' participation and the government support
5	Kilimanjaro Agricultural Training Centre (KATC)	Selection of trainees, training curriculum, training method, extension method and follow-up system
6	Arusha Technical College(ATC)	Curriculum, facilities, acceptance of Ugandan engineer

2.2 Training in Phase 2

(1) Advance GIS Training

The training term was two days, 25th August 2015 and 26th August 2016, and the venue was Nile basin initiative in Entebbe. The content of advance GIS training was decided by requests from participants of previous GIS training. The term was two days in the same as last training. This training was for getting high skill of GIS analysis and knowledge, and these skills are directly utilized for their work. The participants were three people from MAAIF, seven people from MWE. This training was for GIS, moreover instruction of drone was explained for after drone is given to C/P. We selected GIS software in this training was Quantum GIS (QGIS) and Multi-spec which are free download, the participants who attended previous GIS training requested to use free GIS soft. The contents of training were selected tough out for utilization participant's work, and the contents were Basic operation of QGIS, Creating contours form Digital Elevation Model (DEM) data, Land cover Map, Analyzing Landsat8 image by Multi-spec, Area calculation of land cover and layout, Creating watershed using SRTM&QGIS, instruction for drone. Practice time in the training was conducted, and participants asked lecturers some questions personally and conducted the analysis. The installer and

studying material were distributed for self-learning.

Basic knowledge of GIS

Practice of analyzing using GIS

Instruction of drone

Participants

Figure 2.3 Lecture of GIS and Drone Training

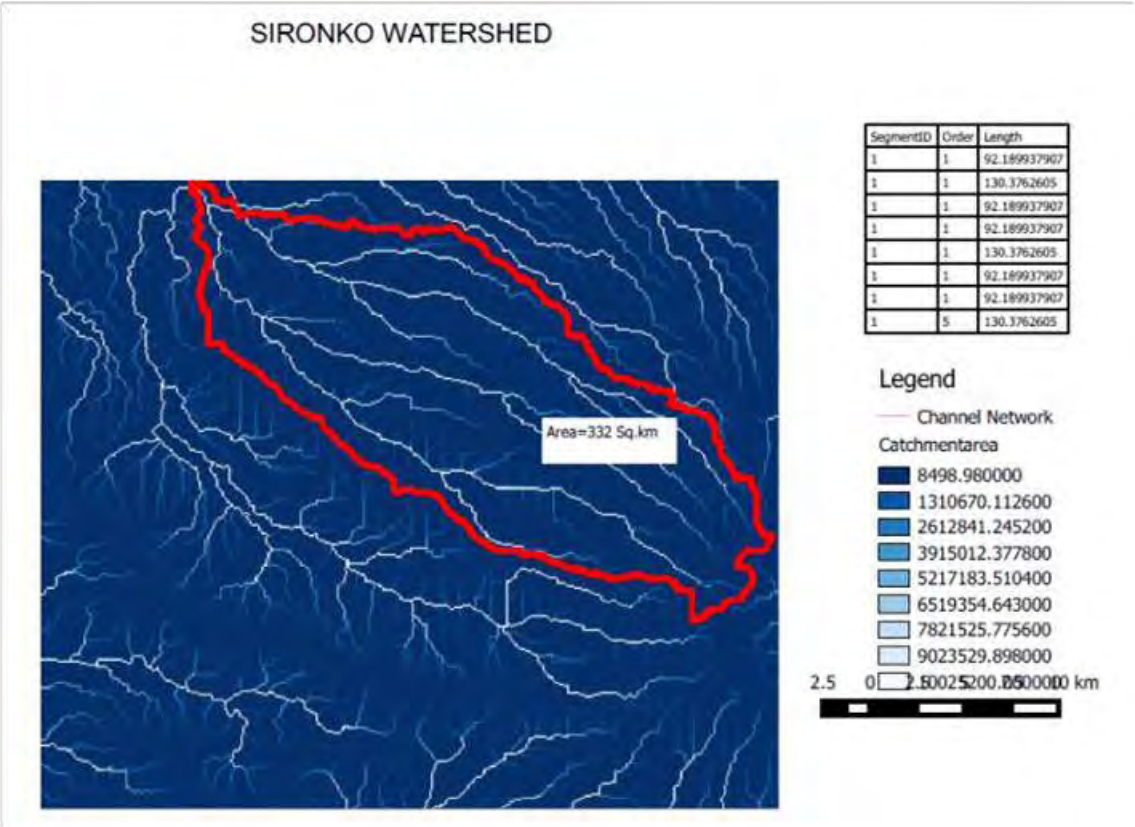


Figure 2.4 Result of Watershed Analysis

(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.

Lecture for hydrology

Lecture for design of irrigation facility

Participants

Explanation for design

Figure 2.5 Lecture for Hydrology and Design

(3) Design of Irrigation Facilities

This training term was 2 days, 5th May 2016 and 6th May 2016, and the venue was Fair way hotel in Kampala. The purpose of training was for studying outline and skill of irrigation design, and the participants were seven people from MAAIF and nine people from MWE. Fast day was about explanation of facility composition, summary and some case of main canal and irrigation facilities, and second day was scale of design and hydrogen. Participants were very interested in study design, and questioner shows participants were satisfy about the training

Lecture for method of design

Practice for designing

Figure 2.6 Lecture for Design

(4) Introduction to Method of Project Evaluation for Irrigation Project

The training was conducted on sixth, and the venue was Fair way hotel in Kampala. The purpose of training was for studying project evaluations which are process of selection of F/S area in Phase 1 and making decision process to select implementation site (Sironko and Atari sites)、and the participants were Four people from MAAIF and seven people from MWE.

The contents of training are consisted by lecture, practice, discussion, and questioner. The contents of lecture were principle of economic evaluation of project (Lecture1) and composition of project cost (Lecture2 Part1), and finally lecture for composition of project benefit was conducted, and mainly experience and practical skill of Project on Irrigation Scheme Development in Central and Eastern Uganda (PISD) were preferred more than logic.

In addition, practice of irrigation project economic analysis using MS-Excel was conducted, and Internal Rate of Return (IRR), Net Present Value (NPV), Benefit-cost (B/C) were calculated by themselves in the training for understanding gist and outline of main criteria. Moreover, some guide lines and manual which are FAO , International Fund for Agricultural Development (IFAD) and etc made and open for evaluation of agricultural project (irrigation project) were introduced for more understanding.

Lecture for method of project evaluation

Participants

Figure 2.7 Lecture of Method of Project Evaluation

Materials Used for Capacity Development Training

1. Basic GIS Training

Time table of basic GIS Training

Date : 23-24 September 2014

Venue: Nile Basin Initiative secretariat, Entebbe, UGANDA

Day 1	Time	Contents	Lecturer
	~9:15	Confirmation of attendance	
	9:15	Opening remark	Mr.Negishi
		Outline of the training	Mr.Kobayashi
		Self-introduction	
	9:30	Lecture 1: Introduction to GIS and remote sensing	Mr.Kobayashi
	10:30	Coffee break	
	11:00	Lecture 2: Demonstration of Basic operation of Arc GIS	Mr.Kikuchi
	12:00	Practice 1: Basic operation of Arc GIS	Mr.Kikuchi
		Launch the ArcGIS	
		Basic operation	
		Open the Shape files	
		Change the layer	
		Making thematic map using Administration boundary and population data	
		Modification of Legend, Labeling	
		Making Elevation map by using DEM data	
		Print out the map with scale and legend	
	13:00	Lunch break	
	14:00	Lecture 3: How to use GPS	Mr.Kikuchi
	14:30	Practice 2:GPS Data Collection in the field	Mr.Kikuchi
	15:30	Practice 3:Utilization of GIS data	Mr.Kikuchi
		Utilization of GPS data	
		Input XY data	
	16:30	Review of today's activity and Discussion	
	17:00	Close	

Day 2	Time	Contents	Lecturer
	9:15	Review of Yesterday	Mr.Kobayashi
	9:30	Lecture 4: Getting Landsat8 and SRTM Image using Earth explorer	Mr.Kikuchi
	10:30	Coffee break	
	11:00	Practice 4: Analzing Landsat8 and SRTM Image	Mr.Kikuchi
	13:00	Lunch break	
	13:30	Presentation of Workplan by Mr. Sato	Mr.Sato
	14:30	Lecture 5: Introduction of Google Earth	Mr.Kobayashi
	15:00	Practice 5: Utilization of Google Earth	Mr.Kobayashi
		Basic operation of Google Earth	
		Find and indicate the place or area	
		Send the point or area to friends	
		Utilization of GPS data	
	16:00	Lecture6: Advanced use of ArcGIS	Mr. Kikuchi
		DEM data	and Mr. Kobayashi
		Contour Generation	
		Making watershed map by using Model builder	
	16:30	Review of training activity and Comment from participants	
	17:00	Closing remark and Issuance of Completion Certificate	Mr.Negishi

Outline of the Basic GIS training

Training Object

- To understand the general information of GIS and learn basic usage of GIS for application on your job.

Schedule Day 1

Time	Contents	Lecturer
9:15	Opening remark	Mr.Negishi
	Outline of the training / Self-introduction	Mr.Kobayashi
9:30	Lecture 1: Introduction to GIS and remote sensing	Mr.Kobayashi
10:30	Coffee break	
11:00	Lecture 2: Demonstration of Basic operation of Arc GIS	Mr.Kikuchi
12:00	Practice 1: Basic operation of Arc GIS	Mr.Kikuchi
13:00	Lunch break	

Schedule Day 1

Time	Contents	Lecturer
13:00	Lunch break	
14:00	Lecture 3: How to use GPS	Mr.Kikuchi
14:30	Practice 2:GPS Data Collection in the field	Mr.Kikuchi
15:30	Practice 3:Utilization of GIS data	Mr.Kikuchi
16:30	Review of today's activity and Discussion	
17:00	Close	

Schedule Day 2

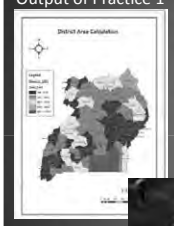
Time	Contents	Lecturer
9:15	Review of Yesterday	Mr.Kobayashi
9:30	Lecture 4: Getting Landsat8 and SRTM Image using Earth explorer	Mr.Kikuchi
10:30	Coffee break	
11:00	Practice 4: Analyzing Landsat8 and SRTM Image	Mr.Kikuchi
13:00	Lunch break	

Schedule Day 2

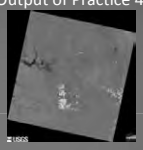
Time	Contents	Lecturer
13:00	Lunch break	
13:30	Presentation of Work plan by Mr. Sato	Mr.Sato
14:30	Lecture 5: Introduction of Google Earth	Mr.Kobayashi
15:00	Practice 5: Utilization of Google Earth	Mr.Kobayashi
16:00	Lecture6: Advanced use of ArcGIS	Mr. Kikuchi and Mr. Kobayashi
16:30	Review of training activity and Comment from participants	
17:00	Closing remark and Issuance of Completion Certificate	Mr.Negishi

Outputs of Practices

Output of Practice 1



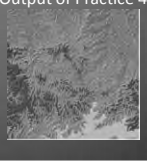
Output of Practice 4



Output of Practice 5

Practice 2

Output of Practice 4



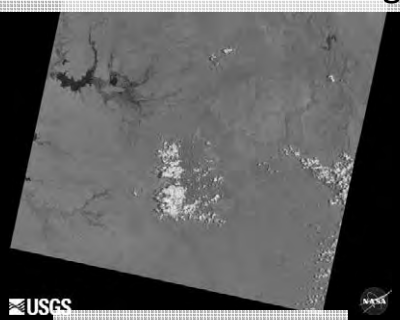
Self-introduction

1 minutes Self-introduction

1. Name
2. Organization / Title
3. What do you expect from this Training?

Until 9:30

Lecture 1: Introduction to GIS and Remote Sensing



Yukimitsu KOBAYASHI

Objectives of Lecture

- To provide basic information on GIS and Remote Sensing.
- To show examples of GIS and Remote sensing application

Table of contents

GIS

What is GIS?

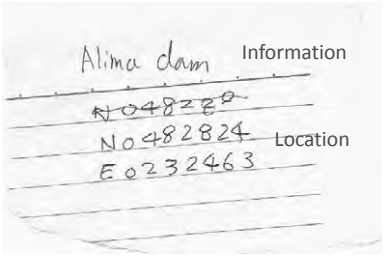
- A Geographic Information System (GIS) is a computerized data management system used to **capture**, **store**, **manage**, **retrieve**, **analyze**, and **display** spatial information.
- GIS= Information＋*Location*
  - E.g. **JICA Uganda Office;** *4th Floor, Course View Towers Plot 21 Yusuf Lule Road, Nakasero, Kampala*

What is GIS?

- GIS in our daily activities.
  - Weather maps on TV
  - Google Map
  - Car navigation system
  - Facebook
  - Mention others….

Examples

7



Examples

8

Source: https://www.google.com/maps/

Examples

9

Source: http://www.weatheronline.co.uk/Africa.htm

Examples

10

- http://www.flightradar24.com/

Source: http://www.flightradar24.com/

Overview of the functions of GIS

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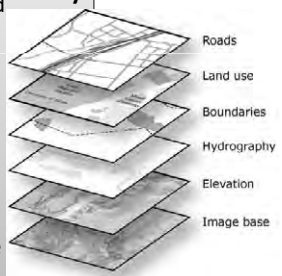
- GIS = Location + Information
- Spatial information
  - Display
  - Capture
  - Store and Manage
  - Retrieve and Analyze

Functions of GIS

12

- Measure Distance
- Raster Calculator
  - Shortest path, Cost -Weighted Distance
  - Aspect calculation, Image enhancement
- Spatial interpolation
  - Interpolation of the observed Meteorological data
- Database operation
  - Processing based on attribute
  - Merge, Select …

Layer structure



Source: http://help.arcgis.com

Example of measurement

13

- How many shops are there within 100m?

Example of Spatial interpolation

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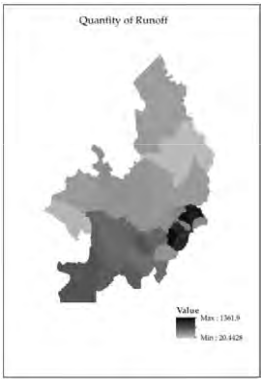
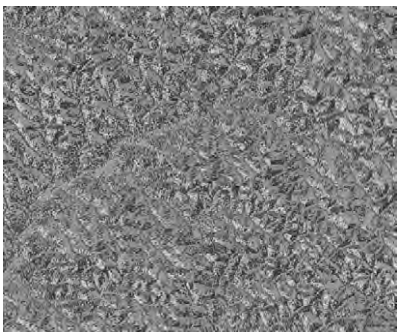


Example of Aspect calculation

15



Desktop GIS Software

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Commercial software

- ArcGIS for Desktop

Free software

- Q GIS
- Google Earth
- GRASS GIS
- ILWIS

GIS DATA

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Types of GIS Data

18

- Vector Data
- Raster Data

Vector data

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- Expressed as Point, Line, polygon
- Referred to as a “Shape files"

Source: http://help.arcgis.com

Raster Data

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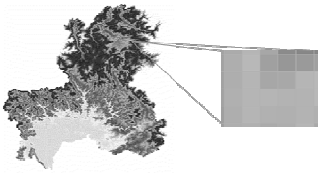
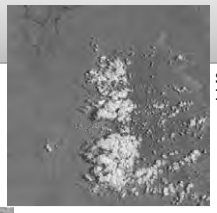
- Expressed as a “colored cell“
  - E.g. Digital photography



Raster Data

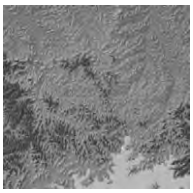
21



Satellite Image

Aerial photo

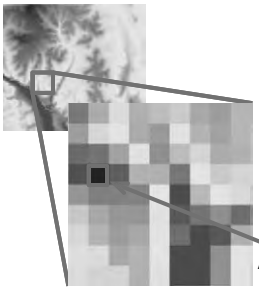
DEM: Digital Elevation Model



Source: http://www.esrij.com/

Raster Data

22



store a Value in each pixels
(Observed value, Elevation, Class value Etc.)

250	180	150	100
130	60	70	40
30	50	35	20

Array of cells / pixel
(Column, Row)=(2, 4)→ Value

Source: http://www.esrij.com/

File formats of the data

23

- Shapefile Type
  - ***.shp, ***shx, ***.dbf (***.prj etc)
  - Widely used for vector data
- Geodatabase
  - ***.gdb
  - the native data structure for ArcGIS
- Geo Tiff
  - ***.tif
  - Widely used for raster data

Examples of Analyzed data

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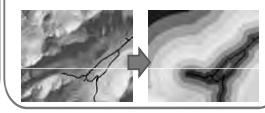
Solar radiation Analysis

Distance Analysis
(Straight-line distance from the road)



Hydrological Analysis

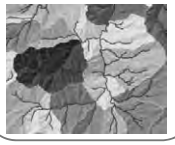
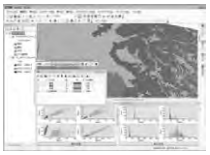


Image classification
(Extraction of forest area)



Density analysis
(Incidence rate of crime)

Source: http://www.esrij.com/

Acquisition of the GIS Data

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- **Earth Explore** (http://earthexplorer.usgs.gov/)
- GADM database of Global Administrative Areas (http://www.gadm.org/)
- **SRTM** 90m mesh DEM (http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp)
- ASTER GDEM :ASTER Global Digital Elevation Model 30m mesh DEM (http://gdem.ersdac.jspacesystems.or.jp/)

+ Existing data (UBOS, Department of Geological Survey and Mines, etc)

Conclusion of GIS

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- Not only display but also store, manage retrieve and analyze the data
- Combination of Raster data and Vector data

REMOTE SENSING

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What is Remote Sensing

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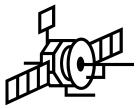
- The acquisition of information about an object or phenomenon without making physical contact with the object.
- Technology to analyze the data (Image) taken by camera, radiometer or radar on satellite, Air plane or balloon.





Examples of Remote sensing

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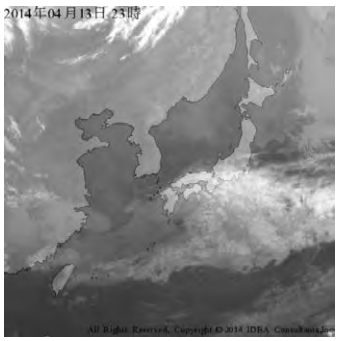
- Tomnod

Advantages of Remote Sensing

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Advantages

- Homogeneously wide area observation
- Periodic and continuous observation
- Possible to analyze Remote areas, hazardous

Disadvantages

- Obtained only data of the surface
- Limited resolution (Pixel size)
- Indirect measurement through the electromagnetic wave

Types of Remote sensing

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▸Passive Remote Sensing

- Satellite Imagery
- Arial Photography
- Observe the reflection of the sunshine or signal (emission) from the target

▸Active Remote Sensing

- Synthetic Aperture Radar (SAR)
- LiDAR
- sends a signal towards the target, Observing the changed signal by the reflection or scattering

Data Collection by Remote Sensing

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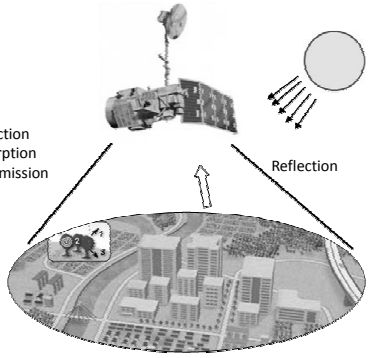
1. Reflection
2. Absorption
3. Transmission



Reflection characteristic

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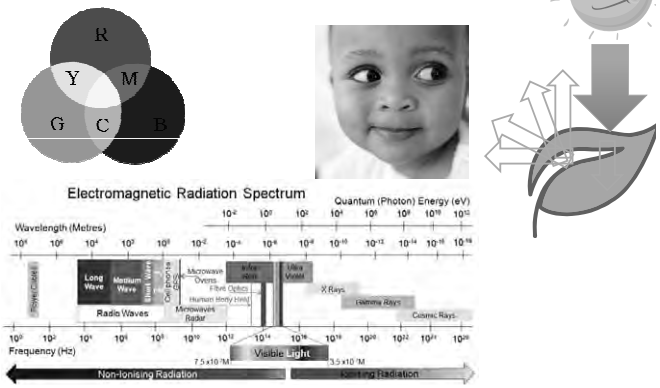
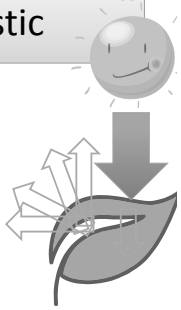
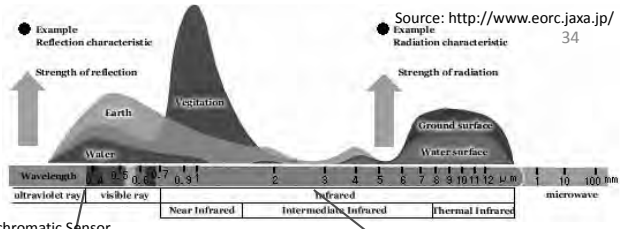


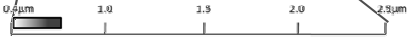


Source: http://www.eorc.jaxa.jp/

34

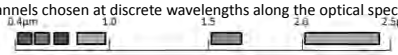


Panchromatic Sensor
(Single-channel detector sensitive to radiation within a broad wavelength range)



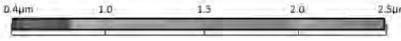
B&W
Aerial Photos

Multispectral Sensor
(2 to 15 channels chosen at discrete wavelengths along the optical spectrum)



RGB Imagery
Landsat
WorldView-2

Hyperspectral Sensor
(hundreds of channels provide a near continuous reading of the optical spectrum)



AVIRIS

Source: http://www.exelisvis.com

Software for Remote Sensing

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Commercial Software

- ArcGIS for Desktop
- ERDAS IMAGINE
- ENVI

Free software

- Multispec
- GRASS GIS

Methods of analysis

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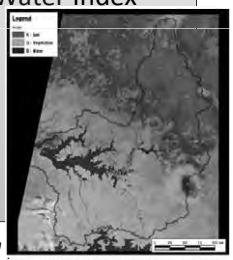
- NDVI: Normalized Difference Vegetation Index
  NDVI=(NIR-R)/(NIR+R)
- NDWI: Normalized Difference Water Index
  NDWI=(G-NIR)/(G+NIR)
- Vegetation - Soil - Water Index
- Colour composition



Source: Final report Supporting report of The Development Study on Water Resources Development and Management for Lake Kyoga Basin

Figure 2-6 VSW Index Image of January of 2003

Color composition

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- **Real Colour composition**
  - Red band on Red
  - Green band on Green
  - Blue band on Blue
- **False Colour composition**
  - NIR band on Red
  - Red band on Green
  - Green band on Blue
- **Natural Colour composition**
  - Red band on Red
  - NIR band on Green
  - Green band on Blue

Sensors Representation

Examples of the Analysis

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Turbid water Assessment

Vegetation amount assessment

Land use classification

Thermal environment assessment

Time series variation analysis

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Examples of Remote sensing application

40

- Measurement of Vegetation
  - Deforestation, Desertification, Land use, Crop condition
- Measurement of surface temperature
  - Heat-island effect
- Measurement of the sea temperature
  - El Nino event , Fishery position forecasting
- Measurement of Elevation
  - Making topographic map
- Measurement of the cloud and vapor condition in the atmosphere
  - Weather forecast, Rain intensity, Internal situation of typhoon
- Measurement of water
  - storage capacity of Lake or dam , flood damage

Conclusion of Remote Sensing

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- Periodic wide area continuous observation
- Analysis based on the reflection characteristic
- Ground truth is necessary to grasp the actual condition in the filed

General Conclusion

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- Available in the field of Agronomy, Social-Economy, Infrastructure, Water resource management and Environment
- Using GIS is not object, just method

Lecture 5: Introduction of Google Earth

Yukimitsu KOBAYAHI

Table of Contents

Objectives of the lecture

- To provide basic information of Google Earth
- To learn Basic operations (use) of Google Earth

What is Google Earth

- **Google Earth** is a virtual globe, map and geographical information program.
- It maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and geographic information system (GIS) 3D globe.

http://en.wikipedia.org/wiki/Google_Earth

Use of Google Earth

- Discover **the Earth**: Fly to any location in the world
- Explore **the Sky**: Enjoy the wonders of the heavens.
- Dive in **the Ocean**: Go beneath the surface and visit the depths of the.
- Walk on **the Moon**: Take tours of landing sites narrated by Apollo astronauts and view 3D models of landed spacecraft.
- Visit **Mars**: Travel the Red Planet and explore NASA's latest imagery of our galactic neighbor.

Source: https://support.google.com/earth/

Coordinate system of Google Earth

- Geodetic datum: WGS 84 (Not Arc1960)
- Projection: Simple Cylindrical (Plate Carree)
- Coordination units: 4 types
  - Decimal Degrees (DD .DDDDDD)
  - Degrees, Minutes, Seconds (DD MMSS)
  - Degrees, Decimal Minutes (DD MM.MMM)
  - Universal Transverse Mercator (Zone XXXXXm E YYYYYm N)

Source: https://support.google.com/earth/

What is Google Earth **Pro?**

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- **Google Earth Pro**
  Tools and capabilities designed specifically for business users, including:
  - Print high resolution screenshots
  - Map large GIS datasets
  - Create custom movies to share with clients and customers
  - Measure area with a polygon or circle
  - View demographic, parcel and traffic data displayed in colorful layers

What is Google Earth **Pro?**

8

- The same imagery database as the free version of Google Earth.
- Print locations at a higher output resolution.
- Allowed to use Google Earth Pro images and data for marketing purposes as long as this data is not sold to any third parties.

Source: http://www.google.com/enterprise/mapsearth/products/earthpro.html

Google Earth (free) V.S. Google Earth Pro

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Features	Google Earth (free)	Google Earth Pro
Print images	Screen Resolution only	Premium high resolution images
Regionate large datasets		✓
Batch geocode addresses		✓
Import GIS data		✓
Import GIS images	Manually Geo-locate	Automatically Geo-located
Import large image files	Up to max texture size	More than max texture size (Super Image Overlays)
Access demographic, parcel & traffic data layers		✓
Measure area of a polygon or circle		✓
Map multiple points at once		✓
Viewshed tool		✓
Map making tool		✓
Price	**Free**	**USD399/Year**

File type

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- KML: Keyhole Markup Language
  - File format for modeling and storing geographic features such as points, lines, images and polygons for display in Google Earth.
- **Note:** KMZ file is a compressed version of a KML file.
- Able to use KML to share places and information with other users of these applications.

Source: https://support.google.com/earth/

Example

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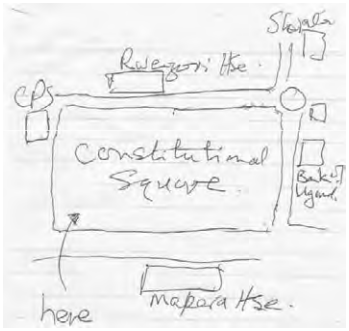

Example

12

https://dl.dropboxusercontent.com/u/53296925/Meeting%20Point.kmz

Basic operation

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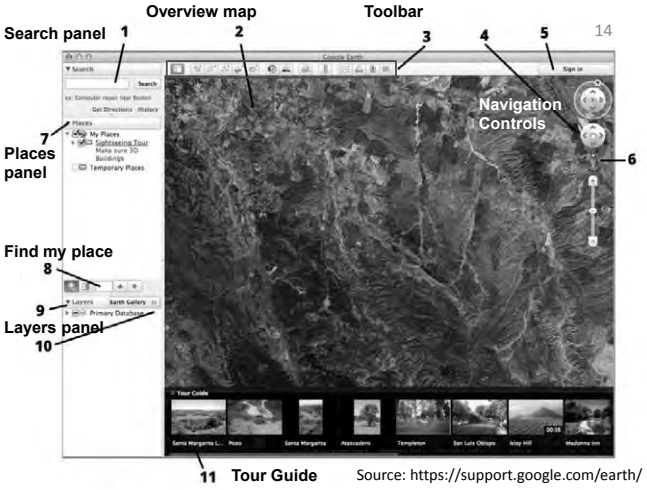
- Launch Google earth !



14

Source: https://support.google.com/earth/

Icons on the Toolbar

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- Hide/Show sidebar
- Add Placemark
- Add Polygon
- Add Path
- Add Image
- Record a Tour
- Show historical imagery
- Show Sunlight across the Landscape
- Swith between Earth, Sky and other planets
- Show Ruler
- Email
- Print
- Save Image
- Show in Google Maps

Source: https://support.google.com/earth/

View recent historical imagery

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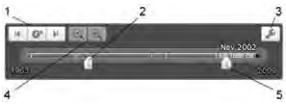
Click the icon on the toolbar



Time slider

1. Click this to play an animation of a sequence.
2. Drag the range marker to the right or left to redefine the time range of data displayed.
3. Click this to set options for the time slider.
4. Zoom in or out to shorten or lengthen the date range
5. Drag this to move the time range earlier or later.

Source: https://support.google.com/earth/

Zooming In and Out

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- Zoom in using a “Placemark”
- Zoom in and out using the mouse
  - Scroll the mouse wheel up(toward you) a number of times.
- Zoom in and out using the navigation controls
  - Zoom in by clicking the zoom in button .

Source: https://support.google.com/earth/

Tilting the View

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- Tilt using the mouse
  - Depressing the scroll wheel button and moving the mouse up or down
  - Pressing the **SHIFT** key and scrolling **DOWN** to tilt
- Tilt using the navigation controls
  - Zooming in. Once you zoom in far enough, Google Earth tilts your view.
- **Moving and Looking**

Source: https://support.google.com/earth/

Option setting

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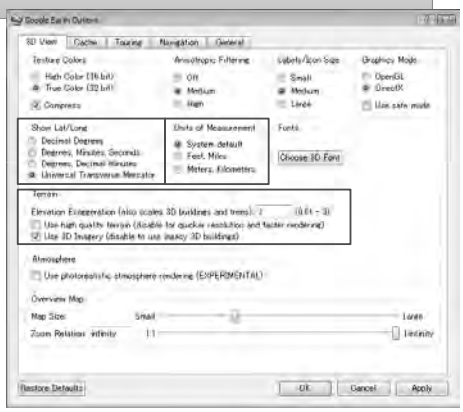
Tools>Option



Convert the data from ArcGIS to Google earth

20

- Shapefile to KML file
- KML file to Arc GIS

ArcTool Box > Conversion tools > To KML> Layer to KML

Shapefiles(Images) ArcGIS ESRI KML

ArcTool Box > Conversion tools > From KML > KML To Layer

Import of Geotagged Picture

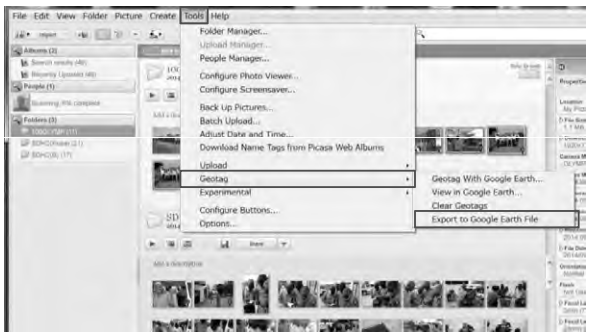
21

- Picasa: An image organizer and image viewer for organizing and editing digital photos.

Picasa → Geotagged Picture →

Import of Geotagged Picture

22



Tips - Short cut keys

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- U
- N
- R
- F11
- Ctrl + L
- Ctrl + M
- Ctrl + Shift + T
- Ctrl + Shift + G
- Ctrl + Shift + P
- Ctrl + Alt +B

Source: https://support.google.com/earth/

Tips - Offline use

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- It's possible to **cache (save) small amounts of data that you can access when you're offline**.
  - Log on to the internet and visit the imagery you'd like to view while you're offline.
  - Please pay attention to the Streaming indicator.
  - When this indicator has reached 100% for the imagery, Google Earth has gathered all available data.

Source: https://support.google.com/earth/

Tips – Make it faster

25

- You have so many places in your My Places folder that **Google Earth is slow to start up.**
- By saving folders to your hard drive, you can improve Google Earth performance by then deleting the data from your My Places folder once they are saved to disk.

Source: https://support.google.com/earth/

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QUESTION AND COMMENTS

Continue to Hands-on Activity ……

Basic GIS Training

~Basic operation of Arc GIS~

Shotaro KIKUCHI

Introduction

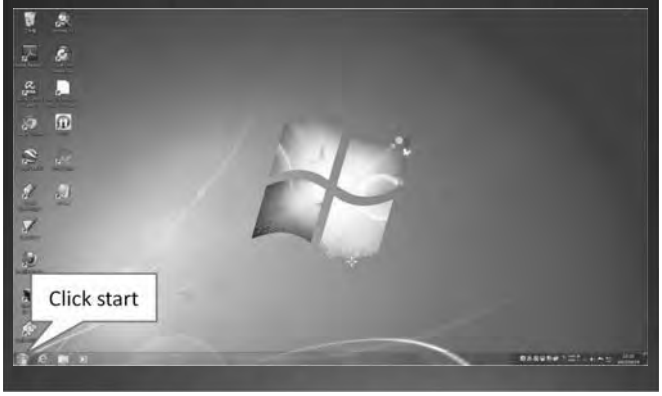
- This lesson is intended to introduce you to the basic use of ArcGIS 10.1. There are some applications which, ArcMap, ArcCatalog, Arc Tool box, ModelBuilder, and ArcGlobe. We will concentrate on ArcMAP in this time.

Content

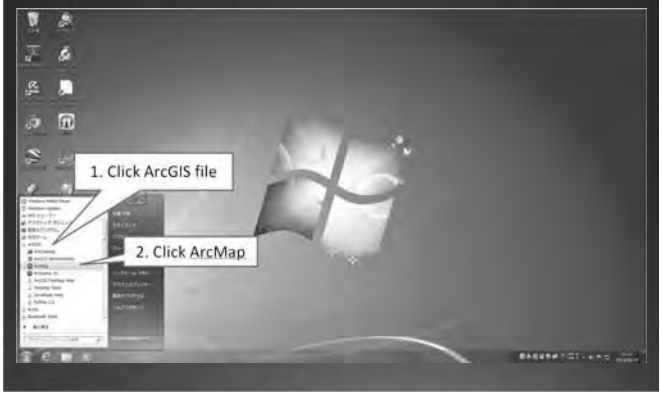
- Start up ArcGIS
- View and Add Data
- Layer Properties
- Calculate Geometry
- Symbology
- Map Layout

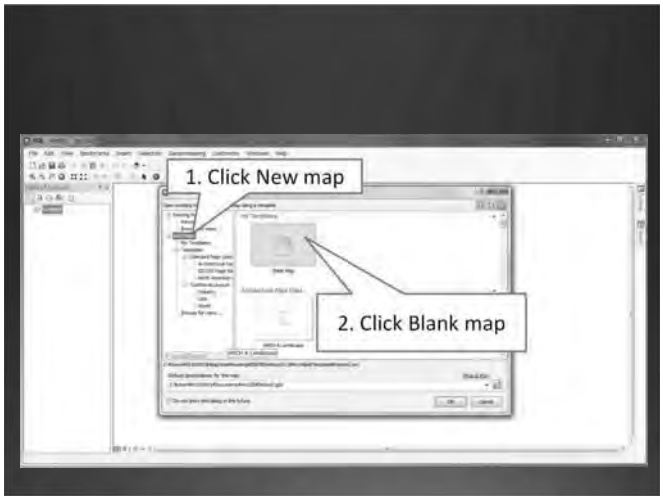
Strat up ArcGIS

①Click start button icon on Windows taskbar

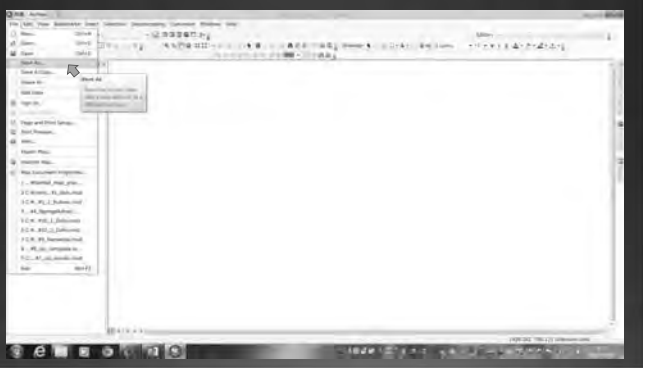


② Open ArcMap

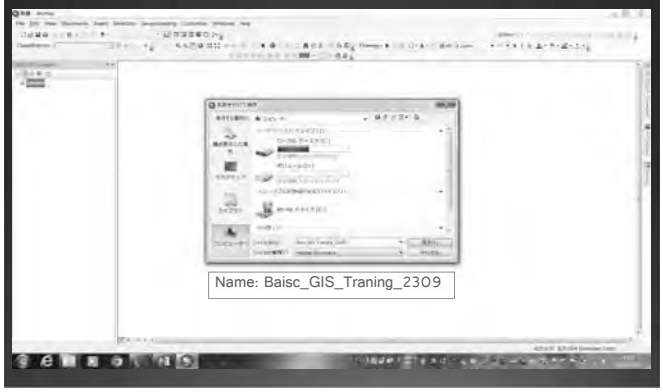




Save as (1)

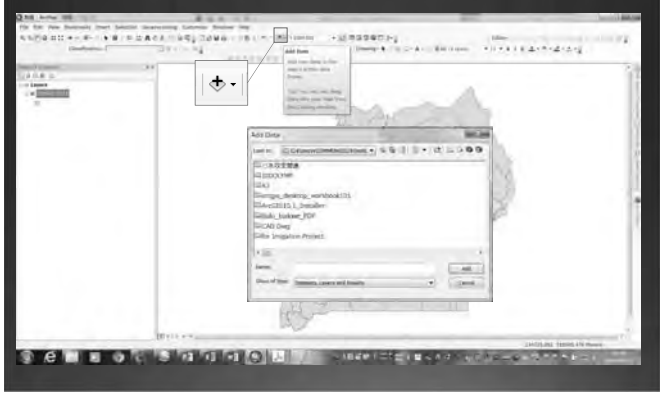


Save as (2)

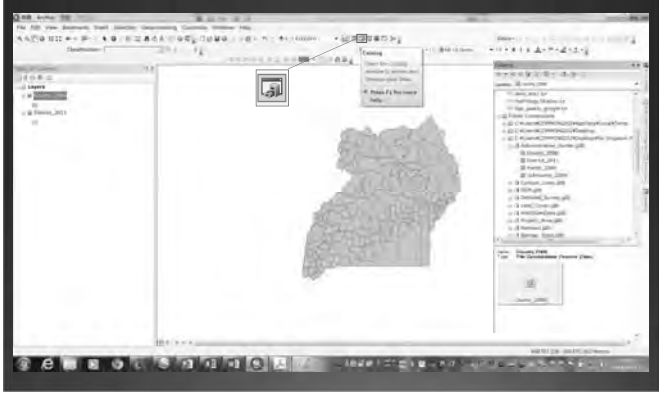


View and Add Data

Add Data (1)

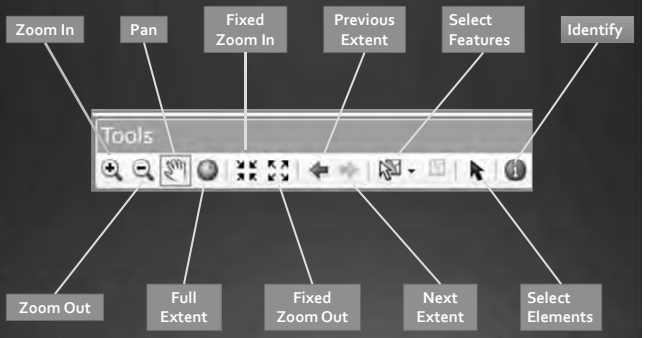


Add Data (2)

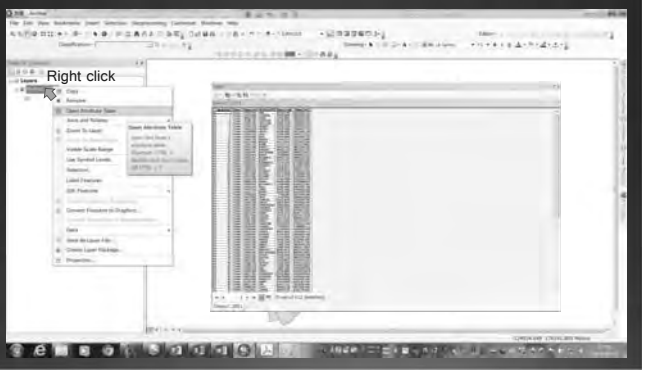


Viewing Data on ArcMap

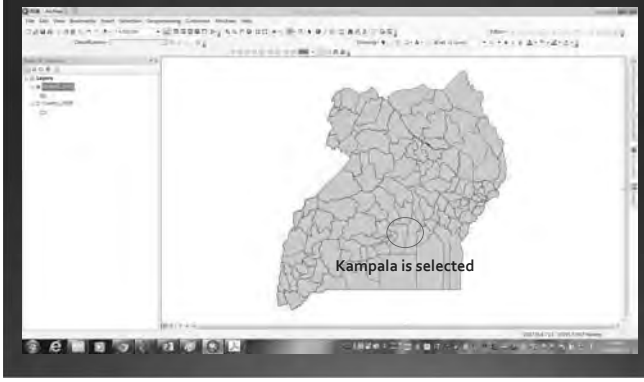
Tool bar



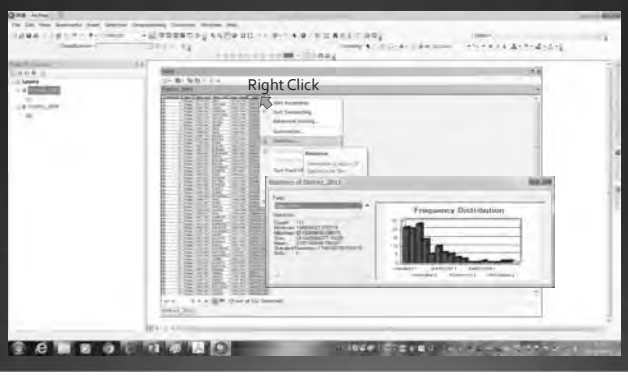
Checking the data



Select data



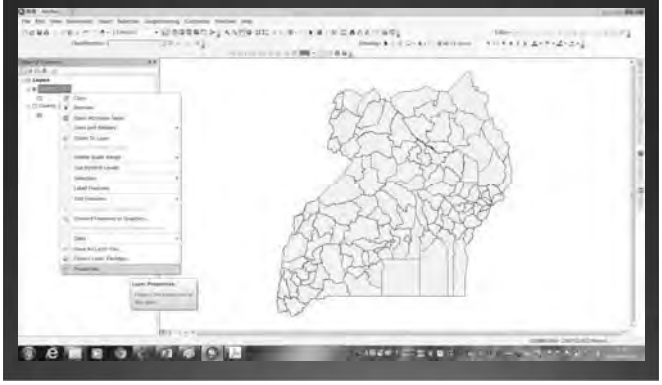
Statistics of the table data



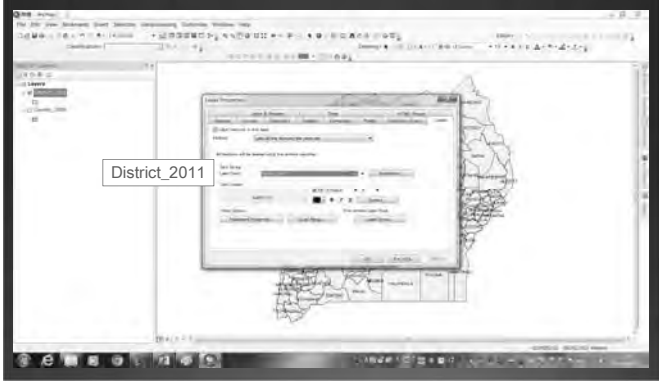
Layer Properties

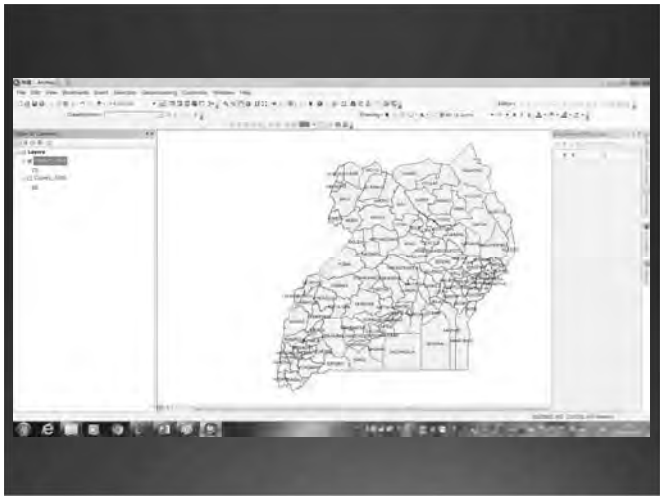
Layer Properties (1)

Layer Properties (2)



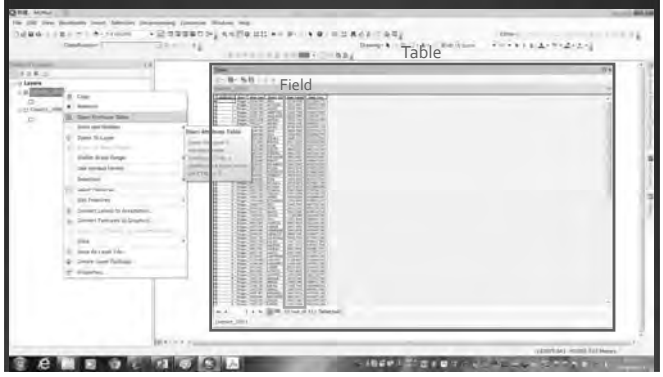
Put Labels



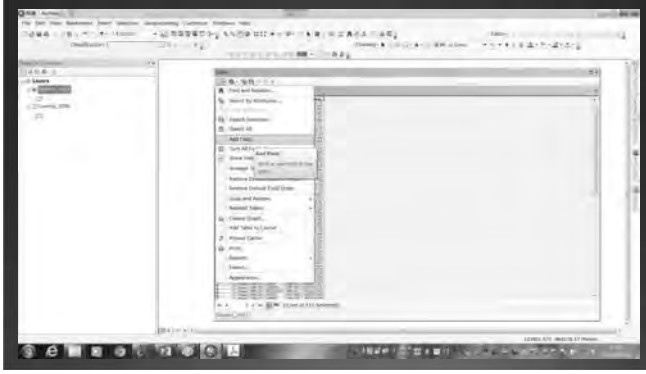


Calculate Geometry

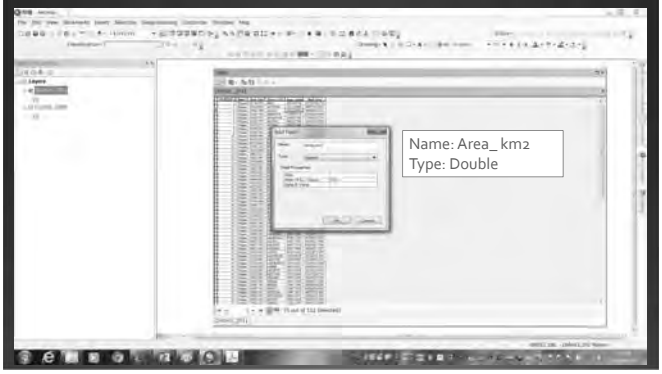
Add Field (1)



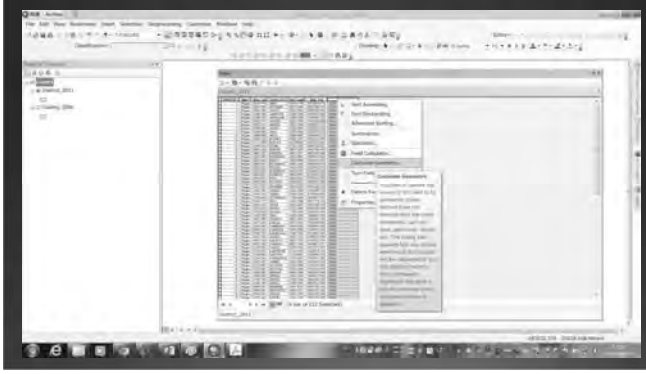
Add Field (2)



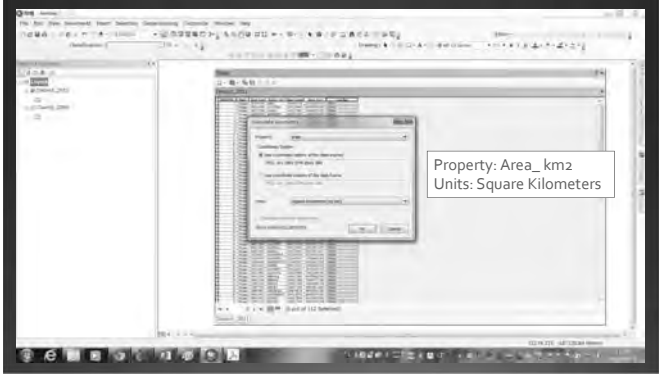
Add Field (3)



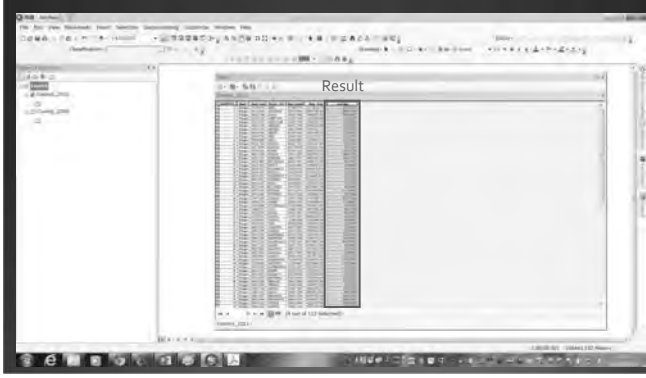
Calculate Geometry (1)



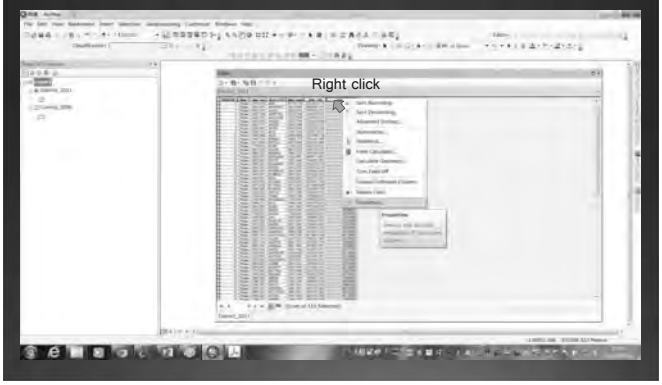
Calculate Geometry (2)



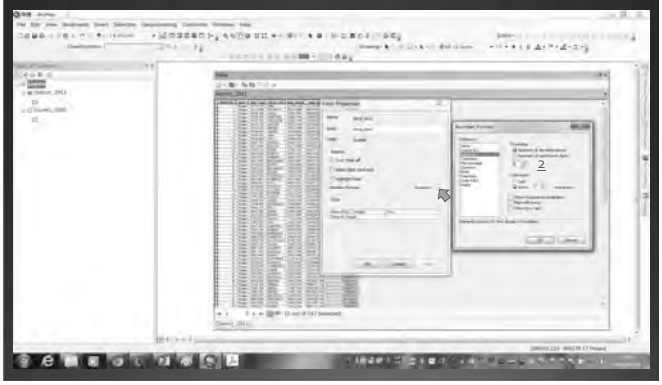
Calculate Geometry (3)



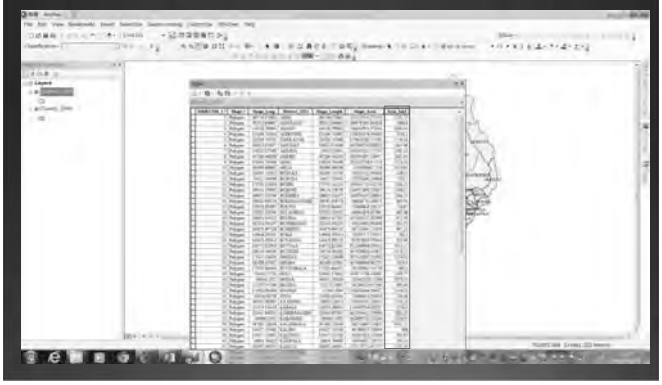
Field Properties (1)



Field Properties (2)

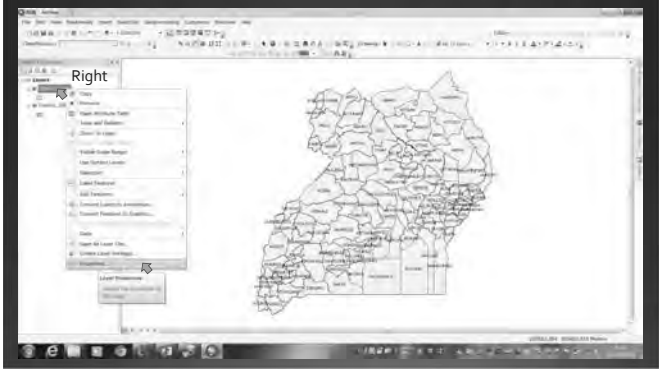


Field Properties (3)



Symbology

Symbology (1)

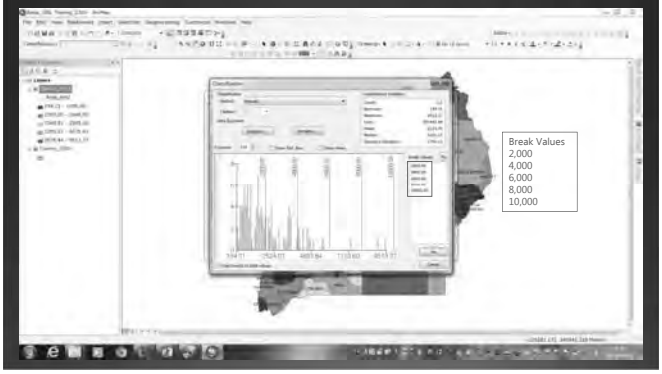


Symbology (2)

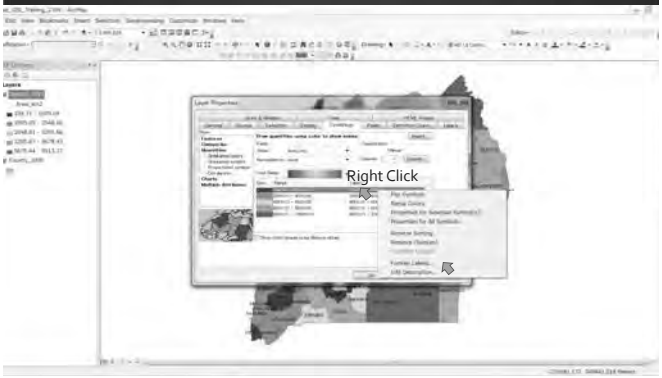
Symbology (3)

Classification (1)

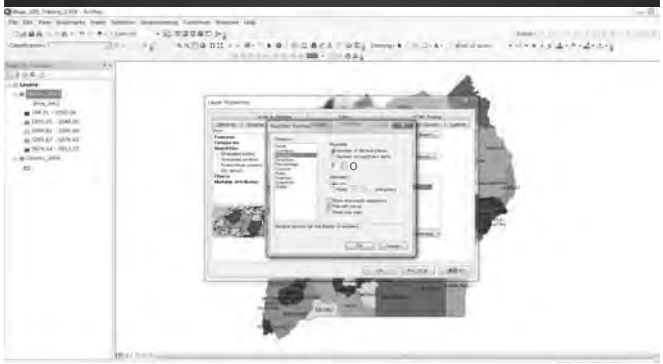
Classification (2)



Format Label (1)

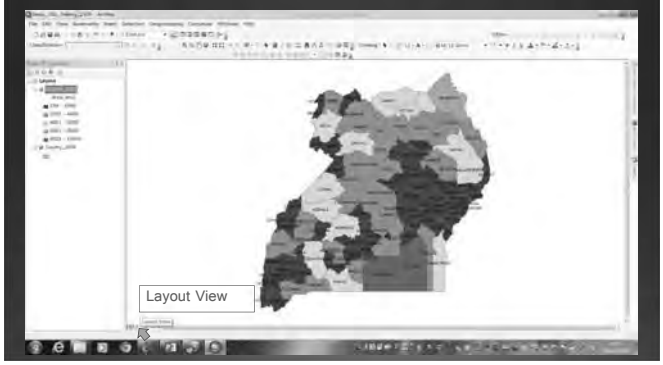


Format Label (2)



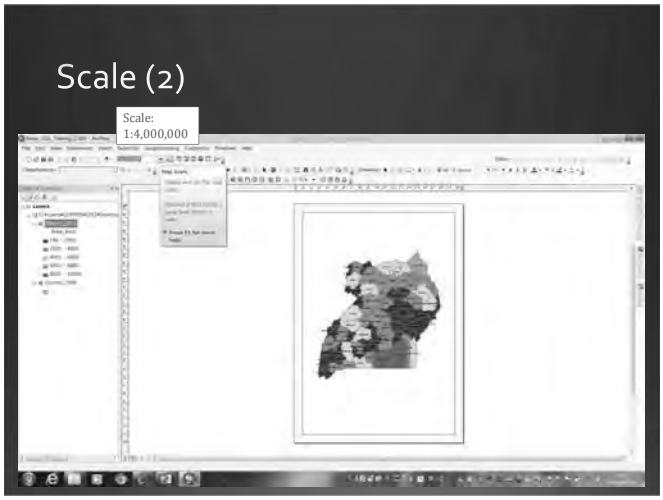
Map Layout

Layout View (1)

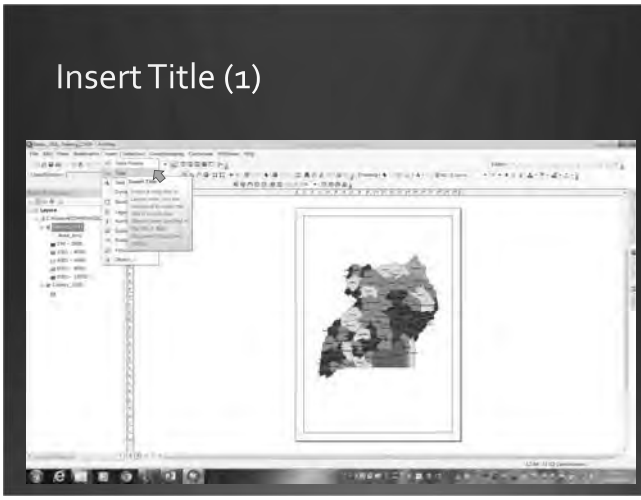


Scale (1)

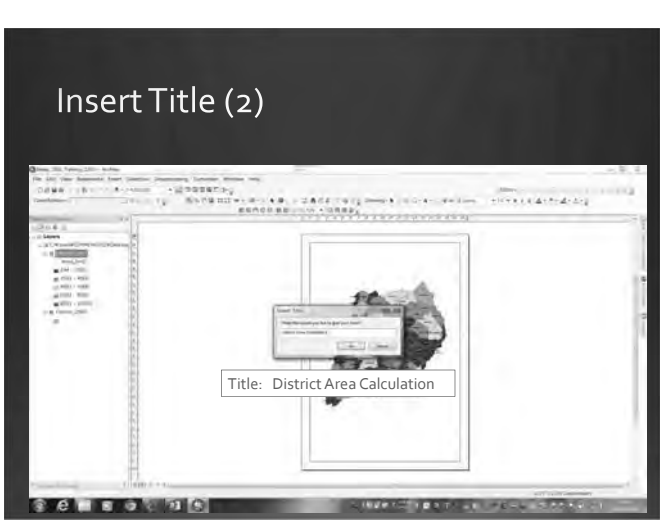
Scale (2)



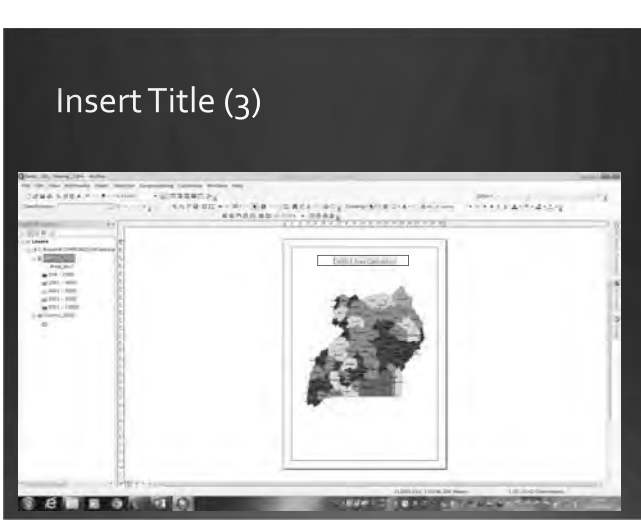
Insert Title (1)



Insert Title (2)

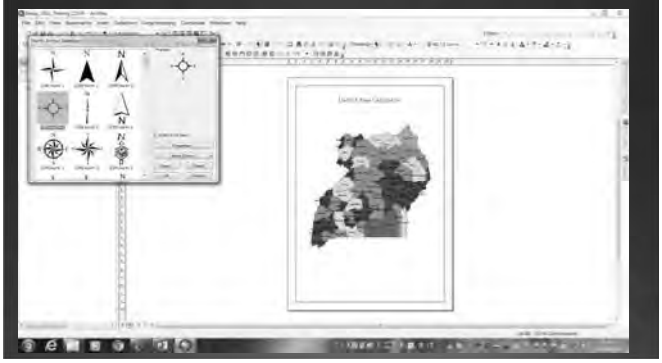


Insert Title (3)

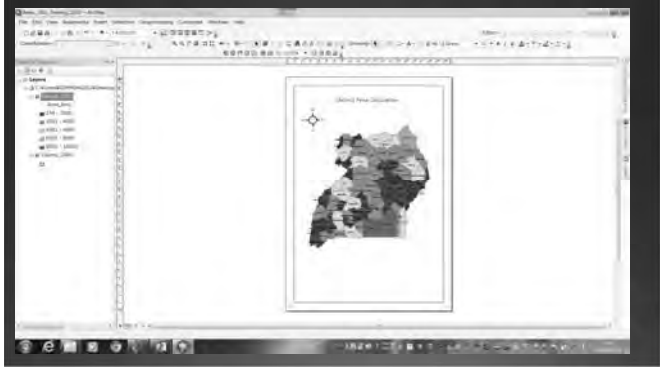


Insert North Arrow (1)

Insert North Arrow (2)



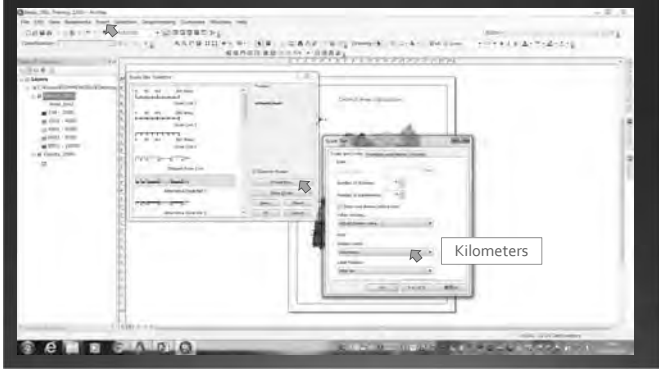
Insert North Arrow (4)



Scale Text Selection (1)

Scale Text Selection (2)

Scale Bar Selection



Legend (1)

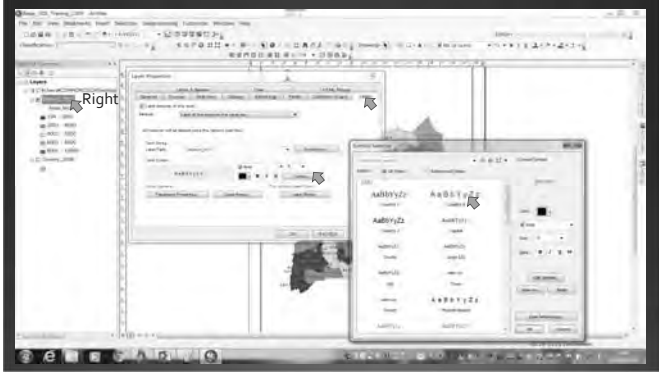
Legend (2)

Legend (3)

Legend (4)

Data Frame Properties

Label Symbol



Finish!

Practice

- Please make the County Area Calculation map as the District map.
- The County border data is put in the Training Data folder.
- If It is difficult to make, Follow the this Power point or ask our staff.

Questions

◇1 How many county are there?
◇2 How much is the average of county Area?
◇3 Which county is the biggest? and smallest?

Print out (1)

Print out (2)

Print out (3)

Make PDF (1)

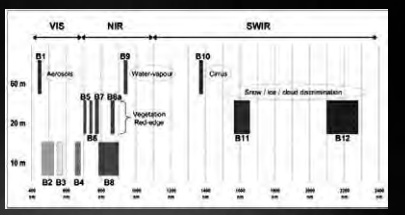
Make PDF (2)

Thank you ☺

SRTM

Landsat8 Band

Band Number	μm	Resolution
1	0.433–0.453	30 m
2	0.450–0.515	30 m
3	0.525–0.600	30 m
4	0.630–0.680	30 m
5	0.845–0.885	30 m
6	1.560–1.660	30 m
7	2.100–2.300	30 m
8	0.500–0.680	15 m
9	1.360–1.390	30 m
10	10.8–11.2	100 m
11	11.5–12.5	100 m



http://www.digital-geography.com/

Landsat8

- Landsat which is satellite has been taking the image since more than 40 years ago.
- Landsat represents the world's longest continuously acquired collection of remote sensing data
- Landsat8 which is newest satellite in Landsat series is launched on 11st Feb. 2013.
- As a joint initiative between the U.S. Geological Survey (USGS) and NASA
- From 3rd May 2013, Landsat8 data has been open for everyone.

Landsat 8

Introduction

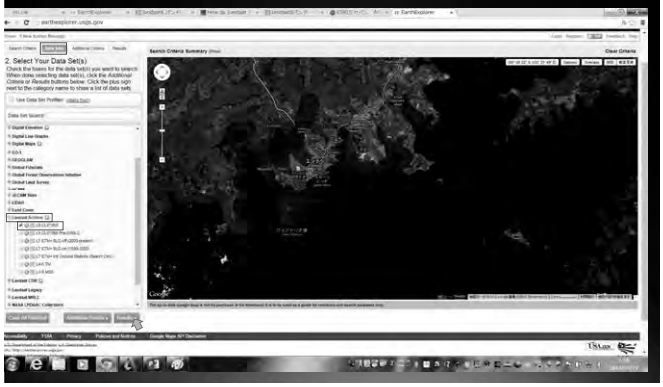
At present, we can take satellite data for nothing. In this lesson, I'd like to introduce Earth explorer, which you can get Landsat8 and SRTM Image data.

Landsat8 and SRTM Image Analysis

~Getting Data Using Earth Explorer~

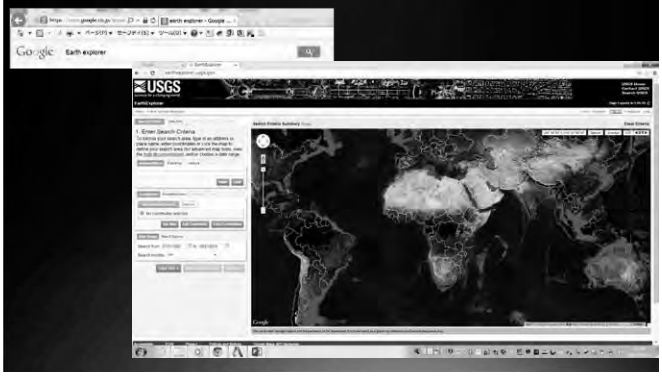
Shotaro KIKUCHI

Data sets



Select Entebbe

Search "Earth Explorer"



Earth Explorer

HOW TO MAKE CONTOUR

Getting Elevation Image Data of SRTM

Smoothing the grand surface

Making contours using SRTM

Putting 1/50,000 map under counter

Shuttle Radar Topography Mission

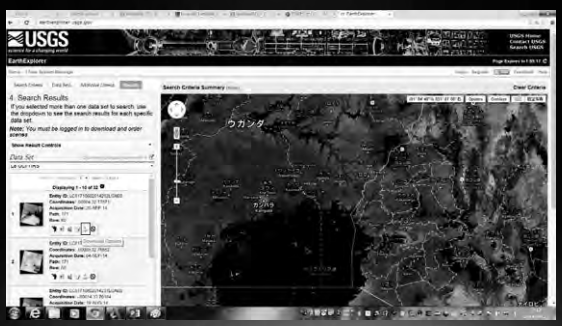
One mesh : 90 x 90 m
One Elevation Data

Let's Register!

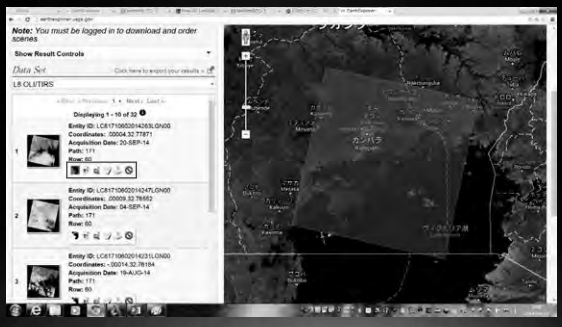
Make your Username and Password

Register

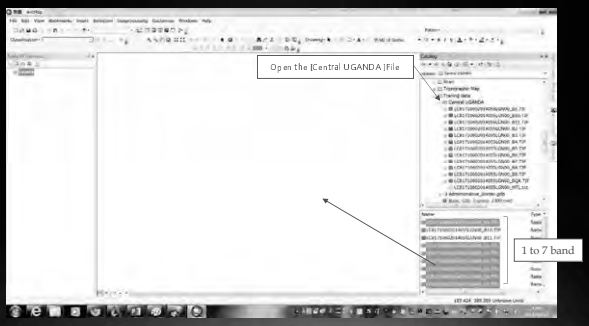
Download the Image Data



Confirm the Image Data

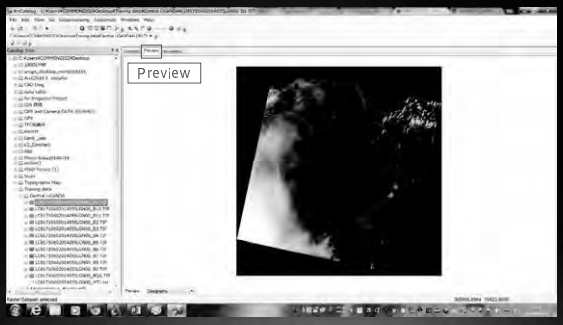


Putting the data on ArcMap

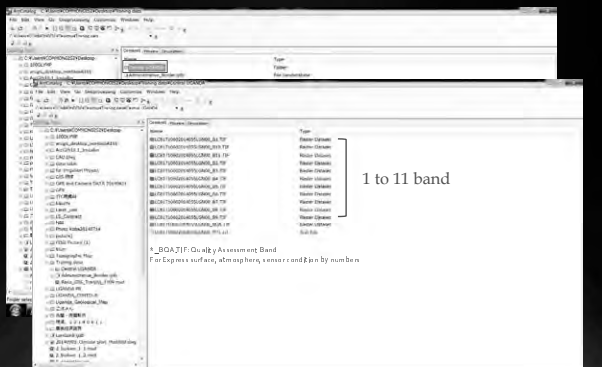


Save as…

Confirm the Image data

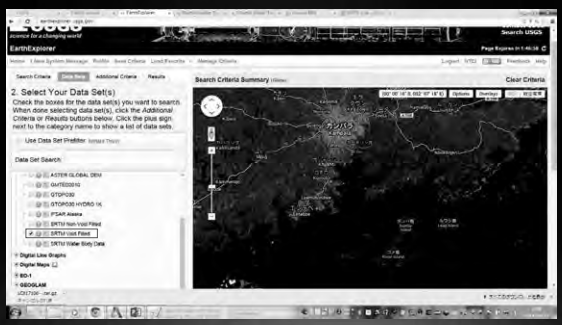


Open the Download file (2)

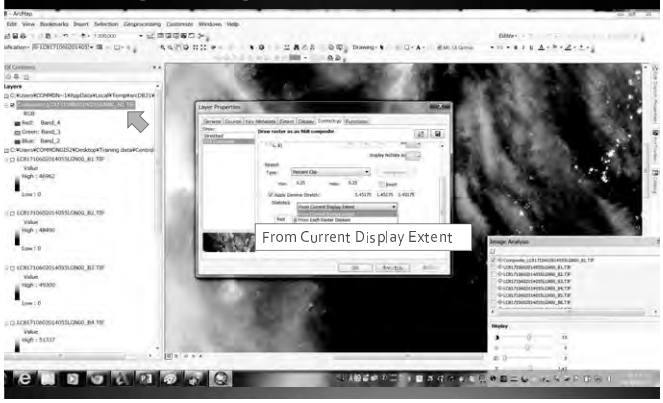


Open the Download file (1)

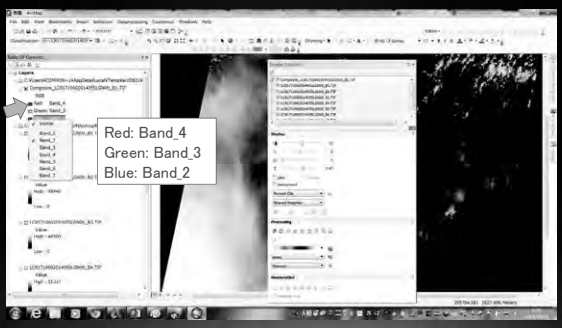
Getting SRTM DATA



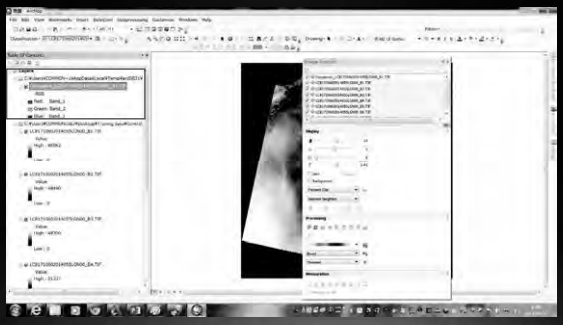
Change Image Statistic



Select color of Band



Multi Band



Composite Bands

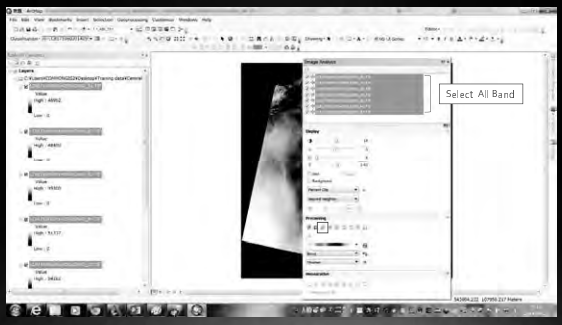
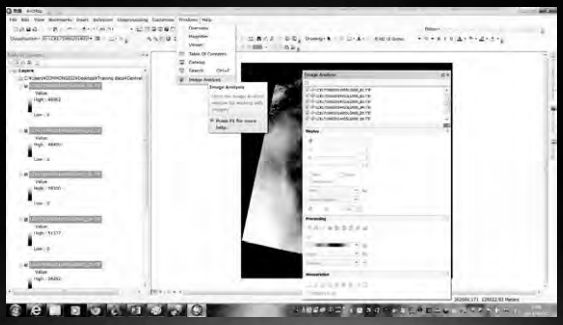
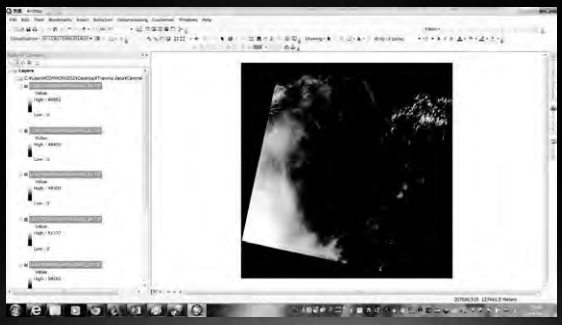


Image Analysis

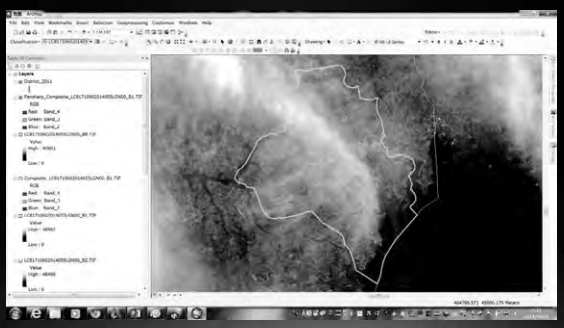


Input the 1 to 7 band

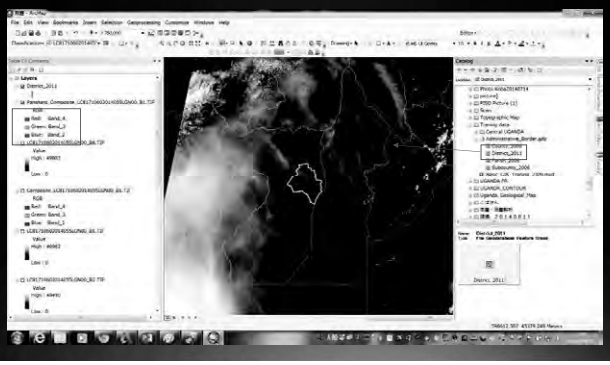


Next is "Analyzing Satellite Image!

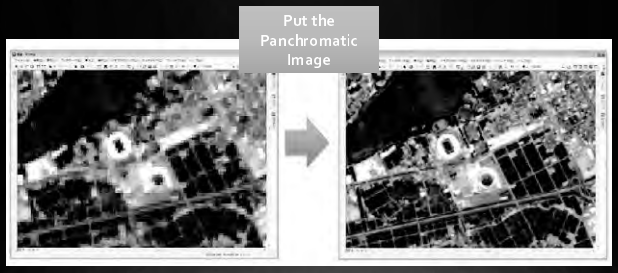
Kampala



Arrangement

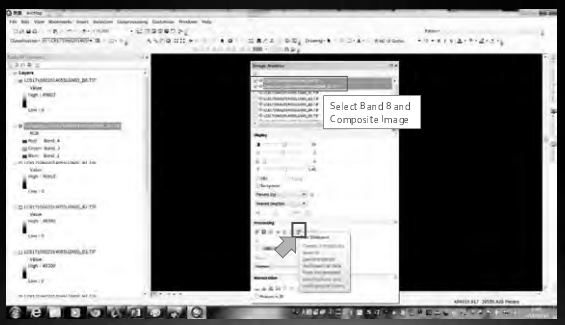


Pen sharpen Image

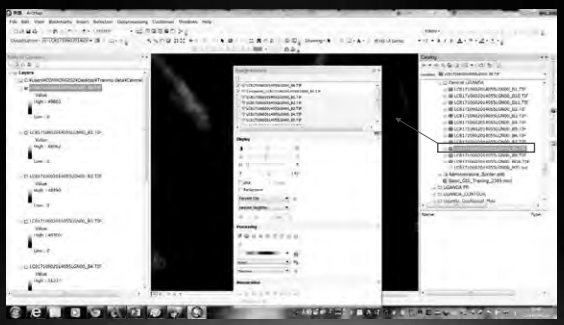


http://blog.esrij.com/arcgisblog

Make Pan sharpen Image



Add Panchromatic Image (Band 8)



Landsat8 and SRTM Image Analysis

~How to Analyze The Satellite Image~

Shotaro KIKUCHI

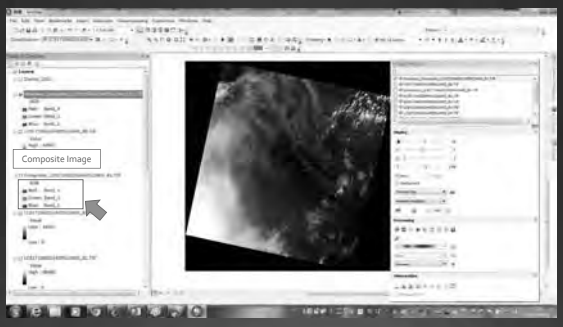
Landsat8

Type of Stellate image colors

Color Infrared (Vegetation)	R:5 Band G:4 Band B:3 Band	The Vegetation becomes Red
Natural Color	R:4 Band G:3 Band B:2 Band	The same as our eyes
False Color 1	R:6 Band G:5 Band B:4 Band	The Vegetation becomes green
False Color 2	R:7 Band G:6 Band B:4 Band	The Vegetation becomes green
False Color 3	R:7 Band G:5 Band B:3 Band	The Vegetation becomes green

http://landsat.usgs.gov/L8_band_combos.php

Let's change the colors!



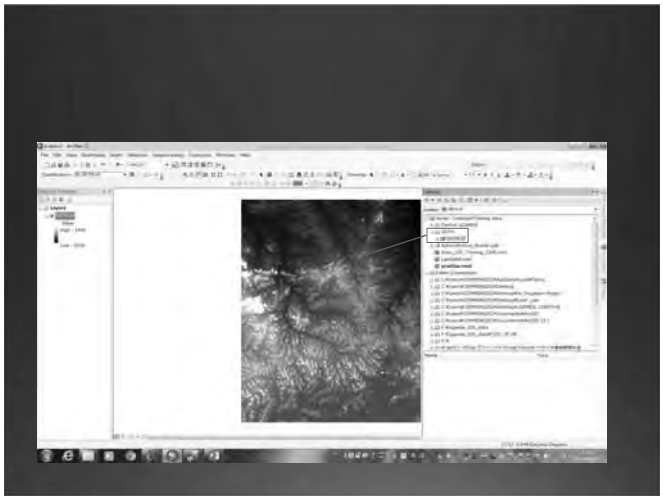
Practice 1: Please make one type of color image and export PDF.

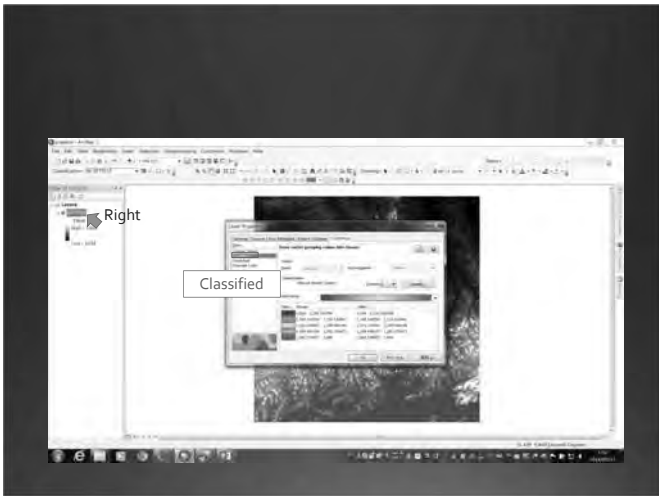
Type of Stellate image colors

Type of Color	RGB
• Natural Color	4 3 2
• False Color (urban)	7 6 4
• Color Infrared (vegetation)	5 4 3
• Agriculture	6 5 2
• Atmospheric Penetration	7 6 5
• Healthy Vegetation	5 6 2
• Land/Water	5 6 4
• Natural With Atmospheric Removal	7 5 3
• Shortwave Infrared	7 5 4
• Vegetation Analysis	6 5 4

http://blogs.esri.com/esri/arcgis

SRTM




Right
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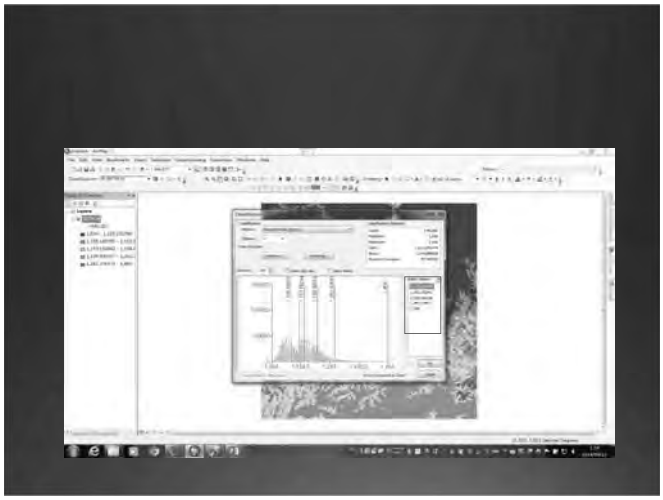
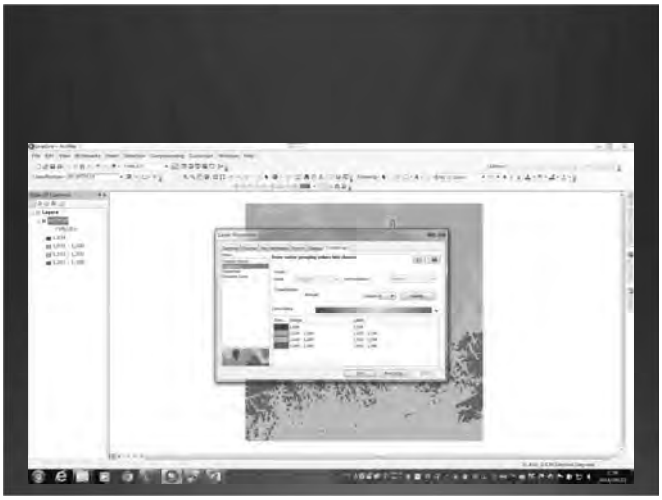
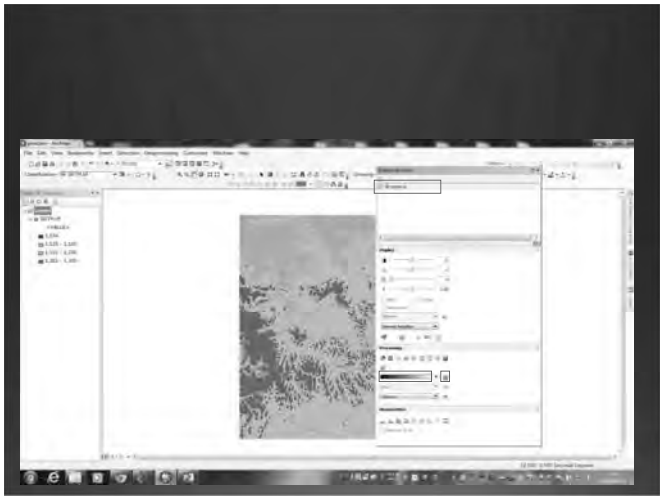
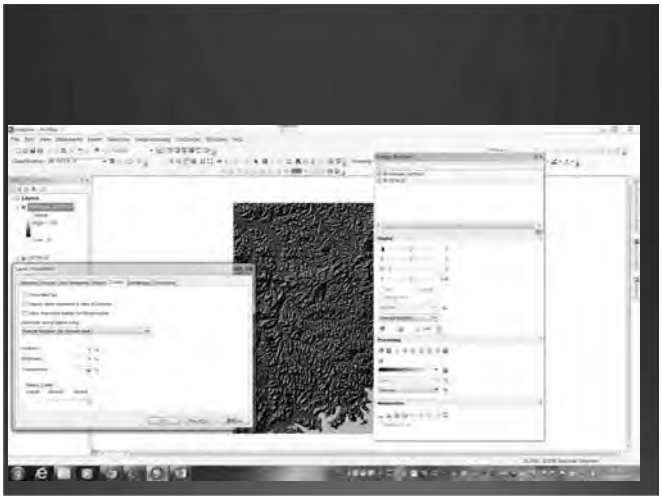
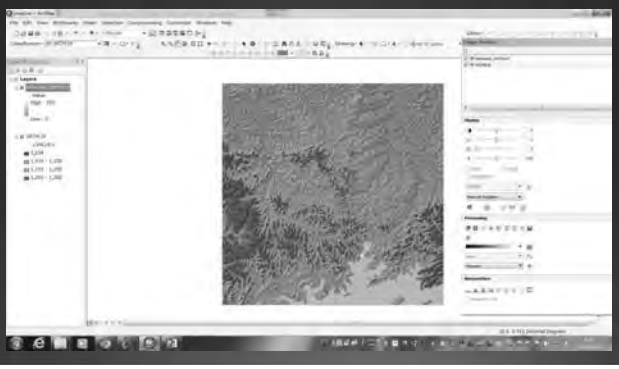




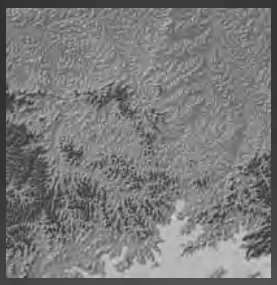




3D Elevation Image

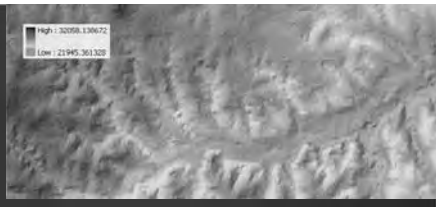


Let's make beautiful Map!



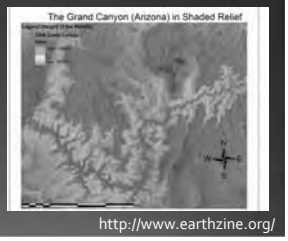
Practice 1: Please make Elevation Map

Elevation Maps



http://www4.ncsu.edu/~hmitaso/gmslab/reports

http://gbelvisi.blogspot.com/



http://www.earthzine.org/