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Measurement of remaining storage, rate of siltation, and rate of erosion of the Ahmadu Bello University Farm Lake drainage Basin in Zaria

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ABSTRACT: Ahmadu Bello University Teaching Hospital at Shika, 547 beds and water demand 154 m^3/d, suffers from inadequate and irregular water supply. But there is a nearby abandoned impounding reservoir constructed around 1966, with original storage capacity 636,300 m^3. The authors propose to use this reservoir as the main source of water for Shika Hospital. However, it is not known whether after 43 years of siltation, the reservoir still contains enough water to meet water demand from the hospital. To determine, how much water is still available in the impounding reservoir after many years of siltation, the authors embarked a boat and measured the remaining storage of the reservoir as 349,911 m^3. Thereafter calculated rate of siltation between years 1966 and 2009 as 6,600 m^3/y, rate of erosion in the drainage basin during the same period as 0.559 mm/y, and safe yield during 176 days of hydrological dry season as non existing, because after deduction of losses to evaporation calculated as 194,560 m^3/y and deduction of 272,700 m^3 of environmental reserve - minimum necessary to preserve aquatic wildlife, there is no active storage left. Since there is no active storage, there is also no safe yield and there is no water for Shika Hospital. The authors conclude that the University Farm Lake cannot serve as source of water for Shika Hospital, unless it is dredged to its original storage capacity. The impounding reserve will soon be lost. In some year to come there will be little or no more water in it because it will completely be silted up as there will even be no trace of it seen on the maps. @JASEM

Ahmadu Bello University Teaching Hospital at Shika, located at northern outskirts of Zaria, suffers from poor and not reliable water supply. In the past it was served with piped water by the Zaria Waterworks but since several years no piped water is coming. The hospital and hostels of medicinal students, which are located close to it, rely on five boreholes and two tankers irregularly coming from the Ahmadu Bello University Waterworks. These are unreliable water sources. Both, boreholes and tankers may one day break down and for some days or even weeks there will be no water in the hospital. A hospital must have a reliable, preferably piped water supply.

There is an abandoned impounding reservoir constructed in early 1970s' for irrigation, some 2.5 km to the north from the hospital, still on the Ahmadu Bello University land, with original total storage of 636,300 m^3, which should be more than enough to meet water demand from the hospital and from the nearby medical students hostels. But what is its remaining storage after over forty years of siltation? Does it justify construction of a semi-treatment plant and 2.5 km long main? In other words: how much water is still available in the University Farm Lake for the hospital? To answer this question the authors decided to measure the lake using paddle boat, metric tape and satellite navigator. Results of this measurement are discussed below.

The University Farm Lake and its drainage basin are located on the Ahmadu Bello University Farmland, on the north-western outskirts of Zaria, within the Crystalline Hydrogeological Province of Nigeria and in northern part of the Guinea Savanna belt. The savanna is deeply degraded and entirely converted to farmland on which mostly grain crops are grown. It has a typical savannah climate of distinct wet and dry seasons. Climatic dry season starts on 1st October and ends on 1st May, its duration 213 days, while duration of the climatic wet season, from 2nd May to 30 September, is 152 days (Walter, 1977). However, an anonymous document in files of Ahmadu Bello University Farm Management, titled "Possible development of lake at University Farm for domestic water supply, 1971, reports: "The average date of cessation of spillway flow is 5th November. The start of rains relieves the pressure on water at about 1st May. This gives a dry period of 176 days". The reader may note that this document, (Anonymous, 1971a, 1971b) refers to hydrological seasons, separated by onset and cessation of spillway flow, while Walter, 1977, means "climatic dry season" marked by onset and cessation of rains. Further, the same Anonymous 1971a and 1971b, writes that depth of evaporation at the University Farm Lake per 176 days of hydrological dry season is 0.893 m or 5.07 mm per day (converted into metric units in 2009).

Depth of rainfall at a nearby (1.5 km from the Lake) Institute of Agricultural Research (I.A.R) ABU

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Samaru Weather Station ($11^0$10'56.4"N, $7^0$37'00.8"E), average for years 1996 to 2005, was 1,053.4 mm (Baba, 2007). Corresponding to this depth of rainfall total runoff coefficient is 0.24, according to Schoeneich, 1999. In this surface runoff is 0.16, while base flow is 0.08.

University Farm Lake, together with Bomo Lake which is located in its headwaters, drains an area 18,062,500 m^2. In these University Farm Lake drainage sub-basin is 11,931,875 m^2, while Bomo Lake drainage sub-basin is 6,130,625 m^2 (Plate 1 and Fig.1).

The reservoir together with its drainage basin is underlain by the biotite gneiss belonging to the Precambrian Basement Complex of Northern Nigeria according to Wright and McCurry, 1970. It is therefore a metamorphic terrain bounded in the west by quartz – mica schist and in the east by biotite granite believed to have intruded the Basement gneiss during the Pan African Orogeny according to McCurry (1973). The greater part of the area is covered with thick soft overburden, consisting of alluvium, regolith, and saprolite all derived from weathering of the Basement rocks. Some areas on the watershed are capped by ferricrete.

Elevation of the water, with spillway flowing, in the University Farm Lake, measured with satellite navigator in August 2009 is 667 meter above sea level (masl) while watershed of the drainage basin is located at up to 686 masl.

The surface streams, which are the major sources of recharge to the dam, are seasonal. The Bomo dam (Figure 1) which is situated upstream of the dam, still within the drainage basin of the ABU Farm Lake, is also seasonal, drying off completely towards the end of the climatic dry season. The impounding reservoir is effluent, recharged also by groundwater. This groundwater recharge causes that the spillway is flowing until 5th of November, about one month after cessation of rains. Although the dam is grossly underutilized - only few portable diesel pumps are watering irrigated plots located close to the edge of the water - yet the level of water is well below the spillway for a greater part of the year due to the seepage under and through the embankment, and to evaporation.

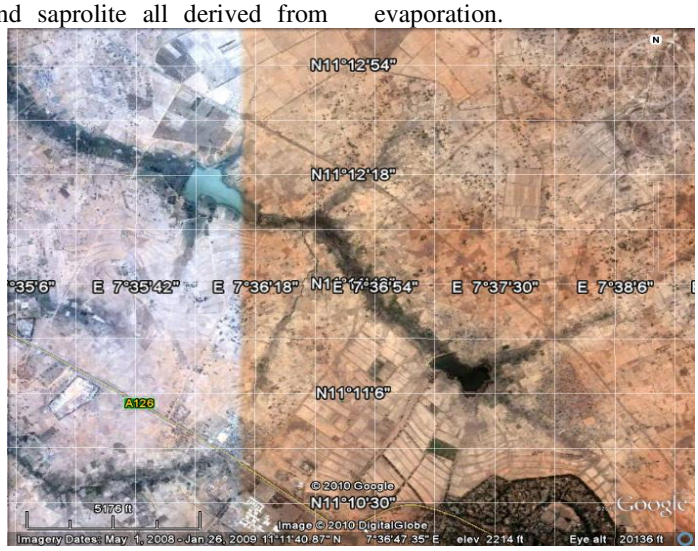

Plate 1: Satellite image of the study area: University Farm Lake and Bomo Lake

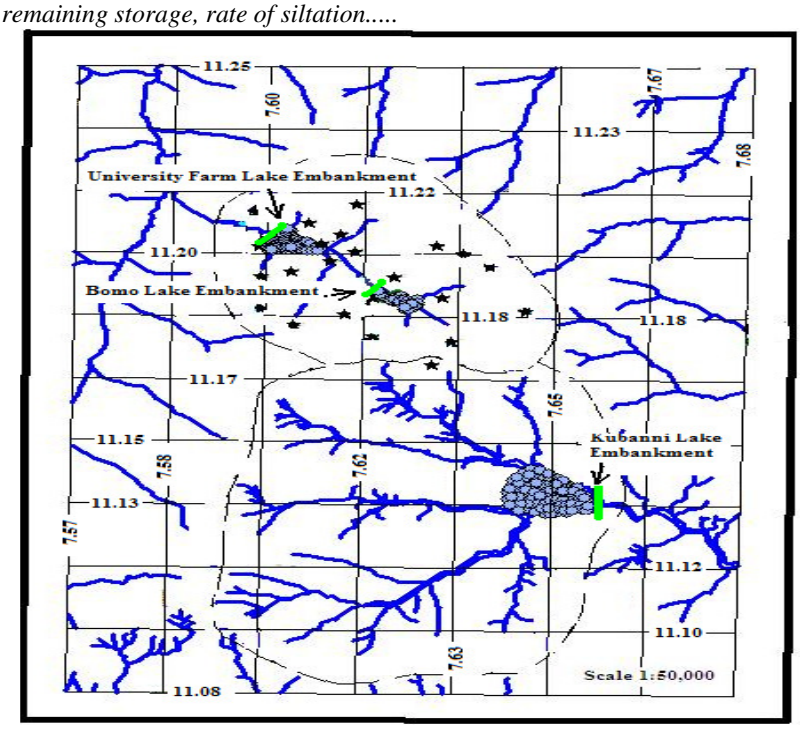

Fig 1. Drainage basin of the Kubanni Lake, University Farm Lake, with the sub-basins "Bomo lake"

MATERIALS AND METHODS

Measurement of the Remaining Depth of the Reservoir: Measurement of depth of the University Farm Lake, on 18th August 2009, with spillways flowing, was done from a fishing boat (Plate 3) with a metric tape having a weight tied to its end. Points of measurement were located with a satellite navigator, its horizontal accuracy 7 m. The boat was not anchored for the time of depth reading, instead was immobilized with paddles. Since there was no wind this day, error resulting from non anchoring the boat is probably negligible and the only inaccuracy of horizontal location is probably of the satellite navigator - 7 to 8 metres. Results of depth measurements are shown in Table 1 and are located on the map of remaining storage shown in Fig 2.

Edge of water table was located with the same satellite navigator on the next day, Tuesday 18th August 2009, still with spillway flowing. Results of water edge location are presented in Table 2 and in Figure 2. Edge of water table was not always easily accessible, often separated from dry land by a few metres wide swampy belt – from where groundwater was seeping to the Lake. Therefore, to locate all details of the water edge, satellite map was sought (Fig. 1). But even satellite map was not of help everywhere because of floating vegetation; especially water lilies *(Papilionaceae)* which are shown in the satellite image in the same green tones as the farmland which is surrounding the lake. With all these, edge of water was located with the utmost possible accuracy using combination of measurements shown in Table 2 and of satellite image in Plate 1.

History of the Ahmadu Bello University Farm Dam and Lake: The Ahmadu Bello University Farm Dam (dam = embankment) is a homogeneous earthfill structure about 3 to 4 m high. It was constructed by the Nigerian Tobacco Company across a small stream thereby creating a lake for irrigation for the tobacco farm. The date of construction is not known. On topographical map 1:50,000 (Northern Nigeria Survey, 1965) plotted from air photography taken in 1962, the impounding reservoir is not yet shown. The Dam was mentioned for the first time in Anonymous 1971a and 1971b when the body of the dam (earth dyke) was already damaged by denudation. This suggests that in 1971 it was already several years old. For the purpose of calculations below, year 1966 was accepted arbitrarily as the year of construction. In July 1971 the dam together with impounding reservoir and the farmland around it were handed over to Ahmadu Bello University. Since then the farm supplied water for practical teaching of agriculture and veterinary medicine. Analysis of the water economy of the lake in 1971 showed that the

existing lake could make a substantial contribution to A.B.U's urgent water needs without jeopardizing the teaching function of the University Farm with respect to both irrigation and wildlife study. The dam had an original total water storage capacity of 140 million gallons (636,300 m^3) and there were plans to develop this huge body of water for domestic water supply (Anonymous 1971, Couper 1973) The University Farm Policy Committee resolved that effort should be made to ensure that the lake never fell below a volume of 60 million gallons (272,760 m^3) for the sake of the conservation of water life in and around the lake (Anonymous, 1971a).

The difference in level between the Dam top and the spillway crest is 4.0 ft (1.22 m) without allowing for evaporation and seepage losses (ground seepage flow) according to El-Turabi, 1972. According to the same source "the maximum lake capacity on the day of visit, 11th May 1972, was estimated at 330,400 m^3 (11.8 x 10^6 ft^3). Since in light of the measurements done by the present authors on 18th August 2009, total storage measured was 349,911 m^3, El-Turabi's estimation of the storage in 1972 seems to be grossly on the lower side. Report from the Farm Management (Couper, 1978) showed that the dam wall (embankment, earth dyke, earth fill dam – written in 2009) had been severely eroded by water lap over past seven years and this erosion will increase unless measures are taken to control it. Plate 2 and 3 shows abrasion of the dam body in August 2009.

Also, Gill (1977) after an assessment of the dam reported that there were severe rain cuts on the dam slope at several places. He also reported evidence of rat holes within the dam and recommended that the top 1-2 m portion of the dam be scraped and new earth fill be built. Also he recommended stone pitching at the sides to reduce intensity of rain cuts. He however termed his assessment of the structure a visual impression. It does not seem that Gill's recommendations were ever implemented, the present authors, in August 2009, observe.

RESULTS AND DISCUSSION

Interpretation of Results of the Remaining Depth Measurement: Results of water depth measurements from Table 1, and results of location of edge of water shown in Table 2, with satellite image in Fig 1 added to help in demarcation of surface water from dry land, were used to plot the map of remaining water storage shown in Fig 3. Then the information on remaining water storage was derived from this map and shown in Table 3. Table 3 shows that the remaining storage on 18th August 2009 was 349,911 m^3 or 55% of the original storage 636,300 m^3 on the most probable date of impounding, year 1966. From the date of impoundment in 1966 to the date of measurement of the remaining storage in 2009, 43 years elapsed. Then the average rate of siltation during this period was (636,300 m^3 – 349,911 m^3) : 43 years = 6660 m^3/y.

Rate of siltation can be converted into the average rate of erosion in the University Farm Lake drainage sub-basin. The total drainage basin, with Bomo Lake in its headwaters, is 18,082,500 m^2, but since Bomo Lake acts as a sediment trap, the University Farm Lake has as deposit only material eroded in the University Farm Lake sub-basin (Fig. 1). Area of this sub-basin, measured in Fig. 1, is 11,931,875 m^2. Then, rate of erosion in the University Farm Lake sub-basin between 1966 and 2009 was 6,600 m^3/y : 11,931,875 m^2 = 0.000553 mm.m/y = 0.553 m^2/y.

Plate 3: After forty three years of existence the original storage has been reduced by siltation.

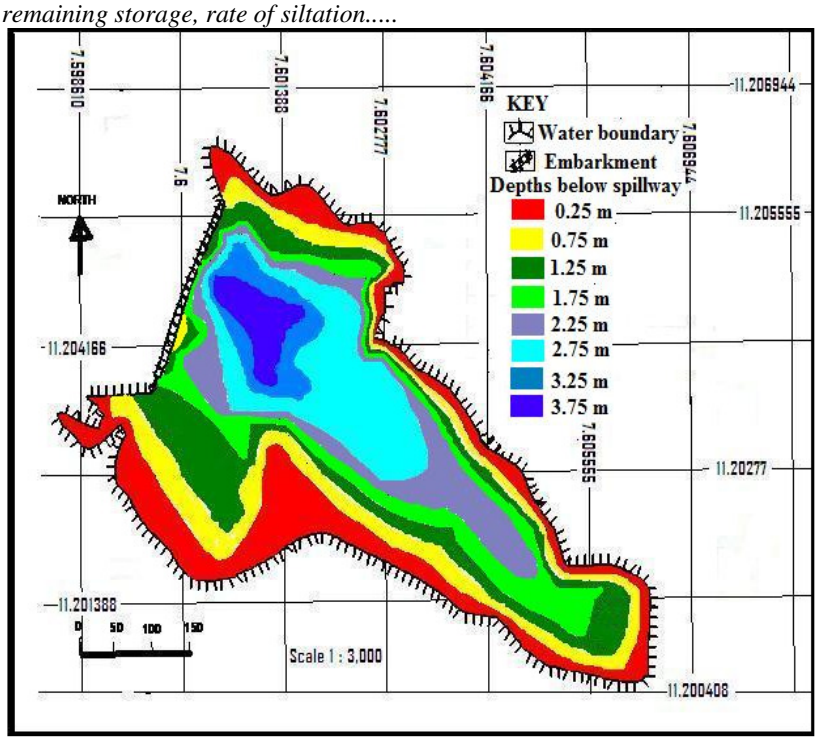

Fig 2: Remaining depth of the University Farm Lake. The results of depth measurement carried out on the 18th of August 2009.

Table 1. Measurements of the remaining depth in the University Farm Lake. Measurements were made on Monday, 17th August 2009, while spillway was flowing.

Point	Coordinates, Minna datum, Garmin satellite navigator	Elevation, m asl	Horizontal accuracy m	Depth in m b. spillway
1	$11^0$12'11.7" N, $7^0$36'00.3"E	664	9	1.05
2	$11^0$12'12.3" N, $7^0$36'00.1"E	664	8	1.35
3	$11^0$12'12.8" N, $7^0$35'59.9"E	664	9	1.65
4	$11^0$12'13.4" N, $7^0$35'59.8"E	664	8	1.65
5	$11^0$12'13.8" N, $7^0$35'59.6"E	665	8	1.60
6	$11^0$12'13.7" N, $7^0$35'59.2"E	664	11	1.70
7	$11^0$12'14.1" N, $7^0$35'59.7"E	667	8	1.75
8	$11^0$12'14.6" N, $7^0$36'00.1"E	657	8	2.35
9	$11^0$12'14.9" N, $7^0$35'59.6"E	661	8	1.05
10	$11^0$12'15.1" N, $7^0$35'59.8"E	663	11	1.30
11	$11^0$12'15.2" N, $7^0$35'59.9"E	664	8	1.40
12	$11^0$12'15.7" N, $7^0$36'00.1"E	665	10	1.30
13	$11^0$12'16.3" N, $7^0$36'00.5"E	665	8	2.05
14	$11^0$12'17.4" N, $7^0$36'01.8"E	665	8	3.70
15	$11^0$12'18.6" N, $7^0$36'02.4"E	665	7	3.25
16	$11^0$12'18.9" N, $7^0$36'02.2"E	666	6	2.75
17	$11^0$12'18.7" N, $7^0$36'01.8"E	666	7	1.55
18	$11^0$12'19.1" N, $7^0$36'02.7"E	665	7	2.75
19	$11^0$12'19.9" N, $7^0$36'03.0"E	665	7	1.75
20	$11^0$12'20.3" N, $7^0$36'02.8"E	666	8	1.25
21	$11^0$12'19.6" N, $7^0$36'03.8"E	667	7	1.45
22	$11^0$12'19.7" N, $7^0$36'04.0"E	667	8	1.20
23	$11^0$12'19.3" N, $7^0$36'04.4"E	667	8	1.25
24	$11^0$12'18.9" N, $7^0$36'04.5"E	667	7	1.45
25	$11^0$12'18.1" N, $7^0$36'04.6"E	668	7	2.30
26	$11^0$12'17.2" N, $7^0$36'05.0"E	668	6	3.20
27	$11^0$12'16.1" N, $7^0$36'05.4"E	668	7	3.60
28	$11^0$12'15.6" N, $7^0$36'05.6"E	669	8	3.25
29	$11^0$12'14.4" N, $7^0$36'05.8"E	669	6	2.95
30	$11^0$12'13.1" N, $7^0$36'05.9"E	669	7	3.05

31	$11^0$12'11.8" N, $7^0$36'05.6"E	669	7	2.25
32	$11^0$12'11.3" N, $7^0$36'05.4"E	668	7	1.50
33	$11^0$12'11.3" N, $7^0$36'05.2"E	668	7	0.60
34	$11^0$12'10.9" N, $7^0$36'04.3"E	668	7	0.40
35	$11^0$12'11.7" N, $7^0$36'03.7"E	668	7	1.45
36	$11^0$12'11.3" N, $7^0$36'03.2"E	668	6	1.75
37	$11^0$12'10.4" N, $7^0$36'02.9"E	668	8	1.70
38	$11^0$12'09.8" N, $7^0$36'02.9"E	667	7	1.10
39	$11^0$12'09.3" N, $7^0$36'03.1"E	668	7	0.75
40	$11^0$12'08.4" N, $7^0$36'02.9"E	670	7	1.25
41	$11^0$12'07.5" N, $7^0$36'03.1"E	669	7	0.30
42	$11^0$12'07.6" N, $7^0$36'02.8"E	668	8	0.85
43	$11^0$12'08.5" N, $7^0$36'02.5"E	668	7	1.15
44	$11^0$12'08.9" N, $7^0$36'02.0"E	668	7	1.30
45	$11^0$12'12.1" N, $7^0$36'01.1"E	665	7	1.70
46	$11^0$12'12.9" N, $7^0$36'02.5"E	666	7	2.55
47	$11^0$12'13.7" N, $7^0$36'03.9"E	666	6	3.55
48	$11^0$12'14.6" N, $7^0$36'05.6"E	668	6	3.00
49	$11^0$12'15.5" N, $7^0$36'06.8"E	668	6	3.00
50	$11^0$12'16.4" N, $7^0$36'07.9"E	668	6	2.60
51	$11^0$12'17.4" N, $7^0$36'09.1"E	668	6	2.20
52	$11^0$12'17.9" N, $7^0$36'10.0"E	668	6	1.70
53	$11^0$12'19.9" N, $7^0$36'06.6"E	666	6	0.30
54	$11^0$12'18.7" N, $7^0$36'07.2"E	661	6	1.40
55	$11^0$12'17.0" N, $7^0$36'08.3"E	662	6	2.40
56	$11^0$12'15.6" N, $7^0$36'08.9"E	664	6	2.85
57	$11^0$12'14.3" N, $7^0$36'09.7"E	664	6	2.80
58	$11^0$12'12.5" N, $7^0$36'11.0"E	665	6	2.60
59	$11^0$12'10.8" N, $7^0$36'11.9"E	665	6	2.65
60	$11^0$12'09.6" N, $7^0$36'12.4"E	667	6	2.45
61	$11^0$12'08.0" N, $7^0$36'12.9"E	667	7	1.80
62	$11^0$12'07.7" N, $7^0$36'13.0"E	668	6	1.20
63	$11^0$12'07.8" N, $7^0$36'13.6"E	668	6	1.95
64	$11^0$12'08.3" N, $7^0$36'15.1"E	668	6	2.35
65	$11^0$12'08.8" N, $7^0$36'16.8"E	667	6	1.45
66	$11^0$12'08.0" N, $7^0$36'17.1"E	667	6	1.70
67	$11^0$12'07.4" N, $7^0$36'17.3"E	667	6	1.90
68	$11^0$12'05.8" N, $7^0$36'17.4"E	668	6	2.00
69	$11^0$12'04.9" N, $7^0$36'17.3"E	667	6	1.95
70	$11^0$12'04.3" N, $7^0$36'17.4"E	667	6	1.30
71	$11^0$12'04.5" N, $7^0$36'18.0"E	668	7	1.75
72	$11^0$12'04.7" N, $7^0$36'18.7"E	668	6	1.80
73	$11^0$12'05.0" N, $7^0$36'19.5"E	668	6	1.60
74	$11^0$12'05.4" N, $7^0$36'20.5"E	669	6	1.55
75	$11^0$12'05.2" N, $7^0$36'20.9"E	668	6	1.45
76	$11^0$12'05.0" N, $7^0$36'21.2"E	668	6	1.40
77	$11^0$12'04.9" N, $7^0$36'21.8"E	668	6	1.30
78	$11^0$12'04.5" N, $7^0$36'20.7"E	667	6	1.30
79	$11^0$12'03.8" N, $7^0$36'20.6"E	668	6	1.30
80	$11^0$12'03.2" N, $7^0$36'20.4"E	669	6	1.35
81	$11^0$12'02.9" N, $7^0$36'20.2"E	667	6	1.35
82	$11^0$12'03.3" N, $7^0$36'19.7"E	667	6	1.50
83	$11^0$12'09.9" N, $7^0$36'09.7"E	667	6	2.70

Table 2. Results of location of the edge of water with satellite navigator, on Tuesday, 18th August 2009.

S/No.	Coordinates Minna datum, satellite navigator	Elevation, masl Satellite navigator	Accuracy of Measurement
1 .	$11^0$12'13.0" N, $7^0$35'55.8"E	666 m (concr.slab)	7
2	$11^0$12'12.7" N, $7^0$35'53.2"E	668	7
3	$11^0$12'11.2" N, $7^0$35'56.0"E	672	9
4	$11^0$12'12.3" N, $7^0$35'53.3"E	668	8
5	$11^0$12'11.0" N, $7^0$35'34.2"E	667	13
6	$11^0$12'11.1" N, $7^0$35'55.2"E	668	10
7	$11^0$12'11.8" N, $7^0$35'56.9"E	670	8
8	$11^0$12'11.4" N, $7^0$35'57.1"E	668	7

9	11^{0}12'09.9" N, 7^{0}35'56.5"E	665	8
10	11^{0}12'08.3" N, 7^{0}35'57.8"E	665	8
11	11^{0}12'07.6" N, 7^{0}35'58.7"E	668	9
12	11^{0}12'06.1" N, 7^{0}36'00.0"E	671	8
13	11^{0}12'07.7" N, 7^{0}36'06.0"E	668	6
14	11^{0}12'04.6" N, 7^{0}36'13.7"E	667	6
15	11^{0}12'03.0" N, 7^{0}36'32.6"E	669	7
16	11^{0}12'06.2" N, 7^{0}36'19.0"E	664	6
17	11^{0}12'11.0" N, 7^{0}36'14.7"E	668	6
18	11^{0}12'14.2" N, 7^{0}36'11.3"E	666	6
19	11^{0}12'15.2" N, 7^{0}36'09.9"E	663	6
20	11^{0}12'15.2" N, 7^{0}36'09.1"E	665	6
21	11^{0}12'17.9" N, 7^{0}36'09.3"E	663	7
22	11^{0}12'34.7" N, 7^{0}36'15.2"E	673	6
23	11^{0}12'20.7" N, 7^{0}36'04.6"E	672	6
24	11^{0}12'22.0" N, 7^{0}36'03.0"E	670	7
25	11^{0}12'22.8" N, 7^{0}36'01.5"E	671	7
26	11^{0}12'22.0" N, 7^{0}36'01.4"E	668	7
27	11^{0}12'23.9" N, 7^{0}36'08.2"E	663	7
28	11^{0}12'23.9" N, 7^{0}36'00.0"E	668	10
29	11^{0}12'19.6" N, 7^{0}35'59.0"E	668	7
30	11^{0}12'14.2" N, 7^{0}35'56.1"E	668	9
31	11^{0}12'18.0" N, 7^{0}35'58.0"E	671	8
32	11^{0}12'19.7" N, 7^{0}36'09.0"E	663	8

Table 3. Results of the measurement of the remaining storage of University Farm Lake.

Depth interval below spillway level in metres	Area of depth interval as measured in Fig.1, square metres	Average depth of water, metres	Volume of water, cubic metres
0.0 – 0.5	35,190	0.25	8,797
0.5 – 1.0	32,130	0.75	24,098
1.0 – 1.5	43,720	1.25	54,650
1.5 - 2.0	28,381	1.75	49,667
2.0 – 2.5	30,562	2.25	68,764
2.5 – 3.0	30,409	2.75	83,624
3.0 – 3.5	10,480	3.25	34,060
3.5 – 4.0	7,000	3.75	26,250
Total	217,872	1.61	349,911

Water Budget for the University Farm Lake: Volume of rainfall over the total University Farm Lake Drainage Basin, Bomo Sub-Basin and University Farm Lake sub-basin added (Fig. 1), is 1.0534 m/y · 18,062,500 m^2 = 19,027,037 m^3/y. Then, volume of total runoff – surface runoff plus base flow recharging the University Farm Lake is 19,027,037 m^3/y · 0.24 = 4,566,489 m^3/y, much more than the total remaining storage of the Lake, calculated above as 349,911 m^3/y. Depth of evaporation from the open water table, cited by Anonymous 1971 as 0.893 metre per 176 days of hydrological dry season, corresponds to the loss to evaporation during the hydrological dry season of 0.893 m/y · 217,872 m^2 of open water table = 194,560 m^3 of loss to evaporation. This is comparable with the loss to evaporation calculated by Anonymous 1971b as 47,700,000 gallons (or 216,796 m^3). The same Anonymous 1971b writes that "at a recent meeting of the ABU University Farm Policy Committee it was agreed that for the sake of the conservation of water life in and around the Lake, every effort should be made to ensure that the Lake never fell below a volume of 60 million gallons" (or 272,700 m^3). Accepting that 60 million gallons (272,700 m^3) must be left in the Lake at the end of dry season as the "environmental minimum", and that 194,560 m^3 will be lost in storage to evaporation, assuming further that the leakage through the dam body, even after collapse of part of the spillway in February 2009 is still negligible, then the water budget of the University Farm Lake is 349,911 m^3/y – (272,700 m^3/y + 194,560 m^3/y) = -117,349 m^3/y. Since the water budget is negative, there is no active storage and there is no safe yield in the lake. And, of course, there is no water available for Shika Hospital.

Conclusion: In attempt to answer the question whether an abandoned University Farm Lake with its original total storage 636,300 m^3 can still be used as

Measurement of remaining storage, rate of siltation.....

the main source of water for the Shika Hospital, with its water demand of only 154 m^3/d (27,104 m^3 per 176 days of hydrological dry season), a canon, a weight with a metric tape, and a satellite navigator was used to measured remaining depth of the Lake as 349,911 m^3 or 55% of its original storage. This corresponds to the average rate of siltation between 1966 and 2009 as 6,660 m^3/y and rate of erosion in the Lake's drainage basin during the same period as 0.553 mm/y. Water budget of the Lake was calculated as 349,911 m^3 of remaining storage, minus losses to evaporation calculated as 194,560 m^3/y, minus "environmental minimum" in 1971 as 272,700 m^3/y. It was found that the water budget is negative, -117,349 m^3/y. It means that all the active storage in the Lake has already been silted up and no water is available neither for Shika Hospital nor for any other human use. The University Farm Lake cannot serve as source of water for Shika Hospital, unless it is dredged to its original storage capacity. The impounding reserve will soon be lost. In 349,911 m^3 : 6,660 m^3/a = 52 years from the day of measurement, namely in 2062 there will be no more water in it because it will completely be silted up and there will even be no trace of it seen on the satellite maps.

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