DOCUMENT 3.4.

HYDROLOGICAL DATA AS APPLIED TO THE RIVER NILE

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SUMMARY

The need of real time data for forecasting is increasing in the Nile Basin for more efficient operations of control works to avoid waste of water.
For Egypt and the Sudan, the need for forecasts of river supply from its different tributaries will continue to be pressing for the full operation of the High Aswan Dam and the several other dams on the Blue Nile, River Atbara and the White Nile.

The present system of hydrological data collection and transmission from the numerous hydrological studies spread along the Nile and its tributaries is based on human records and telephone communications, thus subject to reliability problems.
The Nile is a long river basin and many countries are interested in having up-to-data on flows and levels for forecasting and operation planning.
The use of satellite transmission of hydrological data presents an opportunity to establish, for all countries in the basin, a service that can avoid the present system implications.

RÉSUMÉ

La prévision rapide des informations devient un besoin pressant pour le Bassin du Nil en vue d'une plus grande efficacité des opérations de contrôle visant à réduire les pertes d'eau.
En ce qui concerne l'Égypte et le Soudan, le besoin de prévision des apports au fleuve en provenance de ses affluents, est de plus en plus pressant pour la gestion rationnelle des Hauts Barrages d'Assouan, ainsi que de celle des nombreux autres barrages du Nil Bleu, de Atbara, et du Nil Blanc.

Le système, actuellement en usage, de collecte et de transmission des informations fournies par les différents programmes d'études hydrologiques réparties tout le long du Nil et de ses affluents, est basé sur les transcriptions manuelles et les communications téléphoniques, d'où leur crédibilité relative.
Les nombreux pays, s'étendant sur le long bassin du Nil, sont tous intéressés à obtenir des informations récentes sur le cours et les niveaux du fleuve, tant pour la prévision que pour la planification.
L'emploi de satellites pour la transmission des informations hydrologiques offre l'opportunité d'établir, pour tous les pays du bassin, un service affranchi des implications du système actuel.

THE PRESENT SITUATION OF RIVER FORECASTS... AN EGYPTIAN PERSPECTIVE

Basis of Forecast

01. The forecast procedure in its simplest form is evaluating the sum of discharges arriving Aswan from the different tributaries and reaches of the River Nile. These evaluated values take a period of time to arrive to Aswan and are exposed to transition losses during their travel from their different sources to Aswan. Precise prediction depends to a great extent on the accuracy of estimating those two factors, namely the lag and the losses.

The Lag

02. The lag between two stations is estimated by the time of travel of the discharge or level oscillations from one station to a proceeding one on the river and its tributaries. The length of this period depends on the level and the discharge values. In rivers with natural losses, such as the Blue Nile, River Atdala and the Main Nile, the lag decreases with high levels and discharges and increases with low ones. On the contrary, the lag increases with higher levels and discharges, and decreases with lower ones in cases of channels with high losses such as the case of River Sobat at Nasser. The group of curves shown on Plate No. 3, indicates the lag or the periods of travel between different stations and Aswan in case of a normal year.

The Losses

03. The discharge losses between two stations on the river depend on several factors as evaporation, evapotranspiration, secpage and saturation, besides other different faciors. The method used for estimating the losses in the forecast procedures is by comparing a certain discharge measured on a front station with the corresponding discharge on the next station, taking the lag into consideration.

METHODS APPLIED TO EVALUATE RIVER FORECAST

04. The first method is simply by the summation of discharges from different resources in the corresponding dates (taking lag in account) and deducting the transition losses. Actual discharge measurements are taken in more than 140 stations distributed on the Nile and its main tributaries. The main discharge stations used in our forecast are :

(a) Malakal on the White Nile which represents the supply from the equatorial plateau in addition to the supply of torrents between Lake Albert exit and Mongalla on Bahr el Gebel, as well as the yield from River Sobat.

(b) El Deim on the Blue Nile which represents the yield of this river before being regulated by the Roseires Dam.

(c) Roseires downstream of the Roseires Dam.

(d) Downstream Sennar Reservoir and this represents the regulated discharge of Roseires by the Sennar Dam after deducting the withdrawal of the Gezira canals in Sudan.

(e) River Atbara : Discharges of this river are measured upstream Kashm el Girba Reservoir, 440 km from its junction with the main Nile and also at kilometer 3 from the junction.

(f) The Main Nile at :
Taminat representing all the yields from the White Nile and the Blue Nile.
Hasanab represents the yield before the junction of River Atbara.
Dongolia at 381 km south Aswan, which represents the total yield before entering the High Aswan Reservoir.

Data are collected from those stations and correlation curves are deduced as well as stage discharge curves.
Tables are then prepared to forecast the daily discharge expected to arrive Aswan from the summation of discharges from different sources.

05. Another method is also applied to evaluate forecast of discharges expected at Awsan, by deducting a correlation curve between the river stage at Atbara and the discharge expected to arrive Aswan. From such a curve forecast is estimated for dates between seven and fifteen days in advance.

06. After the construction of the Aswan High Dam, an important new factor is being taken into account, when forecasting the water arriving Aswan. This is the loss in the reservoir by evaporation, seepage and saturation.
The different discharge and gauging stations spread all over the Nile tributaries in Sudan are run by the Permanent Joint Technical Commission for Nile Waters. The recorded discharges and gauge levels are sent to Headquarters in Khartoum by cable and telephone messages. Data is recorded there and by daily telecommunication between Khartoum and Cairo, the same informations are received and recorded in the Cairo concerned offices, where River forecasting processes take place.

THE NEED FOR FORECASTS BEFORE AND AFTER CONSTRUCTING THE HIGH ASWAN DAM

07. Before the High Dam, the success of regulations on the annual storage reservoirs and barrages and the satisfactory completion of such regulations was completely dependant on the degree of accuracy of the river forecast and prediction of its discharges at the different reaches.

THE NILE BASIN

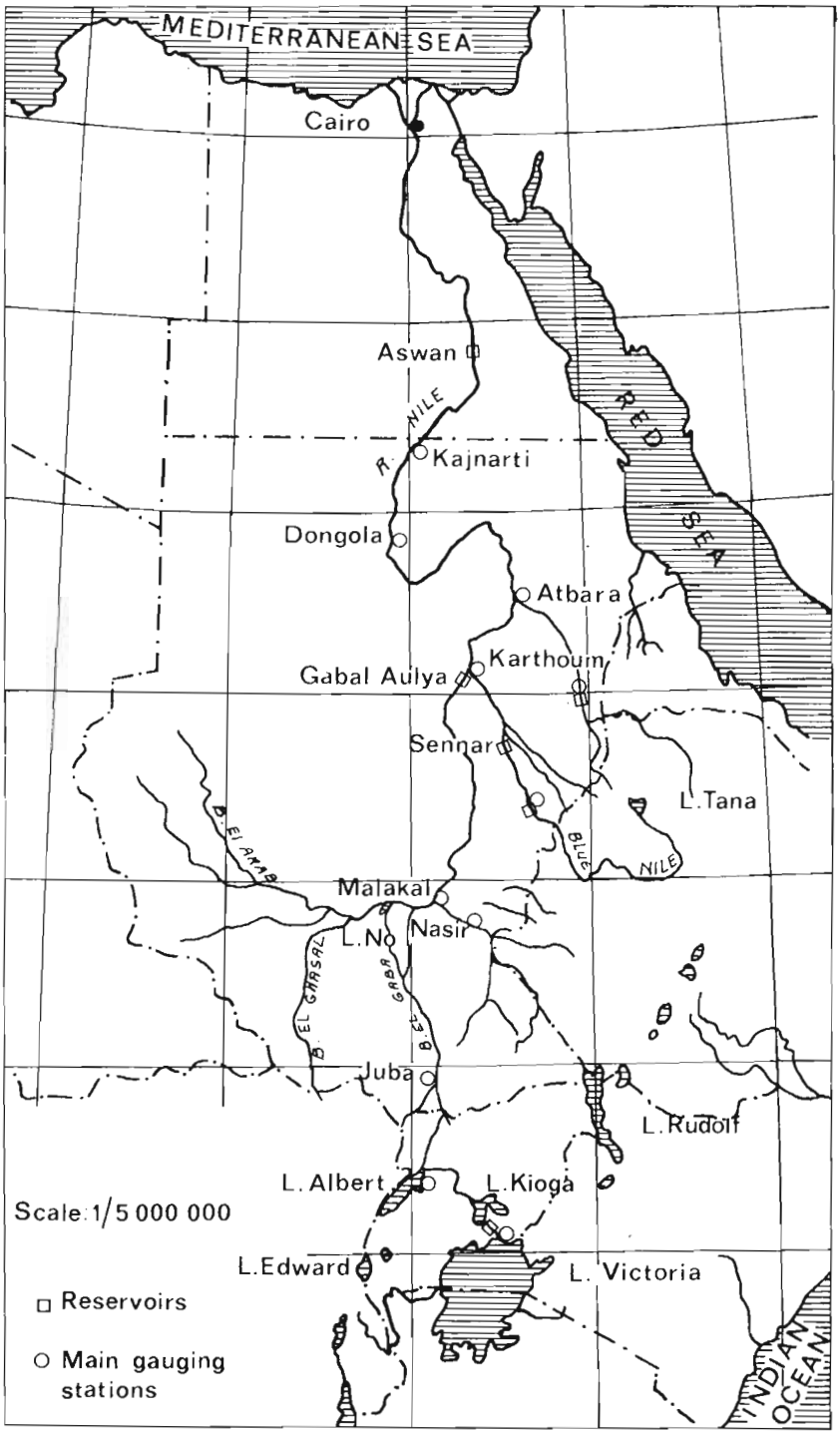

Plate 2.

The filling of Gebel Awlia Dam used to need simple forecast. The prediction of flood both in magnitude and duration as to estimate its expected hazards and to control its damages, used to need forecast. The filling and emptying of the old Aswan Reservoir needed forecasts re-adjusted more than once.

08. The following example shows how it was important to predict the river supply at Aswan during February 1st to July 31st which we used to call the critical period or the timely period :
The different sources of supply during this period are :

(a) A constant stored amount in the old Aswan reservoir having a magnitude of 5.1 10^9 m^3.

(b) A variable amount representing the natural river supply with a great range in variation as shown below :

Maximum Supply (10^9 m^3)	The Normal (10^9 m^3)	Minimum Supply (10^9 m^3)
36.13 (in 1879) 24.50 (in 1918)	15.0 15.0	6.9 (in 1914) 9.0 (in 1922)

This natural supply with such variation has to be forecasted as to achieve a controlled accurate distribution of water during the timely period.
There was no big change in the water requirements during February. March. April and May, after which the water budget should be reviewed to indicate the agricultural lands permitted to cultivate rice

09. After the completion of the High Aswan Dam, forecast is still of high importance. The regulation rules of this dam require to predict the flood supply to draw the reservoir by the end of July to a level which will permit accomodation of that supply.
We also have to forecast the river supply all the year round to estimate the shares between Egypt and Sudan and also to schedule the releases from the reservoir in high years in reasonable discharges that may not cause degradation to the river bed.

10. During the transition stage, before the reservoir having achieved its highest level, flood was forecasted every year to predict the highest expected level to inform the inhabitants living around the reservoir to move up their temporary houses to a level higher than the predicted level, before finally beingsettled at levels higher than full reservoir level (182.0).

THE USE OF SATELLITE TO TRANSMIT NILE WATER DATA

11. Proved technology and equipment are now available to convert water level data into digital information for radio transmission to satellites.
The satellite stores the data temporarily for re-transmittal to a ground receiving station.

12. The telex cost of retrieving the data from the ground receiving station depends upon the location of that station.
If a receiving station was located in Cairo or Khartoum the telex costs for Egypt and Sudan would be very much less than present telephone arrangements. Cost comparisons should be supplemented by comparisons of reliability and timeliness of data. The satellite system is extremely reliable and several readings can be obtained every day. The present system, based on human records and telephone communications, has reliability problems.

13. The Nile is a large river basin and many countries are interested in having up-to-data on flows and levels for forecasting and operation planning. The use of satellite transmission of water level data presents an opportunity to establish for all countries in the basin a service that can avoide all the implications involved in the now existing system.

LAG PERIODS FROM DIFFERENT
STATIONS TO ASWAN IN A NORMAL YEAR

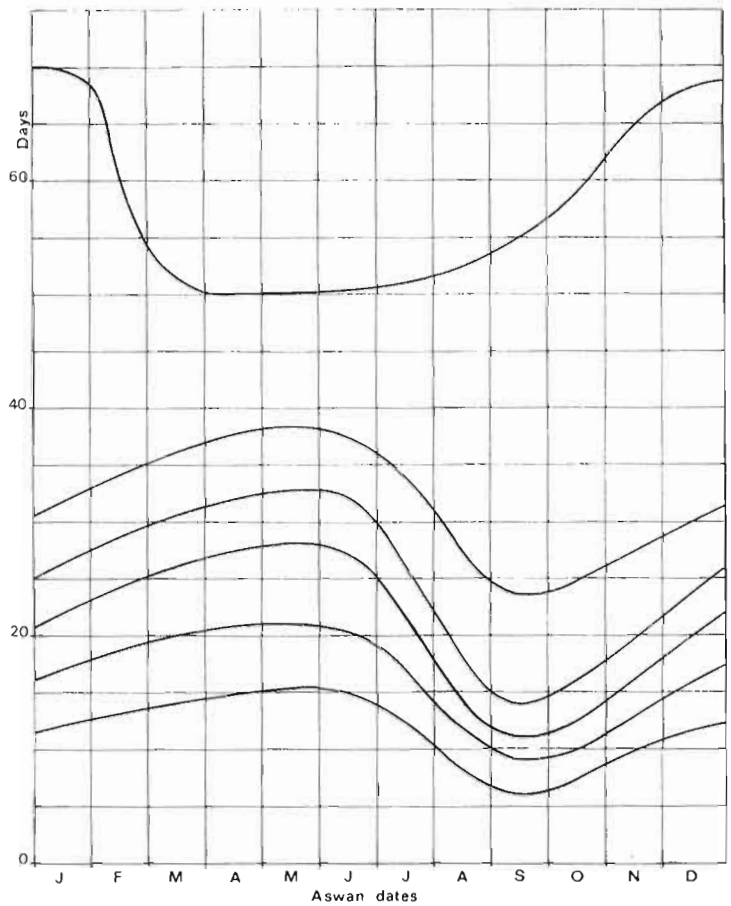

Plate 3.