

How to make & use the inventory of the Marshlands in Rwanda

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1 Back ground

Rwanda relies heavily on agriculture for its income, employment opportunities and the economic well-being of its people. Rwanda is the most densely populated country in Africa. About 80% of the population of Rwanda lives in the rural areas. Achieving food security and increased rural incomes will depend highly on increased productivity in the agriculture sector.

The Government of Rwanda has recognized the need to develop irrigated Agriculture to mitigate climate change induced droughts and has tasked the

Ministry of Agriculture and Animal Resources (MINAGRI) / the Rwanda Agriculture and Animal Resources Development Board (RAB) to spearhead Irrigation development especially in the drought prone areas of Eastern Rwanda. The importance of irrigated agriculture in achieving food security and offering a way out of poverty is unquestionable. Where irrigation has been introduced, yields have doubled or even tripled. Rwanda has a developing market of about 200 million people in Central and Eastern Africa of which Rwanda is the center for this regional block.

On the other hand, there are no inventories of the Marshlands for agriculture in Rwanda, which is very useful and necessary to analyze the situation of the marshlands and to make the plan of the new marshlands development. That is why identification of all marshlands in Rwanda is necessary. From Feb, 2016, RAB & JICA team made the field visits and made the inventory of Marshlands in the Eastern^{*1}, Southern, Western and Northern Provinces of Rwanda. This inventory should be revised periodically for update, and RAB & Districts should make the development plan for the marshlands with reference to this survey report.

*1 Results of Marshland Survey in Eastern refers to The Marshlands in Rwanda(I) (2016)

2 Why do we need this Manual?

On site marshlands identification is very important and necessary for making the development plans for marshlands. Irrigation plan is made based on Irrigation Master Plan of 2010 (IMP) which is abstract and not realistic. Based on survey result, the size of potential irrigation areas is over estimated.

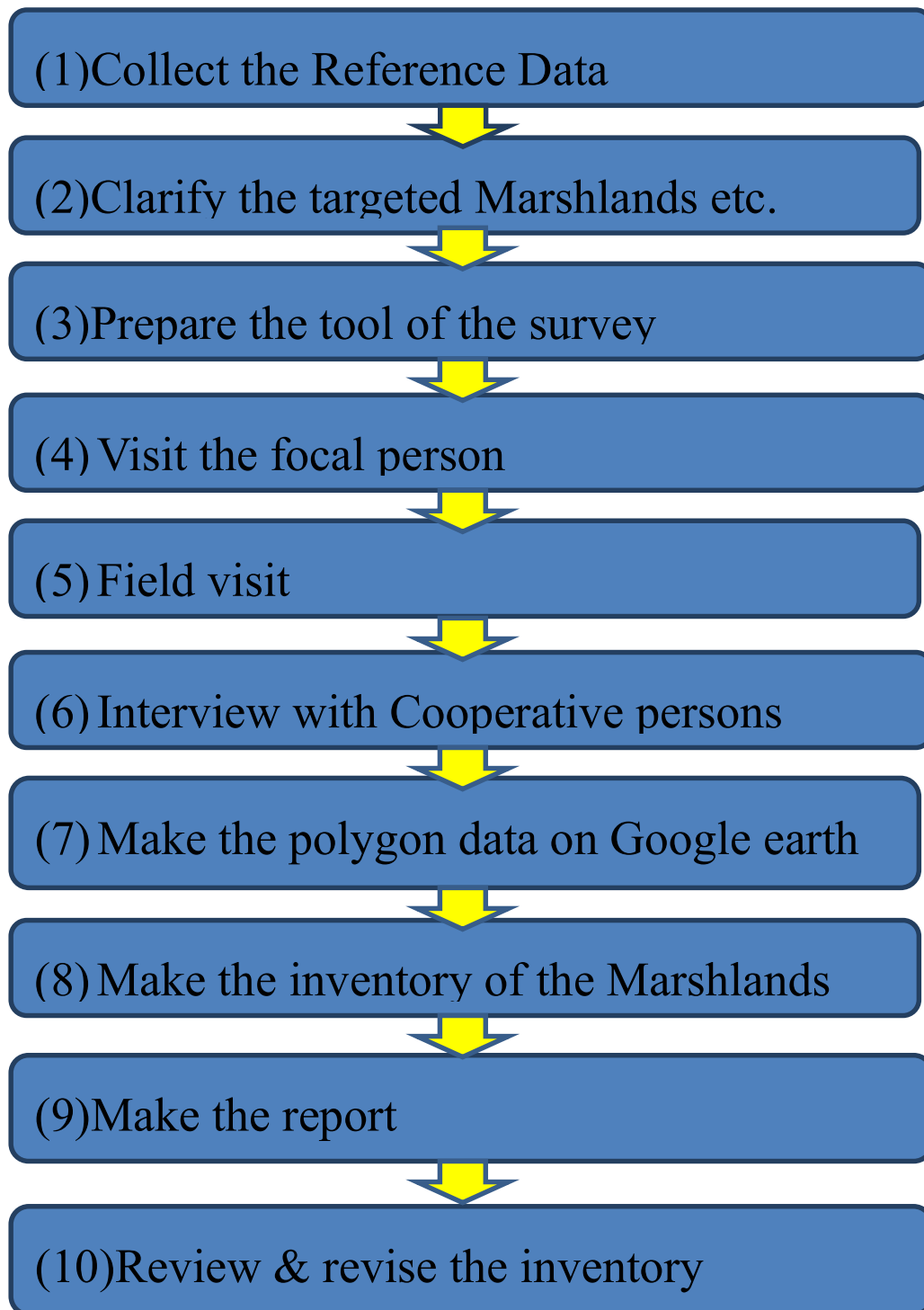
. Apart from IMP, EU Survey Report^{*2} conducted baseline survey for developed marshlands. However, it is not difficult to make the inventory of the marshlands by using on field simple tool like the camera or watch with GPS and the Google earth pro

etc. We can make the inventory of the marshlands easily based on this manual titled 'How to make & use the inventory of marshlands in Rwanda'. Additionally, this manual will be useful for making the inventory of other domain land use like hillside irrigation. We made this manual not only for the RAB Staffs, the Project Staffs and the Consultants but also the Local government Staffs and Cooperatives & IWUOs Staffs etc., because it is very important not only to make the inventory but also to manage the inventory and revise it periodically by the local staffs.

*2 Technical Assistance in the establishment of a baseline of agricultural households using irrigation systems(2016)

3 How to make the inventory of the Marshlands

The RAB & JICA Team (2016-2018) did this survey based on the chart below.



(1) Data collection

First of all, we should collect, process and analyze existing data and information related to marshlands. We have to refer to the reference Data below.

- (a) Rwanda Irrigation Master Plan(2010)
- (b) Land center Polygon from “Rwandan Swamp Land(2017, RNRA)”
- (c) The District Development Plan
- (d) Studies of Irrigation Projects like RSSP, LWH, QWMDP and Others
- (e) Database from the District
- (f) The Marshland DATA BASE from RAB (2017) and SPIUs etc.
- (g) Technical Assistance in the establishment of a baseline of agricultural households using irrigation systems(2016) Surveyed by EU

(2)Clarify the targeted Marshlands etc.

(I) Targeted Marshlands

We have to clarify the targeted marshlands below.

- (a) Developed Marshlands
- (b) Non-Developed Marshlands under cropping

Basically, to consult with District Agronomists and Sector Agronomists, we decided the targeted marshlands. Additionally, we excluded the areas below.

- (a) The area identified as Swamp, which is a flooded area in the whole years.
- (b) Low land that needs to irrigate by rising up water level (pump or construct big reservoir).



(Figure1: The area in Gisagara is recognized as Hillside because of need of pumping to irrigate this area.)

(II) Prepare a clear and simple Questionnaire

The questionnaire should be simple and enough informative. RAB & JICA Team made a questionnaire of 15 questions to collect following information:

- (a) Marshland Name
- (b) Size (ha)
- (c) Cooperative
- (d) IWUO (Irrigation Water Users Organization)
- (e) Water (Enough or not)
- (f) Dam
- (g) Status of infrastructure
- (h) Erosion control
- (i) Household
- (j) History (Construction & Rehabilitation)
- (k) Water Resource
- (l) Crops
- (m) Proposed crops
- (n) Problems (Shortage of water, Flood, Damage of facilities)
- (o) Comments

Information from field is filled in Excel sheet. After making the questionnaire, information is collected from District Agronomists, Sector Agronomists, Cooperative members, IWUO members, Project managers, Farmers, existing documents, field observation and so on. Here is the example from Nyamagabe District marshlands.

Table 1: The inventory of the marshlands in Nyamagabe District

Marshlands survey in Nyamagabe.																						
Visited Marshlands				Cooperatives																		
No	Name	Size Ha	Sector	Yes/No	Name of Coop	Contact	Comment from Coop	MUO	Water	Dam	Status of Infrastructure	Erosion control	Household	History of Construction	Rehabilitation	Water resources	Crops	Proposed crops	Shortage of water	Problems Flood	Damage of facilities	Comments
1	Mushahitu	130 (63.0)	Kibiri-Uvinkingi	Yes	4 Cooperatives	0703010254 SEDO	In the marshland, there are four cooperatives. During development of the marshlands, cooperatives were existing with legal personality. Farmers are growing different crops. The marshland has enough water but the main issue is flood during rainy season.	Yes	Enough	No	Good but some gates not operational	Catchment protected		QWMD 2016	No	Mushahitu river	Maize, Irish potatoes, Beans and vegetables		No	In rainy season	Some gates	The river in the marshland has enough water. The main issue is flood during rainy season and sand brought by the river.
2	Reundo	64 (60.3)	Gakara, Musungu, Buruhukiro	Yes	ABAHORANAMAR	0703232821	The marshland has springs from hills. The marshland has been roughly developed before genocide but in 2011 QWMD constructed irrigation facilities. MUO is not yet well organized but they started water fee collection. Water distribution is difficult.	Yes	Enough	No	Intakes have been destroyed	Catchment protected		QWMD 2011	Some intakes by the service provider	Reundo river and springs	Maize, Irish potatoes, Beans and vegetables		No	In rainy season	Yes	The marshland has enough water but flooded in some parts during rainy season. Intake weirs have been washed away. The marshland has a main river and other tributaries. The maintenance is not well done but the service provider (COCA) was organizing MUO. According to farmers, the main intake upstream and canals were constructed some years ago.
3	Gishungu	8.4	Fata	Yes		0702113695	Gishungu marshland has been roughly developed by an NGO. There are canals but no structures. The water distribution is difficult but the marshland has enough water. The marshland has upstream part and downstream part. The cooperative has been destroyed because of poor management.	No	Enough	No	Not developed	Catchment protected		NA	NA	Gishungu river and springs	Maize, beans and vegetables		No	In rainy season	NA	Located upstream Musungu we can see irrigation canal but the person doesn't know who made them (probably an NGO). No deviation weir or any structure. The soil is sandy.
4	Mwogo	1247	Musungu/ Nyamagabe, Rubaga and Cyabakamyi of Nyaruta	No		0703 259 063		No	Much	No	No structures	Hillside is covered by grasses and trees		NA	NA	Rubara and Mwogo rivers	Maize, rice, sorghum, Irish potatoes, beans, soybeans and vegetables		No	Every rainy season but some parts are permanent flooded	NA	Mwogo downstream is downstream the junction of Mwogo and Rubara. The marshland has much water and some parts are permanently flooded.
5	Rubara	154	Musungu, Kaduha, Mbari and Nyagoozi/Nyaruta	No				No	Much in the river	No	Not developed	Catchment not protected		-	-	Rubara river and springs	Maize, beans and sorghum and red		No	In rainy season	NA	The marshland is along Rubara river. It is long and relatively wide. During rainy season, the river overflows.
6	Mwogo (downstream)	17.0	Musungu	Yes			Irrigation canal on one part of Mwogo was done by farmers and "Uguzi" program. Farmers on that small part are in cooperative and crop rice. The main issue is flood in rainy season.	No	Much	No	Roughly developed	Catchment protected				Mwogo river and springs	Rice	Rice	No	Every rainy season but some parts are permanent flooded		The accessed area is a small part of Mwogo marshland. The area is located between Nyamagabe (Musungu), Nyaruta/Cyabakamyi and Rubaga/Rubara. On the field we can see some canals but not structures. Farmers are growing rice but in rainy season the area is flooded.
7	Nzuru	18.4	Mugano	No			In Nzuru, one part is used for paddy and other farmers are cropping beans, maize and vegetables. The catchment is covered by grasses and trees. Erosion is from the stream. In dry period water is not enough.	No	Not enough in dry season	No	Not developed	Catchment is protected but the stream surface in rainy season		-	-	Stream and springs	Rice, beans, maize and vegetables		In dry season	No	NA	Small undeveloped marshland. Farmers are cropping rice with other crops. Water is not enough in dry season.
8	Guma	22.1	Kaduha	Yes	Different	0703 483 387	Maguma is a long marshland. Farmers grow different crops like maize, beans, vegetables and Irish potatoes. The marshland has been developed many years ago. Irrigation facilities (canals and structures) are now existing.	No	Not enough in dry season	No	old	Hillside is covered by grasses and trees		Before Genocide	No	Stream and springs	Maize, beans, vegetables and Irish potatoes		In dry season	No	Old	A narrow marshland and water is not enough in dry season. On the bridge crossing the marshland, some structures are observed.
9	Cyamba	50.4	Cyamba	Yes		0703 402 842	The cooperative grow soybeans, maize and beans. Irrigation facilities are in good condition but water is not enough in dry season.	Yes	Not enough in dry season	No	New	Hillside is covered by grasses and trees		2016		Stream	soybeans, maize and beans		In dry season	No	No	The marshland has been developed in collaboration with WFP fund was from WFP and QWMDP implemented the project.
10	Kaviri	15.6	Kigoma/Huye, Cyabakamyi/Nyamagabe	No		0722 588 350	Kaviri has been developed before genocide. Farmers are growing different crops like maize, beans, soybeans, Irish potatoes, vegetables.	No	Not enough in dry season	No	Old	Hillside covered by grasses and trees		1990-199		Stream and springs	Maize, beans, soybeans, sorghum, Irish potatoes and vegetables		In dry season	No	Yes	Kaviri has been developed by PDAG (Projet de Développement Agricole de Gishungu) Agriculture Development Project in Gishungu.
11	Kato	12.4	Gasaka				Farmers in groups grow maize, beans, sorghum, Irish potatoes and vegetables. During rainy season, much water is flooding the area.	No	Not enough in dry season	No	Not developed	Hillside covered by grasses and trees		-	-	Stream and springs	Maize, beans, soybeans, sorghum, Irish potatoes and vegetables		In dry season	In rainy season	-	Downstream is Murururungu.
12	Murururungu	71.0	Cyamba, Gasaka, Mbari, Kibiri	Yes	OUTERMBERE	0702118575	Farmers in cooperative grow maize, beans, Irish potatoes and vegetables. Water distribution is not easy due to canals condition.	Yes	Not enough in dry season	No	Some structures need to be redesigned	Hillside is covered by grasses and trees		By QWMDP in 2011		Stream and springs	Maize, beans, Irish potatoes and vegetables		In dry season	No	Yes	The marshland has been developed under QWMDP. The main issue is the shortage of water but also irrigation structures are not in good condition. Gates are at 1m from the bottom of the weir. Water is not flowing well into the canals, some intakes are under soil and not used. The maintenance is not well done.
13	Rubururungu	9.8	Gasaka (Nyamagabe), Kigoma/Huye	Yes			Farmers in cooperative are growing rice. They crop 2 seasons and get training from KOICA.	No	Not enough in dry season	No	Roughly developed	Hillside is covered by grasses and trees		2017 by farmers with a support from KOICA		Stream and springs	Rice	Rice	In dry season	No	No	Rubururungu is mostly under development by farmers in collaboration with KOICA. They have intake on the main stream and construction of the canal being done by farmers.
14	Kavuru	12.6	Kamegeti, Gasaka	Yes			Farmers crop rice, the marshland has enough water for 2 seasons.	No	Enough	No	Roughly developed	Hillside is covered by grasses and trees		2017 by farmers with a support from KOICA		Stream and springs	Rice	Rice	No	No	No	Kavuru is developed by farmers in collaboration with KOICA same as in Rubururungu. Water is enough for rice. Existing deviation weir was constructed before by another project.

(3) Prepare the tool of the survey

Before conducting the survey, tools below were prepared.

(i) The Computer

- *The Microsoft Excel

- *The Google earth pro

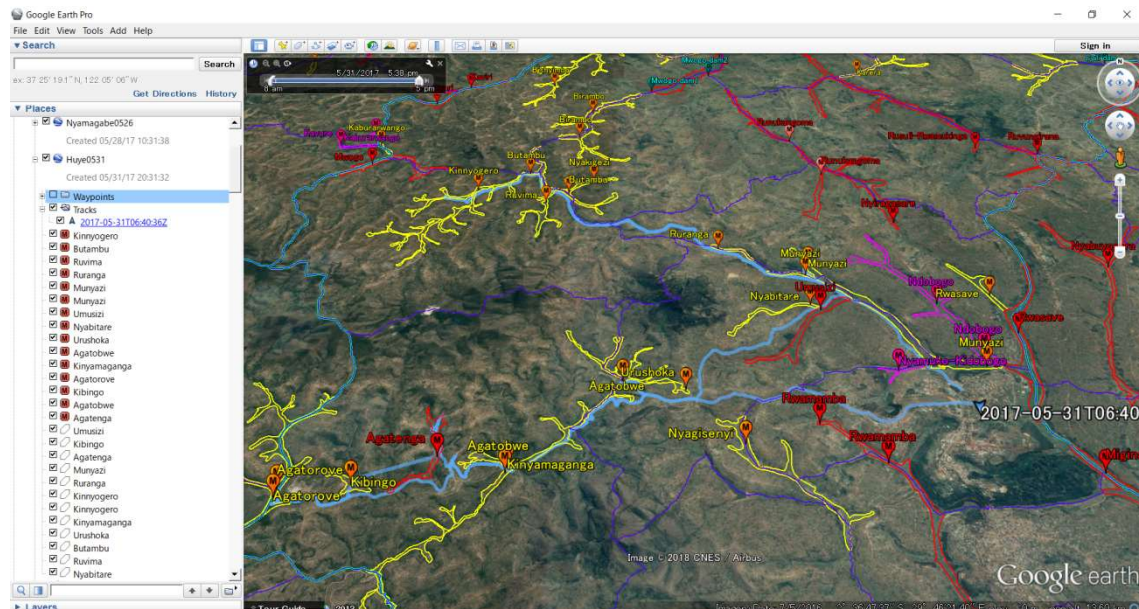
(ii) The Camera or watch with GPS

(iii) Transport means

Google earth pro has been free since 2015, which is very useful software for conducting this survey. However, we have to be careful that the Google INC has the copyright of this software. Google earth pro allow to view and use a variety of content, including map and terrain data, imagery, business listings, traffic, reviews, and other related information provided.

Regarding the Camera or Watch with GPS is essential tool for this survey. Our team used the WG-3 from the Pentax and Garmin GPS Watch, which can make the photo with geo-tag and the GPS log.

We can see the track of our survey at the Marshlands in Huye on 31st May in 2017 on Google earth pro below. We can clarify when and which marshlands we visited on the Google earth by using the Camera or Watch with GPS.

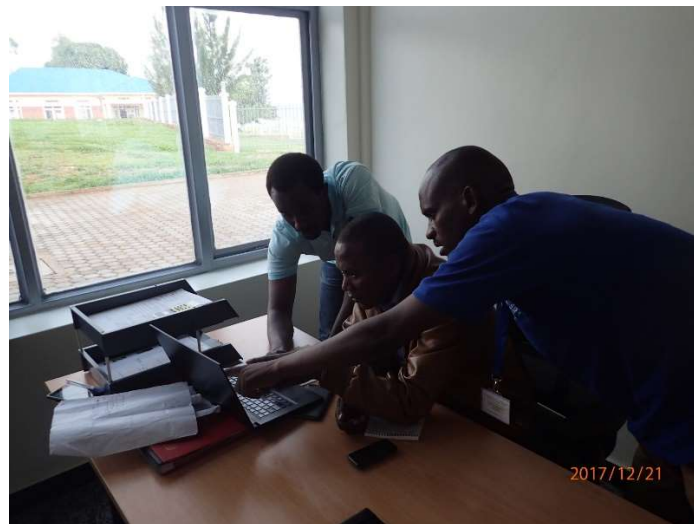


(Figure2: The Map of the Marshlands with the Track of the field visit)

(4) Visit the focal person

Before the field visit, we should visit the focal person about this marshland survey. Who is the focal person? At District level, we should firstly contact the District Agronomist, District Irrigation Officer and the project manager of the irrigation project in that District if available. When we visit him/her, we should explain the objectives of the survey of the marshlands, and collect information of marshlands in that District. It is advisable for us to bring the computer and show the questionnaire Excels sheet and the map of the Google earth. If he knows the situation of the marshlands well, it is better to make the polygon of the marshlands on the Google earth with him/her.

In the next step, we have to make the schedule of the field visit. The focal person will arrange the schedule of the field visit. Before leaving the focal person office, collect information about the contact person like Sector Agronomists, Cooperative managers, IWUOs managers and so on.



(Figure3: Visit the focal person)

(5) Field visit

Before the field visit, don't forget to switch on our GPS log tracker with our camera or watch, and it is advisable to stop by the Sector office. Sector Executive Secretary or Sector Agronomist will tell us the information about the marshlands in the Sector, and if he/she is available, he/she will show around the marshlands of that Sector or delegate someone else.



(Figure4: Visit the Sector Office)

On the field, we should collect information from farmers about the marshland. If developed, we check the situation of the irrigation facilities. We have to check water resources, erosion, vegetation, crops etc. on the field also.



(Figure5: Talk with the farmers on the field)

From the map, we identify the location of the Marshland.



(Figure6: Locate the Marshlands on the field)

Regarding the Irrigation facility, we should collect the data in detail. It is good way to ask the person who manages the facilities if they encounter some problems of the facilities.



(Figure7: Check with the person who manages the facilities)

(6) Interviews with the Cooperative/IWUO persons

We have to interview with Cooperative/IWUO persons about the Marshlands. We should ask questions to them based on the questionnaire that We have prepared. If we couldn't meet with them, we should call and conduct the interview by phone. It is advisable to ask District Agronomists to check those data again.



(Figure8: Visit the Cooperative)

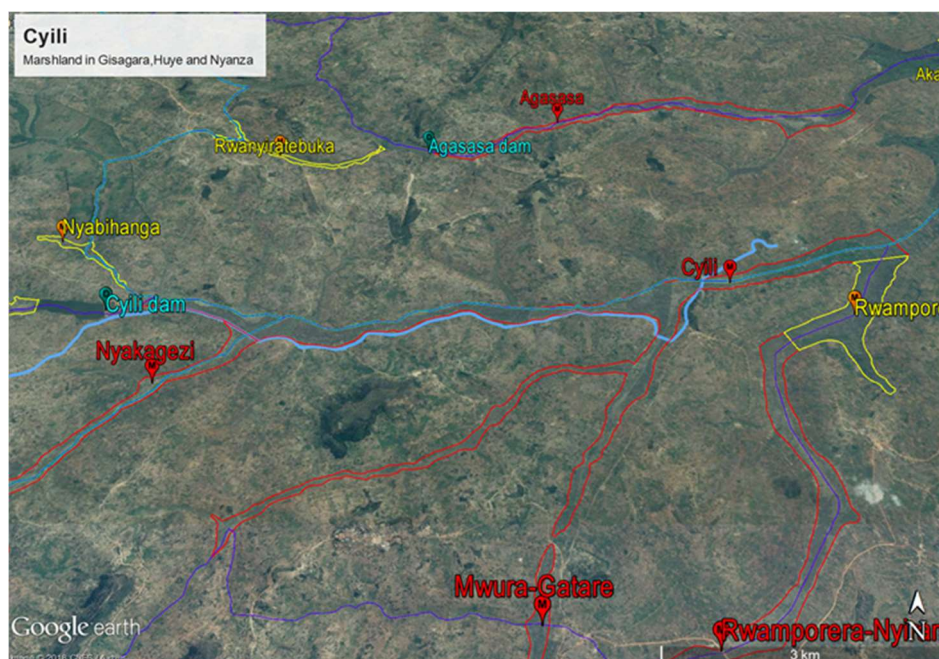
(7) Make the polygon data on the Google earth

Based on the interview with the focal person or the drawing of the Project, we should make the polygon of the marshlands on the Google earth.



(Figure9: Make the polygon Data with the Cooperative person)

We should make the polygon of Developed Marshland in Red, Roughly Developed Marshland in Pink and that of the Non-Developed Marshland in Yellow, and the facilities like Dam, Weir and Pond etc. should be in Blue. Use different colors to differentiate Developed Marshland from Non-Developed Marshland and make clear different facilities. We have to make the place mark with the name of Marshlands.



(Figure10: The polygons in red, yellow and blue)

(8) Make the inventory of the Marshlands

After the field visit, we should fill the data in Excel sheet.

Marshlands survey in Karongi																				
Violated Marshlands			Cooperative				Problems													
Name	Size Ha	Sector	Yes/No	Cooperative	Contact	Comment from Coop	IWUO	Water	Dam	Status of infrastructure	Erosion control	Household	History	Water resources	Crops	Proposed crops	Shortage of water	Flood	Damage of facilities	Comments
18-Feb-18																				
1 Musaho	9 (39.7)	Rubengera (Karongi), Mushubati (Rutiro)	Yes	Banga ry'umuhini	0722 377 510 Thomas	The river has enough water but for farmers it is a valley. They are cropping maize, vegetables and cassava. In dry season they use SST equipment to irrigate vegetables. Water comes mainly from the river.	No	Enough in the river	No	Not developed	Hillside not protected	-	-	Mungya river, springs	Maize, vegetables, cassava	-	In dry season	In rainy season	-	Musaho is located between Karongi and Rutiro Districts. The Mungya river crossing the marshland has much water with much sand.
2 Gisayo	16.0	Birihyura	No				No	Not enough	No	Not developed	Hillside not protected	-	-	Stream	Mulberry	-	In dry season	No flood	-	Gisayo marshland is located in Karongi town. The area belongs to NABED (National Agricultural Export Development Board) and is used for mulberry production by the Ministry of Defense.
21-Feb-18																				
3 Ruhanga-Uwanzumamavi	14.4	Gishyita (Karongi), Makembe (Nyamagabe)	Yes		0762 126006 Nelson	Farmers grow maize in season A, beans in B and vegetables in season C. For season C they irrigate vegetables with watering can.	No	Enough in the river	No	Not developed	Hillside not protected	130	-	Ruhanga river, springs	Maize, beans and vegetables	-	In dry season	In rainy season	-	Ruhanga river flows to Kivu lake. Sometimes in rainy season, floods occur. Sand companies are taking sand from the river.
4 Muwero-Magarama	13.4	Gishyita	Yes		0726 870 019 Nyitegeka JB		No	Enough in the river	No	Not developed	Hillside not protected	-	-	Magarama river and springs	Maize, beans and vegetables	-	In dry season	In rainy season	-	The Magarama river crosses the marshland and flows to Kivu lake. Farmers in cooperative are cropping maize in season A and individually cultivate beans and vegetables individually.
5 Musogoro	6.5	Birihyura	Yes		0726 801 138 Damassone (farmer)		No	Enough in the river	No	Not developed	Hillside not protected	-	-	River and springs	Mulberry, beans and vegetables	-	In dry season	No	-	The marshland is not flooded but in one area fish ponds have collapsed and now it is like a small lake.
22-Feb-18																				
6 Nyabaranga	14.0	Murambi	No		0789 346 437 Joseph	Downstream and upstream farmers are in the same cooperative. Downstream farmers started cropping rice this season. Before they were cultivating soybeans and maize.	No	Enough in the river	No	Not developed	Hillside not protected	-	-	Streams and springs	Rice	-	No	In rainy season	-	The area is along Nyabaranga river. The main source of water are streams from hillside. Much water flows and drainage near hillside is difficult.
23-Feb-18																				
7 Musaho	17.8	Rubengera (Karongi), Makura (Rutiro)	No		0768 835 886, 0763 420 789	Farmers are cropping vegetables in dry period. LWH project planned to make a dam but they changed their plan.	No	Enough in the stream	No	Not developed	Hillside not protected	-	-	Stream and springs	Vegetables, fruits and sweet potatoes	-	No	In rainy season	-	located upstream Karongi. Farmers in groups are cropping different crops (vegetables, fruits and sweet potatoes). The stream floods the area during rainy season.

(Figure11: The table of Surveyed Marshlands)

When we fill in each subject, we should remark the notes below.

1) Name

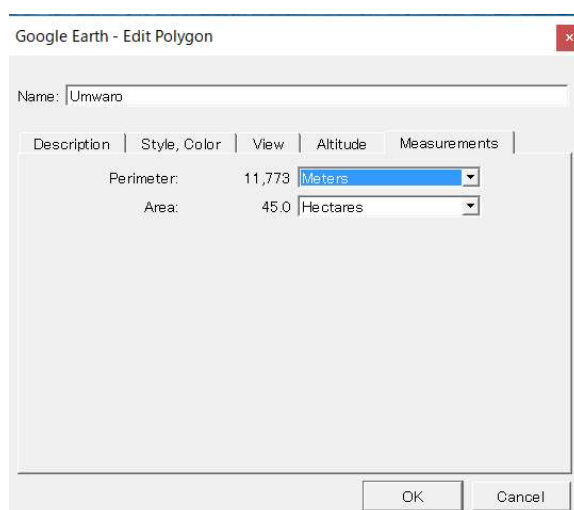
Basically, we can get the marshland name from District/Sector or Cooperative/IWUO.

However, sometimes they have different names in the same marshland. If so, we should

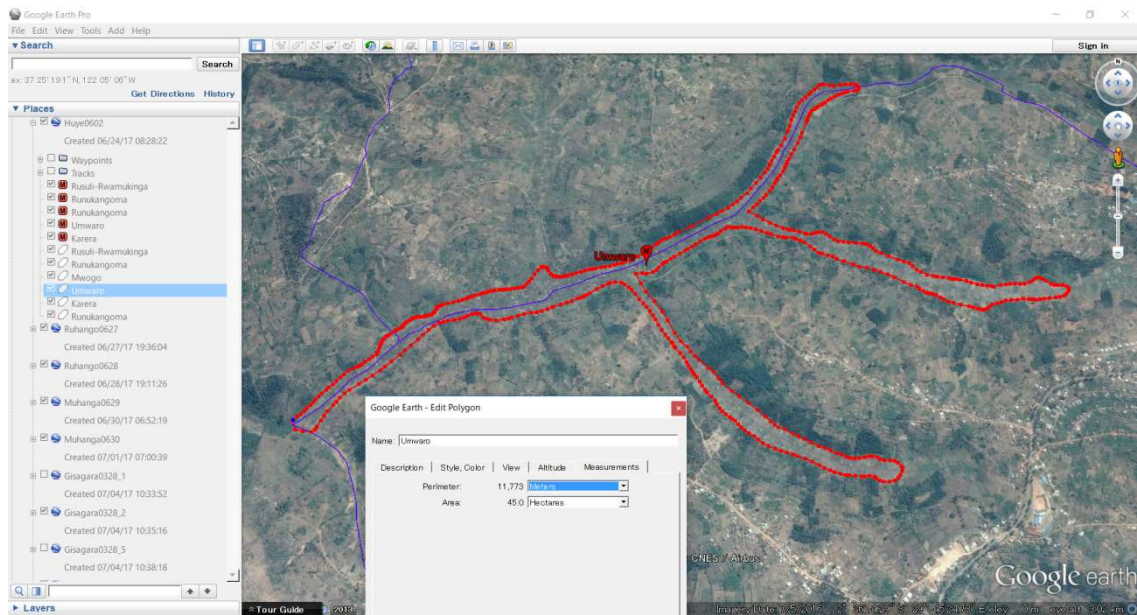
consider one from local authorities or consider both of them like ‘Kilindi/Gatobero’ in Rulindo District. For developed marshland we should consider the name from study documents.

2) Size(ha)

Basically, we should enter the Size of the marshland according to RAB, SPIU, the District/Sector or Land Center Polygon. Meanwhile, we have to check the size of the marshland from the polygon on the Google earth pro. In the case of Developed Marshlands, we make the polygon following main canal on Google earth pro, in case of Non-Developed Marshland we make the polygon referring to the Land Center Polygon data. We can measure the size (ha) of the marshland through measurement tab on the property option of the polygon. we find out the differences between the Size from RAB, SPIU or the District/Sector and the Size from the Google earth pro, we have to decide which Size is more proper on a case-by-case basis. We note both size information on data sheet of each Surveyed Marshland in Annex 3.



(Figure12: The tab of the Measurements)



(Figure13: We can get the size of the Polygon Data on the Google earth)

3) Cooperative

We should check the existence of the cooperative in the marshland. If there is, we should get the contact person and his/her phone number, and get his/her comments about the marshland.

4) IWUO

We should check for the existence of the IWUO and collect information about irrigation facilities.

5) Water

We should study if the water in the marshland is enough or not. Basically, we can get this information on the site, but we should check with the farmers or the cooperative person about the different case between the dry season and the rainy season.



(Figure14-1: Water from the stream with SSIT)



(Figure14-2: Water from the stream with watering can)

6) Dam

On site, we check the existence of the Dam in the marshland. We can get the information from District/Sector officer or the cooperative person. If there is, we should check the status and record comments in Excel sheet. We can enter the existence of the pond or the weir in this cell also.



(Figure15: Check the Dam)

7) Status of infrastructures

We should check the status of the infrastructure in the marshland, and clarify if necessary the operation and maintenance activities by WUO or intervention from the government. Information can be collected from site manager.



(Figure16: Check the status of the facilities)

8) Erosion Control

Sometimes the marshland suffers from the erosion from the hillside. We have to check the situation of the erosion on the site. Meanwhile, there are some marshlands that make good control of erosion by agro-forestry or terracing etc. We should fill in that situation in the cell.



(Figure17: Erosion control is very important)

9) Household

We can get the information about the household mainly from the cooperative in the marshland. We have to note that the household of the cooperative is not equal for the household of the marshland because some farmers don't join the cooperative.

10) History

We can get the information about the history of the marshland mainly from the cooperative members or the irrigation project managers. We should note that there are the construction stage and the rehabilitation stage. We have to enter the both histories in the cell. Basically, we should fill in the year and the project name of the development projects like JICA, RSSP, LWH, QWMDP, KWAMP, Chinese, PADAB/PAIRB, PAPSTA and so on.

11) Water resource

We should clarify the water resource of the marshland. We can get the information on the site or ask the cooperative/IWUO persons about it. Water resources are mostly springs for small marshland.



(Figure18: The children convey water from the Spring)

12) Crops

We should get the information about the existing crops on the site, from farmers and cooperative persons, because the crops change with the seasons.



(Figure19: The farmers cultivate rice)

13) Proposed crops

We should clarify the proposed crops in the Non-Developed Marshlands through the interview with cooperative persons or Sector Agronomists. As long as there is enough water, the farmers prefer to cultivate rice.

14-1) Shortage of water (Problems)

We should clarify the problem about the shortage of water to check the situation of the river flow, springs and so on. If there is enough water in rainy season, there is a possibility of the shortage of water in dry seasons. So, we have to check with the cooperative/IWUO persons or farmers about it.

14-2) Floods

The Marshland near not only the river, lake or swamp but also the stream usually suffers from the flood. We have to check with the cooperative/IWUO persons and farmers about it. Even if there is no water on the site during dry season, there is a possibility that flood may occur in the rainy seasons.

14-3) Damage of facilities

Regarding the assessment at the damage of facilities, we visit and check the facilities, and ask the person who manages facilities.

15) Comments

We make comments about the marshlands after the field visit and the interview. It is advisable to make comments about the availability of the development of Non-Developed Marshlands or the facilities rehabilitation of the Developed Marshlands.

(9) Make the report

(I) The Country level Report; “The Marshland Survey in Rwanda”

Regarding the report of the Country level, it refers to the contents below.

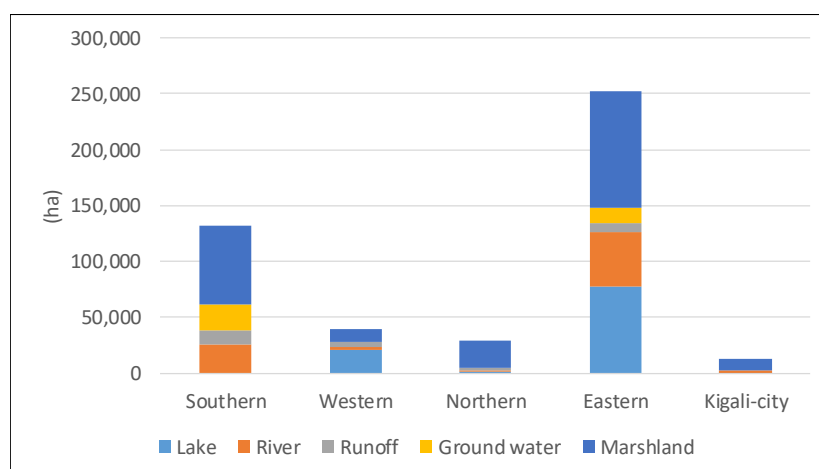
- (a) The Outline of Rwanda’s Four Provinces
- (b) Irrigation Plan of Rwanda
- (c) Surveyed Marshlands in each District
- (d) General Recommendations
- (e) The District Data of Surveyed Marshlands
- (f) The list of interviewees
- (g) References

(a) The Outline of Rwanda’s Four Provinces

In this chapter, it is described the outline and population of each Province.

(b) Irrigation Plan of Rwanda

Rwanda Irrigation Master Plan (2010) has each District Irrigation Plan, and we should analyze the potential irrigable areas in the Province. Based on the Irrigation Master Plan, they clarify the potential irrigable areas as Six (6) types which are i)Lake water resources, ii)Direct river and flood water, iii)Runoff for dams, iv)Ground water resources, v)Marshlands, vi)Runoff for small reservoirs. The total Potential irrigable area in Rwanda is 589,713ha and 37.3% of it is the Marshlands. We can analyze the situation per the Province, for example, the 54.2% of the Potential irrigable areas are belonging to the Eastern Province.



(Graph1: Potential Irrigable areas in Rwanda, 2010)

(c) Surveyed Marshlands in each District

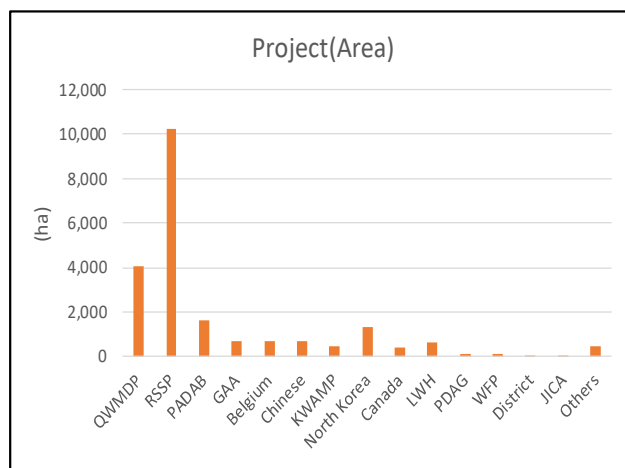
Based on the survey of the Marshlands, we analyzed the situation of Surveyed Marshlands in Four Provinces. It refers to the contents below.

- i) The outline of Surveyed Marshlands in each District
- ii) The Average Size of Surveyed Marshlands
- iii) Surveyed Marshlands Ratio in the Potential from IMP
- iv) Problems in Developed and Non-Developed Marshlands
- v) Water Resources in Surveyed Marshlands
- vi) Marshland development Projects
- vii) Cooperatives & IWUOs in Surveyed Marshlands
- viii) Rice Fields in the Marshlands

In each content, make some comments and attach the table and the graph to be understandable visually.

(Table2: The Average Size of Surveyed Marshlands per District, 2016-2018)

Province	District	Developed (ha)	Non dev.(except for Akanyaru/ Nyabarongo)(ha)	Total (ha)
Southern	Gisagara	141	68	101
	Huye	94	45	65
	Kamonyi	137	39	85
	Muhanga	79	37	46
	Nyamagabe	38	84	57
	Nyanza	114	83	97
	Nyaruguru	49	52	52
	Ruhango	101	67	75
	Sutotal	104	57	74
Western	Rusizi	1752	57	151
	Nyamasheke	84	44	57
	Karongi	#DIV/0!	16	16
	Rutsiro	#DIV/0!	47	47
	Nyabihu	#DIV/0!	80	80
	Ngororero	12	27	25
	Rubavu	#DIV/0!	#DIV/0!	#DIV/0!
	Sutotal	312	43	77
Northern	Musanze	65	42	43
	Burera	204	76	94
	Gakenke	34	38	38
	Rulindo	177	85	106
	Gicumbi	#DIV/0!	53	53
	Sutotal	148	54	63
Eastern	Bugesera	251	200	229
	Gatsibo	798	62	220
	Kayanza	313	30	243
	Kirehe	92	13	78
	Ngoma	99	16	34
	Nyagatare	617	56	281
	Rwamagana	55	72	64
	Sutotal	234	59	130



(Graph2: Projects of the marshlands in four Provinces, ~2018)

(d) General Recommendations

We made the recommendations based on surveyed Marshlands in the Province. RAB & JICA Team made the recommendations below.

- i) Rehabilitation of some Developed Marshlands
- ii) New marshlands development
- iii) Small Scale Irrigation Technology
- iv) Decentralization
- v) Hydrologic data collection

(II) The Province Report

Regarding the Province Report, it refers to the contents below.

- (a) The Outline of Province and each District
- (b) Irrigation Plan in each District based on IMP
- (c) Surveyed Marshlands in each District
- (d) Recommendations
- (e) The District data of Surveyed Marshlands
- (f) The data sheet for each Surveyed Marshland in the District

(a) The Outline of Province and each District

In this chapter, it is described the outline and population of Province. In annex 2, it is described the outline of each District, which is consisted of Demographic features, Geographical features, Economic situation and so on. we can get the initial information about it from the DDP (District Development Plan).

(b) Irrigation Plan in each District based on IMP

Rwanda Irrigation Master Plan (2010) has the each District Irrigation Plan, and it is very informative plan to clarify the marshlands in the District. So, we can refer to the District Irrigation Plan and make a comparison between the Potential Irrigable Marshlands area on the Irrigation Master Plan and the Marshlands area on this survey.

(c) Surveyed Marshlands in each District

Based on the survey of the Marshlands, we analyzed the situation of Surveyed Marshlands in the Province. It refers to the contents below.

- i) The outline of Surveyed Marshlands in each District
- ii) The Average Size of Surveyed Marshlands
- iii) Surveyed Marshlands Ratio in the Potential from IMP
- iv) Problems in Developed and Non-Developed Marshlands
- v) Water Resources in Surveyed Marshlands
- vi) Marshland development Projects
- vii) Cooperatives & IWUOs in Surveyed Marshlands
- viii) Rice Fields in the Marshlands

In each content, make some comments and attach the table and the graph to be understandable visually.

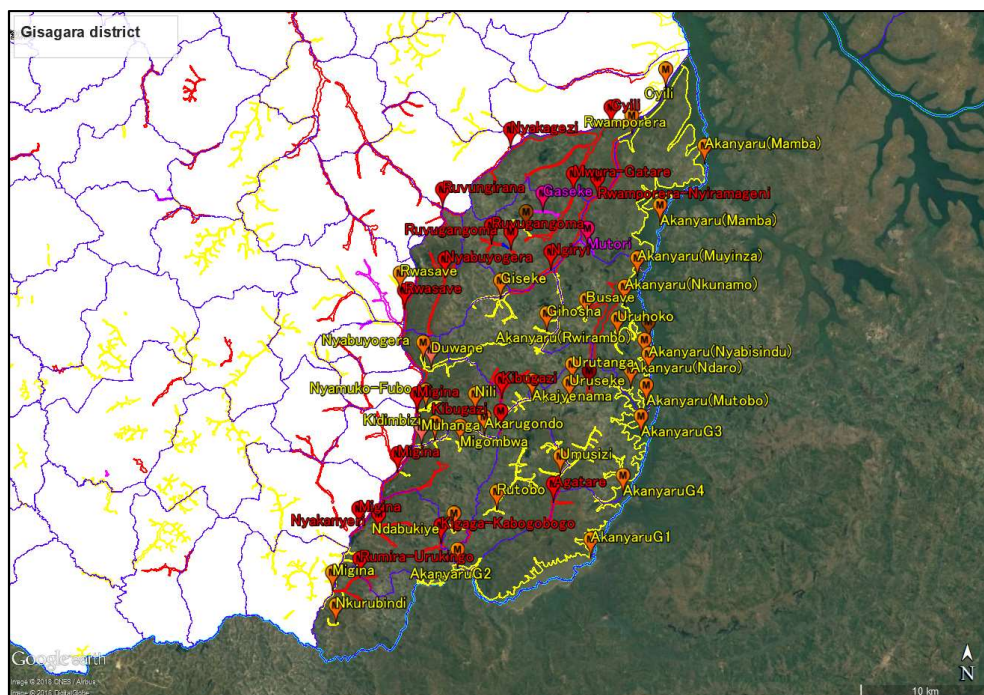
(d) Recommendations

We made the recommendations based on surveyed Marshlands in the Province. RAB & JICA Team made the recommendations below.

- i) Rehabilitation of some Developed Marshlands
- ii) New marshlands development
- iii) Small Scale Irrigation Technology
- iv) Decentralization
- v) Hydrologic data collection
- vi) Recommendation for each marshland in Annex 4)

(e) The District data of Surveyed Marshlands

We described the figure and the Size of the Marshlands in the District, with those of the Developed Marshlands and Non-Developed Marshlands. We attached the map of marshlands in the District, which we can make on the Google earth easily.



(Figure20: Marshlands in Gisagara)

(f) The data sheet for each Surveyed Marshland in the District

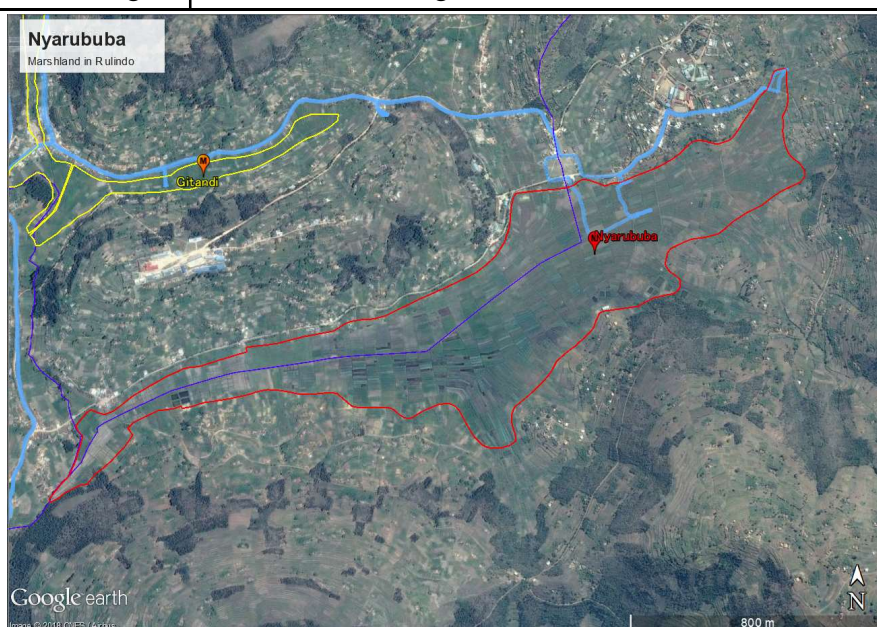
We made the data sheet of each Surveyed Marshland below in Annex 1 and 3.

- (i) Name of the Marshland
- (ii) Summary
- (iii) Location
- (iv) Command area
- (v) Farmers organization
- (vi) Main crops
- (vii) Water resources
- (viii) Project
- (ix) Status and Challenges
- (x) Google earth map with the track of field visit
- (xi) Photo with comments

We attached the map of Surveyed Marshlands on the Google earth pro, which has not only the polygon of the Marshland but also the track of the field visit which is helpful to understand where we visited.

1. Nyarububa(Developed)

a. Summary	The marshland was developed under RSSP. Stream flows sector border. Diversion weirs were destroyed So, canals are not used for irrigation.
b. Location	Cyungo and Rukozo sector
c. Command area	77.0ha(79.7ha)
d. Farmers organization	No (Cooperative for maize and WUO were dissolved.)
e. Main crops	Maize, beans, vegetables and irish potato
f. Water resources	Springs and stream (before)
g. Project	RSSP(2006)
h. Status and Challenges	Rehabilitation of irrigation structures are needed.



(Figure21-1: The data sheet for each Surveyed Marshland)

Status in marshland	
	
Farmers are cropping beans and vegetables.	Diversion weir was destroyed. So, farmers use stream flow with watering can in dry season.
	
Canals with much weed are not used for irrigation.	Farmer says stream flow increases but no flood in rainy season.
	
Upstream side of the marshland diversion is under sedimentation.	Stream floods in rainy season. Much sedimentation is on the farmland near the stream.

(Figure21-2: The data sheet for each Surveyed Marshland)

(10) Review & revise the inventory

It is very important to review & revise the inventory periodically, and regarding this work, we should involve the District/Sector officers & Cooperative /IWUO managers. It is advisable to make (I) the standard for reporting and (II) the structure for reporting below.

(I) The standard for reporting

The Cooperatives or IWUOs managers should report to the District/ Sector Agronomist if they have got the information below.

- (a) The new development project is completed.
- (b) The rehabilitation project is completed.
- (c) The farmers have developed the marshlands by themselves.

(II) The structure for reporting

The information of the reviewing and revising of the marshlands should be reported according to the structure below.

