LAKES VICTORIA, KYOGA AND ALBERT A HYDROMETEOROLOGICAL SURVEY

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INTRODUCTION

The Project for the Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Albert is one of the largest of its kind, intended to arrange for the collection of data for a comprehensive study of the water balance of the Upper Nile Basin in East Africa.

With a surface area of about 69,000 sq. kms., Lake Victoria is the second largest freshwater lake in the world, (next to Lake Superior), lying astride the Equator within the countries of Uganda, Kenya and Tanzania. Lakes Kyoga and Albert downstream have areas of 6,300 sq. kms. and 5,300 sq. kms. respectively. The area of the catchment as a whole is approximately 378,000 sq. kms., of which about 325,000 sq., kms, are in the three East African countries, while the remainder lies in the Rwanda, Burundi and the Congo. The White Nile, fed and regulated by these lakes, flows out of Uganda into the Sudan, and thence, after being joined by the Blue Nile, into the United Arab Republic.

It is interesting to note that, while Lake Victoria is the second largest freshwater lake in the world, the river Nile which flows out of it, is the second largest river in the world next only to Missouri-Mississippi. While the Nile is about 6,500 kms. long, including the Kagera, the Mississippi, including the Missouri, is longer by another 300 kms. Further, the drainage area of the Upper Nile and the Lake Victoria contain within it the third highest peak in Africa, Mt. Rwenzori (16,795′) next only to Mt. Kilimanjaro (19,565′) and Mt. Kenya (17,040′).

LAKE VICTORIA

The area of Lake Victoria, including the islands, is
almost equal to the size of Ireland,
slightly more than Ceylon,
more than twice the size of the Netherlands or Belgium,
more than the combined area of the adjoining territories of Rwanda and Burundi.

There are at least twenty member states of the United Nations which are smaller in area than Lake Victoria.

Although in respect of area, Lake Victoria is the second largest, its shoreline is the longest in the world, about 3,400 kms. as against the 3,000 kms. for Lake Superior, which points to the highly indented nature of its shoreline.

In point of depth, it is way down in the list. Lake Baikal in Siberia with a depth of about 1,740 metres is the deepest in the world. Several other lakes like the Tanganyika, Nyasa, Superior, etc., are deeper than Victoria. It is estimated that the maximum depth of Lake Victoria is about 80 metres This relative shallowness makes the capacity or the volume of the Lake less than several other lakes with smaller surface area. It is estimated that the volume of Lake Victoria is 2,700 cubic kilometres, whereas Lake Superior and Tanyanyika have about 12,000 and 19,000 cubic kilometres.

The general shape of lake Victoria is an open trough running from north to south. The hills to the north and the south are quite low and the watersheds are ill-defined; whilst to the east and the west, the land rises to mountainous heights along the edges of the two rift valley systems.

CLIMATE

Mean annual precipitation is extremely varied over the catchment. Although based on rather limited information, particularly on the central portion of the lake itself, rainfall over the lake proper

seems to vary from greater than 80″ along the western edge to less that 30″ near the eastern shore. Generally speaking, precipitation decreases with distance from the lake and this is particularly true on the western side. As the higher elevations in Kenya are approached to the east, precipitation increases again to as much as 70″. Tentative estimates put the average annual rainfall over the lake as 56″, over the land catchment 40″ and over the catchment in East Africa as a whole, about 45″. According to some previous analyses, it appears that most of the areas receive at least two-thirds of the normal annual rainfall in nine years out of ten.

Estimates of evaporation from Lake Victoria, derived earlier on the basis of water budget methods, put it at almost equal to the rainfall over the lake, both being about five times as big as inflow from or outflow into the rivers.

Variety in Hydrological Conditions

These variations in topographical and meteorological conditions produce corresponding variations in the hydrological characteristics. The Kagera on the west in Tanzania and the Nyando in the east in Kenya are perennial rivers; whereas the streams in the semi-arid lake shore in Sukumaland in Tanzania are seasonal and flashy and, the northern lake shore and the Katonga basin in Uganda are swampy. Mean annual runoff varies from about five to six hundred cubic metres per second for the Victoria Nile to as little as five to six cubic metres per second for some of the smaller rivers. Swift and steep rivers in the vicinity of Mt. Elgon in Kenya are in sharp contrast to sinuous meanders in the lower reaches and extensive swamps in the lacustrine ends of tributary streams.

The Role of Hydrometeorology in Water Resource Development

Hydrometeorology has a vital role to play in water resources development, involving the development of irrigation, hydropower, flood control, navigation, etc.

Schemes for the conservation and utilization of river water for irrigation would involve a detailed understanding of the variations in river runoff from season to season within a year; and, year to year in a succession of years.

Schemes for power development would require a knowledge of the quantum of continuous flow that can be expected in a river and the periods for which flows above and below the normal would occur in order to evolve a suitable pattern for power generation. All schemes involving storage entail provision for surplussing devices as adjuncts to the storage structures so that appurtenant works for disposal of flood waters have to be suitably designed. The design of spillways makes necessary a detailed study of the behaviour of storms, their depths, durations and frequencies over the catchment area upstream.

Flood control structures would require a study of the behaviour and pattern of floods in the basin which in turn are caused by meteorological phenomena.

Inland navigation, swamp reclamation, urban, rural and industrial water supplies, fisheries, recreational facilities and tourism are often combined with irrigation and power development and flood control in plans for comprehensive and integrated multiple purpose river basin development, sound economic investment on which requires a scientific study of the hydrometeorological characteristics of the basin. In the particular instance of the equatorial lakes, it is all the more important in view of the fact that the three lakes, Victoria, Kyoga and Albert are interconnected by the Victoria Nile, apart from their own independent tributaries and any scheme for regulation of the lakes must be based on a determination of the water balance of the lake system in which hydrometeorology plays a significant part.

International Aspects of the Nile Waters

Particularly in international river basins, the feasibility of a project may sometimes depend upon its effect on the streamflow at some downstream point.

In the case of the Lake Victoria, there have also been proposals under consideration from time to time for a fuller utilization of the potential storage by adopting commonly acceptable regulation procedures. A scientific consideration of these various proposals for regulation of the lake system and possible future negotiations on allocation of waters amongst the riparian states would need a comprehensive determination of the water balance of the lake system and hydrometeorological analysis of the several involved parameters like rainfall, evaporation, inflows, outflows, etc. on a commonly acceptable basis.

While the data for such a scientific determination is adequate in some parts of the Upper Nile Basin in East Africa, it is notably inadequate in most locations. It is estimated that, at the present time, streams draining a third of the land area of the Lake Victoria catchment are gauged (less than two-thirds of the estimated total surface flow).

The Objectives of the WMO/SF Assisted Project

Therefore, the major objectives of the Project undertaken by the Governments of Kenya, Sudan, Tanzania, U.A.R. and Uganda with the assistance of the UNDP and the WMO are "the collection and analysis of hydrometeorological data of the catchments" of the Lakes "in order to study the water balance of the Upper Nile. The data collected and the study are expected to assist the countries in the planning of the water conservation and development and to provide the ground work for inter-governmental co-operation in the storage, regulation and use of the Nile."

The proposed additions to the stream gauging network are expected to increase the gauged area to about 90% of the total.

Specific Tasks assigned to the Project

The following specific tasks are assigned to the Project:—

(i) setting up additional data collecting stations (24 hydrometeorological, 156 rainfall, 67 hydrological and 14 lake level recording) upgrading some of the existing stations, in order to complete an adequate network from which basic hydrometeorological data can be collected and analysed;

(ii) establishing seven small index catchments for intensive studies of rainfall-runoff relationships for application to other parts of the catchment areas;

(iii) aerial photography and ground survey of those sections of the lake shore areas which are flat and which will be most subject to change with variations in the levels of the lakes; a hydrographic survey of Lake Kyoga;

(iv) analysis and interpretation of data collected; and,

(v) training staff of the participating Governments in hydrometeorological work.

Organisation and Programme of the Project

The five participating Governments have set up a Technical Committee in order to assume "overall responsibility for Governments' participation and execution of the project" and to act as the co-ordinating agency with the UNDP and the WMO. The Heads of the Water Development Departments in the three East African countries and the Executive Member, Permanent Joint Technical Commission for Nile Waters representing the Sudan and the United Arab Republic, are the members of the Committee. The Director of the East African Meteorological Department is a co-opted member of the Committee.

While the Project headquarters is located at Entebbe, Uganda, there are three regional offices, one in each of the three East African countries. The regional headquarters for Uganda is at Masindi, for Kenya at Kisumu and for Tanzania at Bukoba. Besides, there are being set up a number of field offices to work according to the directions from the three regional offices.

Installation of level recorder at Butiaba on Lake Albert

Lake level recorder at Kisumu on Lake Victoria

The project is designed to have a duration of five years. It is expected that the operations involving the installation of additional stations will be completed within the first two years and the observational programme will be continued for the following three years.

Arrangements will be initiated for systematic publication of data and it is anticipated that the participating Governments will undertake to continue the data collection programme for at least another five years after the completion of the UNDP/WMO assisted Project.

CONCLUSION

The Project, thus, represents one of the largest and most outstanding examples of inter-regional co-operation in the sphere of economic development based on the need for exploitation of the common resources for the common benefit. The valuable data collected and the findings of the scientific analysis will be accessible to the prefessionals of the participating countries to assist them in the planning of water conservation and development not only for the good of the peoples of the country concerned, but in a manner which would not jeopardize the aspiration and interest of the other sister countries.

Another most gratifying aspect of the Project is that the professional and other staff drawn from the five countries, are conscientiously working together in full co-operation and harmony. It is not only the training in the field of hydro-meteorology which these staff would gain, but by the mere fact that they are working and living together, they would get to know each other much better than before and that in itself will bring these countries to even closer contact.

Thus by virtue of their geographical position, the peoples of the Nile, by their free will, are now wielding the Nile and Victoria to fulfil their historic mission of serving and unifying the countries on their banks.

AREAS IN THE LAKE VICTORIA BASIN

Land and Water Distribution

	sq. km.	*sq. miles*	*Percentage*
Lake Victoria (less islands)	67,800	26,200	25.6
Islands	1,500	600	0.6
Main Land	193,900	75,000	73.8
TOTAL ..	263,200	101,800	100.0

Distribution by Countries

Square Kilometres	*Lake*	*Island*	*Land*	*Total*
Kenya	3,900	—	44,000	47,900
Tanganyika ..	34,700	1,000	84,200	119,900
Uganda	29,200	500	32,100	61,800
Ruanda-Urundi ..	—	—	33,600	33,600
TOTAL ..	67,800	1,500	193,900	263,200
Square Miles				
Uganda	11,300	200	12,400	23,900
Kenya	1,500	—	17,000	18,500
Tanyanyika ..	13,400	400	32,600	46,400
Ruanda-Urundi ..	—	—	13,000	13,000
TOTAL ..	26,200	600	75,000	101,800

Percentage Distribution

	Lake	*Land*	*Total*
Uganda	43.0	16.5	23.5
Kenya	5.8	22.7	18.2
Tanyanyika ..	51.2	44.5	45.5
Ruanda-Urundi ..	—	17.3	12.8
TOTAL ..	100.0	100.0	100.0

(WMO/FAO Report on Lake Victoria Catchment, 1963 P. 45)