CHAPTER IV

THE PROBLEM OF THE NILE WATERS

1. INTRODUCTION

Part 1 of the present study gave an overview of the problem of shared water resources, tracing the evolution of doctrine from the dominant navigational interests in Europe to the contemporary multipurpose application of water resources of common interest. It was shown that over the centuries, more so after World War II, the original narrow concept of "river" has expanded in scope in response to the requirements of the times, thus, placing fresh water among the most vital of natural resources.

Although it was submitted that the interaction between man, technology and environment had become the central theme, a point of departure in water resources management and that this growing consciousness of environmental problems and their transfrontier consequences tended to unify doctrine on the subject, it was also recognized that each watercourse retains its own peculiar characteristics. Moreover, a majority of shared watercourses are located within the less developed world community. This, in itself, presents a wide range of complex problems that demand special attention. In view of this, separate reference to the Nile Basin
is of special interest both on a theoretical plane as well as the magnitude of practical challenges it poses.

For a variety of reasons, strategic, political and economic, the Nile has throughout recorded history, attracted the attention of every major power; the Greeks, the Romans and the Turks; Generals and Statesmen alike all of whom have sought to control the Nile in one way or another. Apart from sovereign states, the United Nations and its specialised agencies are paying increasing attention to the Nile watercourse. The river is important on many counts. Geopolitically, it is the only river that connects sub-saharan Africa with the Mediterranean Sea. A whole country, Egypt, that occupies a strategic position on the Mediterranean - Red Sea junction linking the three continents of Africa, Asia and Europe, is entirely the creation of the Nile. In terms of natural resources, the Nile Basin possesses the widest abundant range but yet to be tapped, including the richest wildlife, flora and fauna whose significance cannot be overstated. As the geopolitics of food gains momentum, the Nile basin whose agricultural potential is estimated to surpass that of the North American grain belt is a matter of conjecture.

In the face of all that has been said it is of great concern to note that there is so far no dependable
machinery generally and widely acceptable to the basin states to regulate in an orderly manner the uses of the river. Whatever institutional framework that exists, it is inequitable and inadequate. Inequitable because it ignored the rights and interests of a majority of the basin states; inadequate because it either overlooked uses other than irrigation and did not take into serious considerations the impact of irrigation projects on the environment. And, in addition, the regime established, regulates the river partially. Thus, the regime as it exists is a potential source of dispute.

This regime, however, is a product of dynamics peculiar to the Nile Basin which led to the evolution of what may be termed here, the "Nile Doctrine". It reflected specific geopolitical and geo-economic interests in the region. Necessarily, these were different from the doctrinal basis upon which the law of international rivers in Europe grew, where the Rhine and the Danube regime became the the archetype models. Paramountcy of navigation dictated by mercantilism influenced the institutional development of the doctrine of the "right of access" to shared rivers. In the Nile basin, on the other hand, irrigation was dominant and led to the evolution of a different doctrine based on "natural and historic", or "priority of appropriation" and, "res-
pect of existing uses". Put differently, these concepts state indirectly the natural flow theory. In conjunction with the British colonial and mercantalist policies, generally a hegemonistic doctrine with respect to the Nile regime was developed. Though it reflected the impact of arid lands irrigation needs it was, nevertheless, a mutation of common law derivations.

Since World War II, however, new circumstances unforeseen then have unfolded introducing new variables to the *status quo ante*. The emergence of seven new underdeveloped states, making the total number of basin states nine, has led to proliferation of sovereign water rights and interests. Coupled with this is the rise of water systems as the backbone of socio-economic development and the impact of such uses on the planning and thinking of the basin states relative to water resources management. During the entire British occupation of the Nile Basin, the rights, needs, and interests of the other states were subordinated to the Egyptian requirements. Associated with water rights is the problem of the impact of water resources development on the environment or the impact of development on the quality and quantity of water resources. This is an aspect that was once taken for granted, but has now assumed a central theme of its own. All these problems outlined above have put into
serious questioning the assumptions underlining the existing Nile regime. To avoid conflicts and reap the benefits that the water resources of the river offers, it is imperative that it is time the basin states concerned worked out a viable institutional framework that is both corrective and capable of looking far into the distant future.

Against this background, Part II of the inquiry is an endeavour devoted to the Nile basin. The findings and conclusions in Part I will be applied, assessed and tested here.

To facilitate analysis, the scheme of the inquiry falls into three main sections, each forming a chapter. Chapter IV deals with the general aspects of the basin—climate, hydrology, resources and economic development. In Chapter V a survey and an evaluation of existing agreements is covered. The question squarely addressed here is: Are the agreements an expression of customary rules of international law, if not, do they reflect a regional custom? The Sixth Chapter concludes the Nile Section by focussing on attention on the issues and challenges that the Nile river poses. Having discussed the major issues, some proposals will be put forward on how best to utilize the Nile water resources for the maximum benefit of all the states concerned.
11. GEOGRAPHICAL SETTING

In order to appreciate the problem of the Nile River, it is necessary first to describe its geographical characteristics, the topography and hydrology of the river system.

A. Topography

Geographically, the remotest sources of the Nile watercourse are traceable to the Luvironzo stream near Lake Tanganyika, 6,825 kilometres (4,200 miles) from the Mediterranean Sea into which it finally discharges. This makes the Nile the longest river in the world. The drainage area of the Nile system is approximately 3.1 million km² (1.2 million square miles) which is about ten per cent of Africa's continental landmass, and extends for thirty-five degrees, from latitude 4° South to latitude 31° North. Politically, the Nile is shared by nine sovereign entities: Burundi, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda, and Zaire.

The Nile has two principal sources, the White and the Blue Niles. The main source of the White Nile is Lake Victoria, an inland body of fresh water of a surface area of 69,485 km² (27,000 square miles), second only to Lake Superior. About twenty-five percent of Lake Victoria's inflow comes from the 63,000 km² Kagera River drainage. The main sources of water in Lake Victoria basin comes from the rainfall that falls on it. Nearly the whole of Burundi and Rwanda lie within the Kagera basin while thirty-three and ten percent of the catchment area fall in Tanzanian and Ugandan territories respectively.

Out of Lake Victoria exists the Victoria Nile which courses through Lake Kyoga and then enters Lake Albert. From here the Victoria Nile is joined by Lake

2 Since the construction of the Owen Falls Dam in 1954 the level of Lake Victoria was raised by 4 feet. Lake Victoria then became the world's largest reservoir with a total capacity of 204,800 million cubic metres. see U.S.A., Department of Interior, Bureau of Reclamation, The World's Highest Dams, Largest Earth and Rock Dams, Great Man-Made Lakes, Largest Hydroelectric Plants, Major Dams (Washington D.C., 1975); K. V. Krishnamurthy and A. M. Ibrahim, "Hydrometeorological Studies of Lakes Victoria, Kyoga and Albert", in William C. Ackerman and others, eds; Man-Made Lakes: Their Problems and Environmental Effects - A Symposium of the American Geophysical Union, Geographical Monograph 17 (Richmond, 1973), p.273.

3 H. E. Hurst, A Short Account of the Nile Basin (Cairo, 1964), pp.44-45.
Edward - Semliki River system to form the Albert Nile which flows northwards as far as the town of Nimule on the Uganda-Sudan border. At Nimule the river plunges through the Fola Rapids on the Sudan side. Henceforth, until it reaches Khartoum, the Nile is generally known as the Bahr el Jebel (the river of the mountains).

Between Nimule and Rajaf the Nile enters the Great Sudanese swamp. The distinctive feature of the river from here onwards is the bordering marshland which gradually increases in width until, after the Aliab Valley where it is several miles across, it enters the Sudd region. 4

Here the main channel of the river supplemented by

4 Sudd is an Arabic word meaning 'blockage'. Ibid., H.E. Hurst and others, The Nile Basin: The Hydrology of the Lake Plateau and Bahr el Jebel (Cairo, 1938), pp. 119-120. The Sudd constitutes the largest swamp in the world with an area variously given as 83000 km². Beadle, for example, quoting Rzoska, gives a figure of 40,000 km² of permanent swamp in the Sudd basin, L. C. Beadle, n.9, The Inland Waters of Tropical Africa: An Introduction to Tropical Limnology (London, 1974), p. 250; J. Rzoska, "The Upper Nile Swamp: A Tropical Wetland Study", Fresh Water Biology, Vol. 4, (1974), p. 1 ff. Besides evaporation losses, the Sudd by forming an impregnable barrier across the Nile has hindered navigability of the river for many centuries. However, work is going on to cut a channel to by-pass the Sudd. This is the well-known Jonglei Diversion Scheme, undertaken by the Governments of Egypt and the Sudan.
numerous streams is narrow and winds its way in serpentine course through the thick vegetation of the swamps which extends for miles on either side. At one point water is diverted into Bahr el Zeraf which rejoins the channel below and is joined by the Bahr el Ghazal (River of Gazels) which derives its waters from the west in a different catchment. A few miles down, the Sobat tributary flowing from the east and deriving its waters from the Ethiopian Highlands joins the White Nile at Malakal. The Sobat is formed by two main streams: the Pibor and the Baro.

From the confluence of the Sobat and the Bahr el Jebel, the Nile leaves the Sudd region. It then flows slowly northwards until it is joined by the Blue Nile at the palmy beach of Khartoum to form the Main Nile.

The Blue Nile lies on the northern sector of the Ethiopian Plateau. Some seventy miles south of Lake Tana at Sakala at an altitude 2700 metres are the sacred springs named Ghishi Abbai. These springs are the sources of the Little Abbai, the legendary source of the Blue Nile. It flows into Lake Tana, a grey-green heart-shaped lake which lies on a basin about 1800 metres above sea level. Lake Tana is the source of the Blue Nile.

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Nile from a geographical rather than a hydrographical standpoint. "Bahr el el Asrak", as the Arabs call the Blue Nile, denotes not only blue, but a dark, or even a black river for it contains 0.02 per cent of solids at low water and 0.35 per cent at flood.  

Lake Tana, a creation of recent volcanic activity has an area of about 3000 km²; and excluding the Lake its area is approximately 13750 km² with a mean rainfall of 12900 mm and annual evaporation 1300 mm. Its average contribution to the Blue Nile is estimated at 4 million cubic metres which is about seven per cent of the total flow of the river.  

The river leaves the Lake through a series of six distinct cataracts in the Upper Reef. For the first ten kilometres of its course it consists of ponds and rapids, the ponds generally being fringed with reeds and papyrus. Its main upper tributaries are the Bashillo and Jamma and the lower tributaries include the Didessa, Dabus and Balos. These streams coming from the southwest are thought to be the most important feeders of the Blue Nile since they drain areas of the greatest rainfall.  


7 Hurst and Others, n.4, p.11.
With the exception of the grand Tis Esat Falls, twenty miles down Lake Tana, there are hardly any water falls. The river descends into a canyon which is in some places 4,000 feet below the general elevation of the plateau. It continues in an immense curve, at first in a southerly direction, then north until it pours out of the mountains into the Plains of the Sudan at Roseires, a distance of 900 kilometres from Lake Tana. All along its course the slope of the Blue Nile is approximately 1.5 metres per kilometre so that between the Lake and Khartoum the drop is about 1470 metres. On its way to join the White Nile, the Blue Nile receives the tributaries of Dinder and Rahad inside the Sudan. The tributaries themselves have their headwaters in Ethiopia.

Khartoum where the two Niles meet to form the Main Nile is named after the trunk-shaped peninsula formed by the confluence, for Khartoum means "elephant trunk". Below Khartoum is the Gazira triangle an important cotton growing region. From Khartoum northwards till the mouth at the Mediterranean the Nile flows through the Great Sahara Desert. The Main Nile from Khartoum to the Mediterranean receives only one tributary, the Atbara, a large muddy river in flood, but reduced to

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8 Hurst, n.4.
pools in the dry season. It is formed by a number of streams rising in the Ethiopian Highlands of which the main stream originates near Gondar just north of Lake Tana. Its main tributaries are the Bahr el Salaam and the Setit or Takazze. It supplies fifteen per cent of the flood water.

From Aswan to the sea the cultural landscape dominates the Nile. Several control works, barrages, dams and canals have been undertaken for purposes of irrigation. At the apex of the Delta is the city of Cairo built on both sides of the river. The Delta is a flat alluvium plain where agriculture has been practised from the theme of discussion in another section.

B. Climate and Hydrology of the Nile Basin

The Nile Basin is a very complex geographical and climatic region, making classification of its geography and its interaction with the other factors a difficult exercise. Since the river stretches for thirty-five degrees of latitude, it obviously displays extreme variabilities both of climate and hydrometeorological condi-

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tions which range from the equatorial regions of the Lake Plateau, through semi-arid plains of the Sudan to the arid regions farther to the north. Reasons for these diversities are traceable in geophysical terms to the earth upliftings associated with the phenomenon of the continental drift which created the present alignment and shape of the African continental landmass and its relationship to global atmospheric pressure systems and ocean currents, and in recent times to the activities of man.

Average precipitation over the Nile catchment area is highly varied, and seasonal. The Lake Victoria basin is one of the wettest sections of the Nile drainage system with a mean annual rainfall of 1200 mm. However, when compared with regions located within the same latitudes this amount of rainfall is not as high as it appears. Most of the neighbouring Congo basin, for instance, has more than 1500 mm. and about half the Amazon system has precipitation of more than 2000 mm., while some parts of West African Coast receive average rainfall exceeding 4000 mm. Even within the Plateau

10 Hurst, n.4, p.21,
marked variability is noticeable. Along the western edge rainfall is more than 2000 mm., but less than 700 mm. in the eastern shore. Rainfall may, however, fall on any part of the plateau at any time of the year. Over Lake Victoria, the greatest quantities fall in April, while over the Albert basin, September and October rain is heavier than at any other time of the year.

Similarly, rainfall is heavy on the Ethiopian Plateau averaging 1400 mm around Lake Tana with marked seasonal extremities which are, moreover, influenced by latitude, altitude and slope of exposure.12 Maximum precipitation occurs from June to September with a peak in July. It is this rainy season that causes the Nile floods.

Moving northwards to the middle and lower courses, the basin rainfall decreases progressively. At Khartoum for example, precipitation is 200 mm and further north of Cairo, it is only 30 mm.13 Most of the basin north of Khartoum through the Sahara Desert is rainless. In some areas rainfall does not fall for as long as three years.

Generally, therefore, precipitation on the Nile

12 Ibid., UNESCO, n.9, p.280.
13 Hurst, n.3, p.28.
catchment is sparse, a fact accounting for the comparatively small discharge of the Nile River in spite of its gigantic area. The Congo, for instance, has a basin area of 37,20,000 km² and a mean discharge of 35,000 cubic metres per second or twelve times that of the Nile whose basin is 30,30,700 km² but an average discharge of only 3000 cubic metres per second. 14 Having outlined the rainfall regime of the basin, its impact on the flow discharge of the river is shown below.

C. Flow Discharge of the Nile

Due to the crucial role of the Nile to Egypt, studies to measure the quantities of the water of the river and the time of its floods were initiated by the ancient Egyptians at an early date. Consequently, the oldest and the most intensive hydrological records in the world are found on the Nile River. River levels were recorded on nilometres, 15 some of which still

14 UNESCO, n.9, pp.298-99; Government of Sudan, n.11, p.4.

15 The Nile River has the longest hydrological record among the world's large river. As early as 2000 B.C., a gauge existed at Aswan, Asit K. Biswas, n.1, pp.14-17; UNESCO, n.9, p.272.
survive. For example, the nilometres on Roda Island, near Cairo, dated to as far back as 860 A.D. Records for 220 years exist, though with some gaps.

In spite of this long hydrometeorological history little was known about the origins of the Nile water supply. After World War I, however, studies were extended to the upper parts of the river, especially Uganda, so as to obtain complete empirical knowledge about the hydrological features of the Nile. 16

It has already been observed that relative to discharge of volume, the Nile is surpassed by many river systems. The Amazon discharges annually 2500 million cubic metres and the Congo has a yearly flow of 1250 million cubic metres compared with the Nile's mean discharge of 84 milliard cubic metres. In addition, the Nile is famous for its remarkable annual seasonal variations. More than eighty per cent of its discharge occurs between August and October, measured at Aswan, and only twenty per cent in the remaining nine months. 17 Although its seasonal variation is fairly predictable both in volume and time, it is of interest to note that the Nile has, nevertheless, displayed extreme characteristics in certain periods of its life history. In 1913-1914, the

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16 Hurst, n.11; UNESCO, n.9. p.272.
17 Ibid., Hurst, p.40.
Nile hit the lowest discharge of 41 milliard cubic metres as compared with its all time highest record of 151 milliard cubic metres in 1878-1879. Both cases were disastrous. While the former meant famine, the latter brought flood disaster. For this century, the average flow of the Nile is 84 milliard cubic metres.

The volume of water contributed by the main tributaries of the Nile have been a subject of dispute. Some authorities compute the percentage contributions as follows:

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<thead>
<tr>
<th>Tribe</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Blue Nile</td>
<td>59%</td>
</tr>
<tr>
<td>Sobat</td>
<td>14%</td>
</tr>
<tr>
<td>Atbara</td>
<td>13%</td>
</tr>
<tr>
<td>White Nile or Bahr el Jebel</td>
<td>14%</td>
</tr>
</tbody>
</table>

Eighty five per cent of the Nile flow comes from the Ethiopian highlands and only fifteen per cent from the East African Plateau. The same authorities give the flood volume as follows:

<table>
<thead>
<tr>
<th>Tribe</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Blue Nile</td>
<td>68%</td>
</tr>
</tbody>
</table>

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18 For a detailed account, see Hurst and others, The Future Conservation of the Nile (Cairo, 1946), Vol. VII, p.32ff.
19 Government of Sudan, n.11, pp.4-5.
20 Ibid.
Atbara 22%
Sobat 5%
Bahr el Jebel 5%

In other words during the flood time ninety-five per cent of the water comes from the Ethiopian highlands and only five per cent from the Lake Plateau, and further that during the low period sixty per cent of the water drains from Ethiopia and forty per cent from the Lake Plateau.

The other authority gives the quantities of the average discharged of the Nile measured at Aswan as follows: 21

White Nile 10%
Blue Nile 68%
Atbara 22%

Thus, the Ethiopian highlands contribute ninety per cent of the discharge during the peak in September. The minimum which occurs in May is broken down as follows: 22

Blue Nile 17%
White Nile 83%

21 Hurst, n.4, p.40.
22 Ibid.
Or at low season the White Nile contributes the largest share of flow.

Whatever the statistical and methodological differences may be, two facts can be established from the above figures. Firstly, the Blue Nile and its tributaries contribute the largest volume of water to the Main Nile during the flood period i.e. from August to October, and the White Nile contributes the largest amount during the low season. Secondly, the flow of the White Nile is more stable, predictable than the Blue Nile. The proportion of maximum and minimum annual discharge on the White Nile is 1:50. Due to the slightness of the slope, the White Nile is ponded by the Blue Nile during the flood period thereby creating a natural reservoir. The White Nile is also said to lose much of its waters through evaporation in the swamps.

Before concluding this section on the hydrology of the Nile Basin, the sediment problem of the river may be mentioned.23 The silt carried by the Nile annually is estimated at 110 million tons per annum measured in Egypt. Compared with other rivers such as the Mississippi (150 million tons), and the Yellow River (2000 tons), the silt content carried by the Nile is small.

23 Government of Sudan, n.11, p.5.
The main source of the Nile silt is from the Ethiopian Highlands brought down by the Blue Nile and the Atbara. The White Nile carries relatively less silt due to the fact that most of it is deposited at the lakes, swamps and marshes.

The estimated suspended matter of the Blue Nile per annum is 140 million tons constituted as: Sand forty-five per cent, Silt fifteen per cent and Clay forty per cent.24 The decisive role of the Nile silt in history is an acknowledged fact. The whole of Egypt and the origins of domestication of crops have been conditioned, though not exclusively, to no less a degree by this silt. But the appearance of modern technology, facilitating the construction of large control dams has created new problems in which silt today poses a threat instead of its earlier beneficial role.25

Having briefly given the main hydrometeorological features of the basin, the next section deals with the economic development of the basin, the level of water resources utilization including proposed projects.

III. ECONOMIC IMPORTANCE OF THE NILE BASIN

That the Arab Republic of Egypt is entirely the

24 Ibid.

25 Hurst and others, n.14, p.130ff.
creation of the Nile River dramatically demonstrates the economic significance of the river. This is even more so if it is recalled that man first began to domesticate plants 10,000 years in the Nile Valley. Since then irrigated agriculture has been a predominant factor of the basin, evolving from antiquity to modern sophisticated methods of water resources management.

From essentially agricultural uses the economic application of the Nile waters has expanded enormously to industry, power production, domestic supplies, fisheries and many other areas. In short there is growing recognition that the Nile water is one of the crucial inputs into the socio-economic progress of the basin. Before discussing economic development of the basin, it is felt appropriate at this stage to mention something about the resources and potentialities of the basin since the development of water resources is logically linked to the development of other resources.

There is so far no comprehensive inventory of the

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basin's natural resources. \textsuperscript{27} Whatever data is available, however, indicates that the Nile catchment possesses vast and varied resources. In terms of agriculture the basin is endowed with a potential certainly greater than the North American Prairies. A variety of crops ranging from wheat, millets, rice, maize to citrus fruits, cotton, coffee, tobacco and many others can be cultivated economically. The agricultural potential of the basin could be described as one of infinite possibilities. In addition to this the region also possesses wide scope for livestock and fisheries. The Nile basin is not only right in species, but also extremely productive of fish. \textsuperscript{28}

\textsuperscript{27} However, a detailed inventory of the Kagera Basin has been done. See, Government of Uganda, Ministry of Regional Cooperation, Brief for the Hon. Minister of Regional Cooperation on a Meeting of Multi-sectoral Development of Kagera River Basin Countries Held in Addis Ababa from 10-17 June 1980 (Kampala, 1980).

Valuable fisheries exist in the Delta Lakes, in the White Nile, Jebel Aulia Dam basin in the Southern Sudan (which exports as much as 2000 tons of dried fish to Zaire annually), in Lake Albert with an annual output up to 12000 tons, and Lake Victoria which can yield above 70,000 tons per annum. 29 Although fishing is important along most of the river and its tributaries, it is far from being fully exploited.

Similarly the Nile Basin possesses a wide range of mineral resources. Mining activities are known to have been undertaken in tin (Rwanda and South-western Uganda), wolfram (Rwanda and Uganda), rare earths, copper, limestones. Other minerals in the basin include nickel, uranium (Kagera basin and Southern Sudan), Iron ore in Uganda, phosphates in Uganda and gold.

In terms of energy resources the Nile has vast potentialities reserves. Apart from hydroelectric 30

29 Ibid., Hermerton, p.185.
30 The Sudan alone has planned to develop hydroelectric energy within its territory to the magnitude of 1605 MW. At present, it has an installed capacity of 118 MW: 90 MW at Roseires on the Blue whose total capacity is 210 MW. 15 MW at Sennor (installed) which has planned potential of 30 MW and 15 MW at Kashur El Girba on the Abhoras. Sudan Government, n.11, pp.20-21. In Egypt the High Dam alone generated 6 million Kwh in 1979 representing 46% of the country's total energy output. Apart from the Owen Falls (150 MW), Uganda has as yet to tap its hydroelectric potential. It plans to construct a dam at Murchison Falls or Mutir or both. Comprehensive plans have been drawn for the development of the Kagera basin hydroelectric energy.
power, recent surveys suggest presence of a fair amount of recoverable crude oil on Lake Albert basin and possibly in other areas, too. Already mining of crude oil has started in Southern Sudan. Other energy and industrial resources in the basin are methane gas, peat and wood found along the Rift Valley. It must also be mentioned that the basin, apart from the Sudan, is quite densely populated, at least in the African context. Thus, it possesses a fair amount of human resources, though the level of skilled manpower is generally low, but nevertheless higher than in most parts of Africa.

The Nile basin as a whole falls under the category of the less developed world. Thus, it is characterised by a dual economy in which the majority of the population eke a subsistence living in the rural areas while a small proportion of the population, often not more than ten percent, lives in urban centres. Like in most underdeveloped countries, the most developed sector of the economy are mining industries and plantation cash crops, notably cotton, coffee, tea, sugar and tobacco. However, in the post-colonial era there is growing drive towards diverse industrial activities which at the moment are confined to primary processes. All indications point to an intensification of industrialization and diversification of the agricultural sector by the turn of the century.
The success of these plans will depend to a very large measure on the Nile water resources whose level of development markedly differs from the upper and lower parts.

III. DEVELOPMENT OF THE NILE WATER RESOURCES

Utilization of the Nile River for irrigation, navigation and domestic needs has all along been well documented. Not only was irrigation on a vast scale practised from the remotest historical epochs, but the river was also the main channel of communication. Irrigation however, commanded the greatest attention. So crucial was the construction and maintenance of irrigation works in Egypt that it was considered from antiquity as one of the principal responsibilities of the rulers. Earliest among the major works undertaken were the construction of a channel between the Nile and the Red Sea, the periodic clearing of the Nile cataracts and, in about 200 B.C., the development of Fayoum water

31 This is particularly so on the Lakes. Even the Nile, in spite of waterfalls, contracts and swamps. The navigable portions of the river have continuously been used for communication purposes. The Jonglei Diversion - a channel of about 280 km. will greatly increase the navigability of the Nile along the Sudan-Egyptian portions, Hurst and others, n.4, Jonglei Investigation Team, The Equatorial Nile project, Vol.1-IV, (Cairo, 1954).
storage and irrigation system. 32

Irrigation has followed four main phases: eotechnic or pre-dynastic period, paleotechnic period, basin irrigation, neotechnic period or the era of perennial irrigation, and the modern age or biotechnic period characterised by multipurpose uses of water resources. During the first stage, irrigation depended entirely on the annual inundation by the Nile flood. Once the flood receded seeds were sown on the wet silty plains. By 3000 B.C., still in the pre-dynastic age, this system of water utilization began to undergo modifications. Natural over-fill channels were deepened and levels were breached with ditches. This period also witnessed the introduction of new techniques of water conveyance. Bucket-like hand devices, notably the dawl and the natall, were forged to raise water to land that were not naturally inundated. 33 Thus, the foundations for artificial irrigation were laid.

32 D. Hermmerton, n.26, p.171.

The next phase that dominates the whole history of irrigation in the Nile is the basin system. Land was divided into plots of 1,000 to 40,000 feeders. From 2700 B.C. techniques for drawing water into the canals underwent improvements. The Shaduff and the Sagia or lift irrigation became the main technology in use until the introduction of new methods such as the pump in the very recent times. 34

By the 19th century two developments that were to revolutionise the economic assumptions and technological basis upon which the centuries-long Egyptian irrigation rested occurred. The Egyptian population had exploded, 35 putting pressure on existing cultivable land. Concurrently, the American Civil War had made cotton growing an attractive idea to Mohammed Ali Pasha. 36 Already preliminary experiments confirmed that the Nile Delta possessed optimum conditions for long staple American cotton. Apart from the alluvium soils; there existed a large supply of cheap labour, an important factor in cotton cultivation. Above all else, this labour force

34 Ibid.
35 Ibid.
36 Ibid.
was a well organised peasant community. Thus, in 1830 cotton seeds were imported from Brazil and India, ushering the era of cash crop economy in the Nile valley. Obviously, these developments brought a conflict between cotton on one and food crops on the other. The two competed for a limited amount of land as well as water then available. Which should take priority over the other became a major policy question. It was plain that food production could not be relegated to a second rate priority. How to reconcile the two uses of water was the main problem.

To produce cotton on a large scale demanded a radical departure in the existing irrigation system since it had to be planted prior to the Nile flood and required regular and frequent watering. Consequently, it became imperative to dig deep canals to conduct low level water to fields under cotton and also to guard them against inundation.37

Food crops, on the other hand, continued to be grown under the basin irrigation method in which sowing was done in November after the inundation by the flood. After harvesting in April the canals were drained to allow flow of summer water to irrigate cotton and rice.

37 Ibid.
These then were the foundations of perennial irrigation. This may also be described as the period of canals and barrages.

In order to cope with the new situation major engineering works were started. First among these was the Delta Barrage (1843-1861) constructed to eliminate silting in the canals. Before the canals partially irrigated land in the Delta was in the region of 2 million feddans as compared to 3 million after the barrages. Other important works during this period included the Ismailia and Ibrahim Canals. Ismailia Canal served a dual purpose: to create a navigable waterway between the Nile and the Suez, and at the same time to provide a daily supply of water of 70,000 m² to the towns of Port Said and Ismailia. Ibrahim Canal, completed in 1873, was constructed to meet the irrigation requirements of Middle Egypt. Essentially it provided perennial irrigation to the sugarcane estate of the Khedive. By 1900 the Canal supplied perennial irrigation to 690,000 feddans while flood irrigation catered for another 4,20,000 feddans. Before proceeding further, it may be worth

38 Ibid.
39 Ibid.
40 Ibid.
a while to stop and make a few observations.

1. The introduction of cotton structurally altered the production processes in the Nile valley. It brought the Nile once and for all into the fold of international economics. What is important to note here is that external interests began to acquire rights in the Nile waters and consequently to direct and organize the development of the water resources of the river.

2. Unlike the Asiatic irrigation which was based on a canal system, irrigation in the Nile valley had rested on the basin system dictated by the natural behaviour of the river. This is certainly not to say that there existed no canals in the Nile but rather that it was not on such an extensive scale as in India or China. The construction of barrages and canals began to interfere with the natural conditions of the river laying foundation for future innumerable environmental problems.

3. Whereas basin irrigation exerted hardly any pressure on the water, perennial irrigation required a large amount of water during the low season. To ensure sufficient water supply the control of the Nile waters was deemed necessary. To this effect, the idea first of the unity of the Nile valley and subsequently of the whole
Nile system crystalized in the minds of the Egyptian policy makers. It was translated into legal rights in such instruments as the 1929 Nile Water Agreement.

4. Before the First World War, until the late nineteenth century the use of the Nile waters for irrigation had been an Egyptian monopoly. After the First World War, due to increased international demand for cotton, the British identified the Gezira triangle in the Sudan to grow irrigated cotton. By 1890 however, perennial irrigation in Egypt was 2,900,000 feddans estimated to consume the whole of the natural flow of the Nile during the low period, from January to July. In 1908 a formal proposal had been prepared to construct a dam at Sennar that would supply water 500,000 feddans at the Gezira Cotton Scheme. Due to the outbreak of the First World War these proposals were not complemented. By 1919, 16,416\(^41\) feddans at Gezira were being irrigated. Extension of irrigation to the Sudan on a large scale at the turn of the century introduced a new important factor to the Nile waters. Henceforth it was no longer a question exclusive to Egyptian interests, but those of other riparians too. Cotton growing in the Sudan obviously clashed with Egyptian interests on two levels.

\(^41\) Hamdan, n.24, p.136.
First on sharing of water, and secondly, competitiveness of the Sudanese cotton on the international markets. To accommodate these competing water interests of the two states new control works in the Nile were inevitable.

These new problems, the expanding Egyptian water interests and the development of perennial irrigation in the Sudan led to the next stage of Nile Control Works, the age of the dams. First among these was the Aswan Dam, completed in 1902, with an initial storage capacity of 1 milliard cubic metres. It was further heightened twice in 1912 and 1934 to provide a capacity of 2300 million cubic metres and 5300 million cubic metres respectively. To reconcile the conflicting irrigation requirements in Egypt and the Sudan, the Nile commission was constituted for this purpose.

It recommended the construction of the Sennar Dam on the Blue Nile. The dam with an initial capacity of 800 million cubic metres was completed in 1925. Sennar facilitated the irrigation of 1,000,000 feddans in the Sudan region. In 1903, the developed area of the Gezira had expanded to 1.4 million feddans consuming 4 million cubic metres of water. Meanwhile, Gebel Rulia Dam was completed in 1937 to augment the rapidly increasing

42 Sudan Government, n.11, p.18.
Egyptian water demands.

After the Second World War, irrigation efforts both in Egypt and the Sudan intensified, leading to a more keen competition between the two states for the Nile waters. By the mid-fifties Sudan planned to irrigate a total of 4.5 million faddans. In 1956 irrigated land in Egypt had touched 6 million faddans consuming 55.5 million cubic metres of water. Thus, after the completion of the Aswan High Dam with a capacity of 157 million cubic metres, in 1968, Sudan and Egypt had exhausted the Nile's annual discharge of 84 million cubic metres, measured at Aswan.

During this period other developments that would affect substantially the interests on the Nile waters unfolded. Beginning with the Sudan in 1956, winds of decolonization swept across the Nile so that at the time of completion of the Aswan High Dam, seven new sovereign states had emerged in the Nile Basin. All these underdeveloped states controlling the headwaters of the Nile would assert their rights and interests in the river. The appearance of these new sovereignties was of utmost importance since they would question the raison d'être guiding the utilization of the Nile waters.

43 Ibid.
For centuries Nile control works were of a single-use nature, specifically for storage of water for irrigation. But due to the needs of industrialisation, multipurpose projects are envisaged to include irrigation, hydroelectric power, domestic supplies, fisheries, and many more. Under such circumstances where the interests of the basin states are moreover not uniform, several problems are bound to creep up. Furthermore, multipurpose uses, as already stated elsewhere, create complex ecological problems.

Given this range of problems, proposals have been put forward with a view to maximisation of water to Egypt and the Sudan. The projects are based on the fundamental idea of the unity of the Nile.

The concept of the unity of the Nile is a geopolitical one. It arose most eloquently in Egypt in the nineteenth century when it assumed a fervent nationalist character. Due to Egyptian dependence on the river, it was believed that to guarantee water supply political control of the upper Nile was but a logical necessity. Upper Nile at that time meant the Sudan.

This policy was pursued till the Sudanese independence in 1956. To bolster the argument, geographical, cultural and historical factors were invoked. However, British and Egyptian imperialism clashed in the Sudan, thus, frustrating the former concept of the Nile valley unity. Sudan was put under a condominium between Egypt and Britain from 1899 till 1955. At the same time, Britain ruled the Lake Plateau comprising of Uganda, Kenya and Tanganyika.

In due course, nevertheless, the hydrographical concept of the Nile unity began to take root between Britain and Egypt. The ever expanding Egyptian economic interests in the Nile water and the emerging Sudanese irrigation needs strengthened the technical necessity of the Nile unity. As a result, a series of control works throughout the river were drawn up by the Egyptian Irrigation Department which by now was under the control of British engineers. The principal projects envisaged are summarised below:

1. A Main Nile reservoir in the region of Wadi Halfa to be used for flood protection and also for summer storage.

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2. A reservoir for over-year storage in Lake Albert with a regulator in Lake Victoria. This proposal was rejected by Uganda. Instead Ugandan authorities suggested Lake Victoria as the reservoir and Lake Albert as the regulator. In 1949, a series of agreements between Egypt and Britain were signed to convert Lake Victoria into a century storage. For this purpose the Owen Falls Hydroelectric Dam was constructed and the level of the lake raised by 4 feet.

3. A diversion Canal or the Jonglei Diverison in the Sudd region to carry about half the "timely water" from Lake Albert with small losses. At the same time the other half would flow down the Bahr el Jebel with minimum losses. The Sudanese authorities were apprehensive of its repercussions on the political economy of the people affected. A multi-disciplinary team of experts were commissioned by the Sudanese Government to study all the facets of the proposed diversion. In its four-volume report, the team recommended instead a series of small dams at Nimulo and Beddan rapids. It in effect eliminated Lake Albert and Lake Victoria in the Nile projects. Construction of the Jonglei canal is on its advanced stages at the time of writing. Various aspects of the scheme are examined elsewhere.
4. The fourth link in the Nile unity is the proposed reservoir in Lake Tana for Sudan's irrigation and maintaining hydroelectric levels in Egypt as well as for flood protection.

These proposals constitute the master control works of the Nile based on the concept of hydrographical unity of the river. Out of the original plan, only one, the Jonglei Diversion, has been executed. In the late 1940s, however, Egyptian policy makers deviated from the earlier master plan to construct the Aswan High Dam, which, in any case, depends on the Lake Plateau projects. To carry out these other projects requires an agreement with the basin states concerned, Uganda and Ethiopia in particular.

Apparent from the foregoing discussion is the fact that over the years interests in the Nile waters have gradually and progressively expanded. And so have its uses. Until the nineteenth century, the Nile could be considered an "Egyptian river" in the sense that only that country utilised its water on a large scale, primarily for irrigation purposes. While the British tended to maintain the status quo, they also undermined it by introducing perennial irrigation in the Sudan.

In due course, the generation of hydroelectric energy, industry, and other uses began to compete with
irrigation. At the same time, the hitherto backyard basin areas which, moreover, are strategically positioned, regained their independence and are asserting their rights in the Nile. As a result of these competing interests, legal control of the riparian rights became necessary leading to conclusion of various agreements. It is this conventional system that the next chapter surveys and examines in the light of this background.