WMP レポート

WATER QUALITY ASSESSMENT

OF NAMATALA-DOHO AND AWOJA WETLAND SYSTEMS

1. Background

The National Wetlands Management Project (the Project) is a four-year project of the Wetland Management Department (WMD) funded by Japan International Cooperation Agency (JICA) to establish a model of conservation and wise use of wetlands in Uganda. The Project is designed to achieve the purpose by generating five (5) outputs: 1) National Wetland Information System is upgraded and functional; 2) Scientific information on target wetland systems is available; 3) Wetland management plans are prepared; 4) Pilot activities for wise use of wetlands are implemented based on wetland management plans; and 5) Wetland management officers' capacity is strengthened. A geographical focus is given to two (2) wetland systems in the country: Namatala-Doho Wetland System and Awoja Wetland System. The experience in the two wetland systems will be multiplied over the country upon the completion of the Project.

Under the second output, the WMD in collaboration with the JICA Technical Assistance Team (JICA TAT) has developed a sub-project inventory for resource assessment applicable to the two wetland systems. The subprojects in the inventory were identified on the basis of the findings in 1) workshops participated by the relevant district officers in Mbale for Namatala-Doho Wetland System on 6th June and in Soroti for Awoja Wetland System on 8th June 2012; 2) the Reconnaissance Survey conducted from 19th June until 29th June 2012; and 3) follow-up communication with district officers via e-mail to fill the gaps of findings that took place after delivery of the brief report of the survey.

One of the priority subprojects in the inventory is a water quality assessment with three thematic activities with different objectives and therefore different sampling design.

Paddy Sustainability: It is often stated, that compared with Kibimba Rice Irrigation Scheme (KRS), Doho Rice Irrigation Scheme (DRS) has limited sustainability. Water quality parameters that may have relevance with soil fertility were chosen to compare between them.

Sediments Monitoring: The subcomponent is to estimate sediment transport at the existing gauging stations in the two wetland systems to support the findings of the Preliminary Assessment of Soil Erosion and Sediment Yield that is also a subproject in the inventory.

Nutrients in Lake Opeta and Bisina: GIDUDU et al.1 reported significantly pristine water of Lake Bisina with a concentration of nitrate as low as 21 ug/L. On the hand, there is a potential farm land endowed with Vertisols at an upper stream of the lakes and a demand for investment for rice farming. Considering the fact that the irrigation area for rice production in Bulambuli and Kween districts in the upper stream area are begin considered2 as potential irrigation infrastructure development areas, it is of importance to develop baseline information on the current level of water quality.

2. Objectives

The general objective of the water quality assessment is to support planning process for management of two wetland systems. More specifically the assessment is designed: 1) to compare water source quality of Doho and Kibimba Irrigation Schemes; 2) to estimate sediment transport at the existing gauging stations in the two wetland systems that will be compared with the findings in the Preliminary Assessment of Soil Erosion and Sediment Yield; and 3) to provide baseline information on water quality of the two lakes that is designated as Ramsar sites.

3. Methodology

3.1 Paddy Sustainability

Sampling time: Water samples were collected on 1) 2nd May 2013, 2) 3rd to 10th June 2013, 3) 28th July to 4th August 2013 and 4) 10th to 17th October 2013.

[1] B. Gidudu, R. S. Copeland, F. Wanda, H. Ochaya, J. P. Cuda, and W. A. Overholt, Distribution, interspecific associations and abundance of aquatic plants in Lake Bisina, Uganda, J. Aquat. Plant Manage. 49:19-27

[2] The project on Irrigation Scheme Development in Central and Eastern Uganda

Sampling sites: The sampling sites were spread over six sites in the two lakes. Three of them locate in the Lake Opeta, the rest in the Lake Bisina. They are presented in Table 1 and Figure 5.

Sampling method: Sample water was collected by single grab at 50cm using vandon sampler.

Table 1 Sampling Sites for the study on nutrients in Lake Opeta and Bisina

Lakes	Sampling Sites	Coordinate	
		Latitude	Longitude
Opeta	WQ 1	1°37'54.52"N	34°13'8.88"E
	WQ 2	1°39'2.28"N	34°10'3.83"E
	WQ 3	1°38'30.50"N	34° 7'59.56"E
Bisina	WQ 4	1°39'48.22"N	34° 2'7.66"E
	WQ 5	1°38'10.89"N	33°56'42.86"E
	WQ 6	1°40'28.49"N	33°51'14.42"E

Figure 5 Sampling sites for Nutrients in Lake Opeta and Bisina

Parameters: The parameters monitored were: 1) Nitrate, 2) Ammonia and Total Phosphorus.

3.4 Laboratory Analysis

The Principal Water Analyst of the National Water Quality Reference Laboratory in Entebbe undertook planning, field work for sample collection, sample shipment and laboratory analysis.

Table 2: Water Quality Parameters and Method of Analysis

S/N	Parameter	Analysis Method
1	pH	Electrometric method-using a pH meter
2	Temperature	Electrometric-using a pH meter
3	EC	Electrometric-using an EC meter
4	TSS at(105°C) and TSS at (500°C)	Gravimetric
5	Nitrates	Spectrometry
6	Ammonia	Spectrometry
7	Calcium	Ion Chromatography
8	Magnesium	Ion Chromatography
9	Potassium	Ion Chromatography

Water samples were collected only from the location designated above. Water samples were taken and collected from mid-stream or in the main flow of the river and away from slumping and scouring effects found near the banks, or by using boat from the surface of lakes at designated locations. Appropriate precautions were exercised by adhering to the laboratory sampling and preservation protocols. The laboratory's standard methods for analysis of water and wastewater were used in determination of the water quality parameters. The methods of analysis is summarised in Table 2.

4. Results and Discussion

4.1 Paddy Sustainability

The results of the analysis in May are presented in Table 3. Other results are shown in Table 4 and 5. From the second sampling, the sampling locations were transferred to a lower part of each irrigation area to allow broader comparison among the sites; and also considering apparent tendency of the suspended solid. It is noted that samples at the lower sites were affected by farming activity particularly in Kabimba Rice Field. For the Doho Irrigation Area, farming activity was not fully started due to the delay of rehabilitation work. The physical disturbance of the paddy field as a result of farming activity may have raised the TSS concentration in the KRS.

Table 3 Quality of Irrigation source water in May

	pH	Temp (°C)	EC (µS/cm)	TSS(105°) (mg/L)	TSS(500°) (mg/L)	Nitrates (mg/L)	Ammonia (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)
Doho	6.7	24.3	264	27	22	0.28	<0.04	29	7.7	4.2
Kibimba	6.9	28.5	309	18	14	0.41	<0.04	120	11.8	2.6

Table 4 Water Quality Monitoring Paddy -1

	pH		Temp (°C)		EC (µS/cm)		TSS 105° (mg/L)		TSS 500° (mg/L)	
	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba
June	6.8	7.1	25.0	29.4	232	372	30	43	13	37
July	6.9	7.3	24.6	28.8	235	390	14	179	2	42
October	7.1	7.6	24.0	26.7	290	312	4	20	3	17

Table 5 Water Quality Monitoring Paddy -2

	Nitrates (mg/L)		Ammonia (mg/L)		Calcium (mg/L)		Magnesium (mg/L)		Potassium (mg/L)	
	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba	Doho	Kibimba
June	0.13	0.13	0.22	0.4	25	35	6.3	14	3.6	2.8
July	2.2	4.6	0.3	0.47	25	42	6.8	17	5.6	3.5
October	0.09	<0.02	0.45	0.53	30	11.3	9	12	4.4	1.71

The concentrations of TSS (100°C) were in a range between 14 to 27 mg/L. It was confirmed that the concentration of Total Suspended Solids in irrigation water of Doho Rice Irrigation Scheme (DRS) was almost fifty (50) percent higher than Kibimba Rice Irrigation Scheme (KRS). Practically visual observation of the irrigation water also indicates significantly higher suspended materials at DRS. Since the capacity of the head works is designed as 1.39 m^3/s according to an engineer at DRS, an estimated one (1)

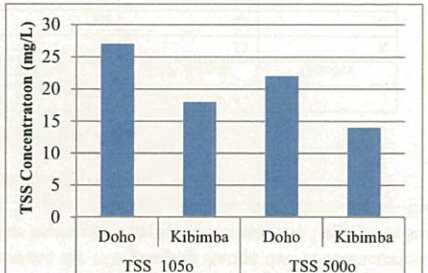

Figure 6 TSS in Irrigation Water

The discharge of the river in Awoja Wetland System differs significantly due to the varying size of the river profile. It was, however, observed that concentration of TSS significantly differs depending on the location and seasons. The difference may be attributable to the rain-fall pattern of the area, which is becoming more erratic.

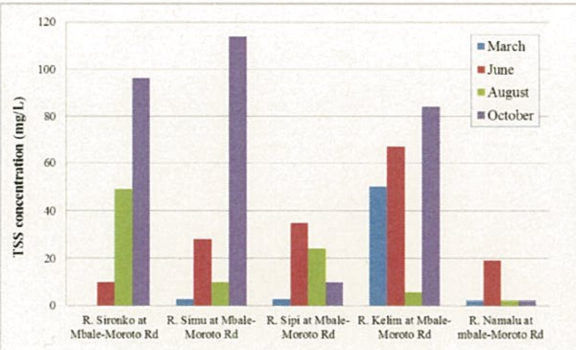

Figure 12 TSS of the rivers in Awoja Wetland System

4.3 Nutrients in Lake Opeta and Bisina

The results of the analysis are presented in Table 7.

Table 7 Nutrients in Lake Bisina and Opeta

SN	Site	Nitrate (mg/L)		Ammonia (mg/L)		Total Phosphorus (mg/L)	
		April	June	April	June	April	June
1	Lake Opeta poit 1	0.5	<.02	<0.04	3.22	0.21	0.19
2	Lake Opeta poit 2	0.09	<.02	0.17	2.09	<0.08	<.08
3	Lake Opeta Point 3	0.11	<.02	<0.04	0.28	<0.08	0.17
4	Lake Bisina point 4	0.26	<.02	<0.04	1.17	<0.08	<.08
5	Lake Bisina point 5	<0.02	<.02	<0.04	0.25	<0.08	<.08
6	Lake Bisina point 6	0.02	<.02	<0.04	0.85	<0.08	<.08

Nitrate level in the lakes ranged up to 0.26 mg/L over the two sampling period. The concentrations of nitrate in June were below the detection level at 0.02 mg/L at all the sampling points. The concentrations detected in the lakes were well below the most stringent standards at 25 mg/L[4] set forth under the EC Directive regarding quality required of surface water intended for the abstraction of drinking water (75/440/EEC). The toxicity of nitrates to fish is generally low, and 80 mg/ litre is considered to be the maximum admissible nitrate concentration for carp and 20 mg per litre for rainbow trout[5]. The contamination by nitrate of the lakes is, thus, negligible level at the moment. This is mainly due to limited fertilizer use at the upper stream as well as lake shore areas.

On the other hand, the maximum concentration of ammonia was 3.2 mg/L at Opeta Point 1 in June. The ammonia quantified in the assessment exercise indicates rather high level of contamination. The level of contamination would require intensive physical and chemical treatment[6] to serve as sources for drinking water according to 75/440/EEC. This ammonia may have occurred in water bodies arising from the livestock waste. In Australia, 0.5 mg/L is the Protected Environmental Values for Aquatic ecosystem (Fresh water) in its water quality criteria. The value is total as nitrogen so that it should be read as 0.6 mg/L as ammonia.

For phosphorus, the highest level was observed at Opeta poit 1 both in April and June. The values detected in the assessment exercise were, however, well below the problematic level. For instance, the water quality criterion in Australia for fresh water for Aquatic ecosystem is set at 0.5mg/L. The major sources of phosphorus are deemed livestock waste considering the current farming practice. There are also naturally-occurring sources of phosphorus in lakes, such as decaying organic matter, and eroding rocks and soils. When the phosphorus balance in lake is lost and phosphorus levels are too high, the excess phosphorus contributes to excess algal growth. Phosphorus is usually the limiting nutrient in freshwaters. The level of phosphorus is believed to be critical in management and conservation of freshwater systems.

In summary, the current levels of major nutrient contaminants are low except ammonia that may arise from excretion of animals. Limited use of fertilizer at the upper streams contributes to the current level of lake's pristine state. However the lake ecosystem is maintained on a fragile balance depending mainly on lake phosphorus cycles. In other words, the use of chemicals in the upper stream may have significant irreversible impacts on the lake ecosystem.

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[4] The Guide value for Category A1 Simple physical treatment and disinfection, e.g. rapid filtra- tion and disinfection.

[5] Zdenka Svobodova, Richard Lloyd, Jana Machova, Blanka Vykusova, Water quality and fish health, EIFAC TECHNICAL PAPER 54, Food and Agriculture Organization, 1993

[6] Extended treatment and disinfection e.g. chlorination to break-point, coagulation, flocculation, decantation, filtration, adsorption by activated carbon, disinfection by ozone and final chlorination.