CHAPTER VI

ISSUES AND CHALLENGES

In the course of this inquiry reference has been made to some of the issues pertaining to utilization of water resources in general and of the Nile River in particular. Among these challenges, the problem of inadequacy of the Nile water resources to meet the demands of all the riparian states and, the complex challenge of environmental protection deserve to be highlighted further. Thus this chapter is an outline of these two issues. It must be pointed from the outset that these areas present one major difficulty; data relating to actual and projected water use is not easily available, except for the Sudan and Egypt to a certain extent. As such these two cases are used as illustrations. A similar problem is encountered in the matter of environmental protection. This aspect started receiving empirical attention only in recent times. Therefore, data on it is still scattered. Keeping this in mind, this section is an attempt to identify principal environmental - developmental problems in the Nile water resources and to indicate broadly the existing responses to these problems within the Nile setting, but from a broader perspective of water resources management and ecological protection. The presentation will underscore an awareness of comparable
problems elsewhere. An attempt will be made to draw useful norms, principles and institutions from elsewhere and test their feasibility in the context of the Nile River system.

1. THE PROBLEM OF INADEQUACY OF WATER:

The 1959 Agreement between the Republic of the Sudan and the Arab Republic of Egypt apportioned between these two riparian states the whole flow of the Nile within their territorial jurisdiction. For this purpose, the mean annual flow of the Nile measured at Aswan was taken as 84 billion cubic metres. Of this the Sudan received 18.50 billion cubic metres. Since the Sudan did not yet possess the capacity to absorb the whole of its allotted share, the Agreement loaned to Egypt 1.50 billion cubic metres of the Sudanese share until the end of 1977. The balance of 10.00 billion cubic metres was written off to provide for evaporation and seepage from the High Dam reservoir then under construction. It was further projected that these quantities would be increased by 18.00 billion cubic metres through the Upper Nile Projects the main components which include: the Jonglei Diversion Canal (Sudan); the exit of Lake Victoria (Uganda) would be raised to give the Lake an additional storage depth of 3 metres equivalent to 200 billion cubic
metres; regulation of Lake Kioga (Uganda) between 11 and 14 metres depth equivalent to 14 billion cubic metres of additional storage; a dam at Nimule (Sudan) to control storage in Lake Albert (Uganda-Zaire) of 170 billion cubic metres; improvement of carrying capacities of Bahr el Jebel and Bahr el Zeraf (Sudan) to convey 75 million cubic metres daily.

However this optimistic supply could be risky when the following factors are considered. In 1976-77 the Egyptian Ministry of Irrigation calculated that country's annual water supply from the Nile as under: 1

**TABLE 1**

<table>
<thead>
<tr>
<th>Source</th>
<th>Quantity (billion m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Aswan</td>
<td>55.50</td>
</tr>
<tr>
<td>Return Flow into Nile between Aswan and Cairo</td>
<td>2.30</td>
</tr>
<tr>
<td>Reused Drainage Water in the Delta</td>
<td>2.50</td>
</tr>
<tr>
<td>Groundwater</td>
<td>0.35</td>
</tr>
<tr>
<td>Total</td>
<td>60.65</td>
</tr>
</tbody>
</table>

1 Abd al-Aziru Abu al-Atta (Minister of Irrigation), "Long-Range Planning in the Sphere of Irrigation and Drainage", being a paper presented at the Conference on Long-Range Planning and Regional Integration, Institute of National Planning, Center for Arab Economic Unity and UNDP (January 14-21-1976); see also U.S. Department of Agriculture and USAID, Egypt: Major Constraints to Increasing Agricultural Productivity (Washington, D. C., 1976), p.89.
From these figures it must be subtracted 1.50 billion cubic metres loaned by the Sudan in accordance with the 1959 Agreement. The loan is supposed to have expired in November 1977. Setting these figures against sectoral projections, it is to be observed first that Egypt's population is estimated to reach 55 million by 1990 and expected to have a domestic water consumption of 3.51 billion cubic metres. By this same year industrial demand is conservatively estimated at 3.00 billion cubic metres. Hence, non-agricultural sectors would consume a total of 6.50 billion cubic metres by 1990.2

Assuming that the 5.7 million faddans cultivated in 1975 will be increased to 6.7 million faddans by an addition of 700,000 reclaimed faddans and 300,000 added to areas brought under tile drains, and further that cropping efficiency will be increased to 2.2 crops per year per faddan, this would give a cropped area of 14.7 faddans by the mid-1980s. Thus demand from irrigation will be about 51.45 billion cubic metres by 1980.3 This figure is arrived on the estimate that each cropped faddan will need 3,500 cubic metres.

2 Ibid.
From the table below, however, it would seem as if Egypt could have a surplus of 15.8 billion cubic metres towards the latter part of the 1980s. But this assumes that the planned projects are completed as scheduled. In the likely event that these projects are not completed in time, authorities forecast that Egypt could be faced with a huge water deficit of 14.10 billion cubic metres. The proposed projects, it must be emphasized, are located outside Egyptian territory. Their execution will require an agreement with the states concerned. So far such an agreement is not in sight.

There are in existence ambitious expansion plans that would exert great demands on the present and future water resources of the Nile River. Egyptian authorities, however, suggest the presence of alternative sources of water supply to meet the projected desert reclamation plans. Among these alternatives, the most publicised is the New Valley aquifer. It comprises of a series of cases underlaid by an extensive Nubian sandstone strata which holds deposits of fossil water through which water trickles northwards from the Erdi and Ennedi mountain

4 Arab Republic of Egypt, Ministry of Irrigation, Long-range planning in the Sphere of Irrigation and Drainage (Cairo, 1976), p
5 see generally, Abu al-Atta, n.1
### TABLE 2

Projected Total of Egyptian Water Supply and Demand, 1986-90 (billions m³)

<table>
<thead>
<tr>
<th>Supply</th>
<th>Optimistic</th>
<th>Cautious</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Aswan</td>
<td>55.50</td>
<td>55.50</td>
<td>55.50</td>
</tr>
<tr>
<td>Upper Nile Projects</td>
<td>9.00</td>
<td>1.90</td>
<td>1.90</td>
</tr>
<tr>
<td>Reused Drainage Water</td>
<td>12.00</td>
<td>6.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Groundwater</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>77.50</td>
<td>64.40</td>
<td>62.00</td>
</tr>
</tbody>
</table>

**Demand**

<table>
<thead>
<tr>
<th></th>
<th>Optimistic</th>
<th>Cautious</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>51.40</td>
<td>54.40</td>
<td>55.80</td>
</tr>
<tr>
<td>Navigation and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January closing</td>
<td>2.50</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Conveyance Losses</td>
<td>7.70</td>
<td>9.80</td>
<td>11.20</td>
</tr>
<tr>
<td>Industrial Use</td>
<td>1.00</td>
<td>2.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Domestic Use</td>
<td></td>
<td>2.00</td>
<td>3.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>62.60</td>
<td>72.00</td>
<td>76.50</td>
</tr>
<tr>
<td><strong>Surplus/Deficit</strong></td>
<td>+14.90</td>
<td>-7.70</td>
<td>-14.10</td>
</tr>
</tbody>
</table>

ranges in the Chad basin. It is estimated that over 200 billion cubic metres of water may be locked in this aquifer some of which ooze out in the Siwa and Qattara depressions. Hydrologists, however, express the technical difficulty that only about one percent of these water resources is within a depth of the first 150 metres. Furthermore, due to the slow rate of recharge, it may be feasible to tap only 1 billion cubic metres annually without risking lowering the water table drastically. This argument is supported by the Libyan experience when it reclaimed 50,000 hectares at the Kufa oasis using the same aquifer. It is reported that in the first year of pumping, the water table dropped by 10 metres. Some authorities are of the opinion that in Egypt the upper layers of the aquifer are already being over-utilized and point out that at Kharga, wells 650 metres deep and more have had to be sunk. In view of this, either projects in the New Valley will have to remain on a modest scale, in which case 100,000 feddans could be cropped annually with one billion cubic metres of water, or alternatively larger areas could be cultivated by "mining" the water.

6 Ibid., USAID, n.1; C. Gischler, Present and Future Trends in Water Resources Development in the Arab States (Cairo, UNESCO, 1976), pp.53-66.
7 Ibid.
8 Ibid., see also Al Ahram (Cairo), 21 May 1977.
for a definite period ultimately leading to the abandon­
ment of the reclaimed land as there would be no more
water resources to support it. These and other projects
are a part of a long-range plan to achieve food suffi­
ciency by the year 2000. To meet this target, however,
experts estimate it would require a cultivated area of
22 million feddans.\(^9\) As it has been shown, the water
to realize this target would have to come from the Nile
River, a river shared with eight other states. The
water demands of these other states is increasing since
they also have similar food production and industrial
strategies. The case of the Sudan cogently illustrates
this point.

By the 1959 Agreement, as already noted, the Sudan
was apportioned a total of 18.50 billion cubic metres of
the Nile waters. In addition there would be 2.40 billion
cubic metres from phase 1 of the Jonglei and another 2.00
billion cubic metres from the Machar Swamp Scheme. Thus,
the Sudan's water supply in the 1980s would be between
22.90 billion cubic metres and 24.90 billion cubic metres.

At present 4.30 million feddans are under irriga­
tion in the Sudan (Table 4). Plans are afoot to develop
within this decade an additional 2.30 million feddans the

\(^9\) Al-Ahram, 27 February, 1977.
most important of which are: Rahad Phase 11 - 500,000 feddans; Seteit - 600,000 feddans; Rank - Gelhek - 400,000. By the end of the century a further 1.5 million feddans is expected to be added along the Blue Nile. In forecasting water demands the Sudanese official sources envisage a consumption of 4,000 cubic metres per feddan per year in the medium term and a long-term reduction to 3,335 cubic metres. This of course, assumes that land use will still be extensive rather than intensive and also that low water consuming crops will be introduced. But given the current trends in use and an emphasis on sugar cane and rice, it would appear that crop demand for water is likely to increase greatly. So far land use and water demand is as indicated in Table 3:

Thus, within this decade the crop demand for water in the Sudan is estimated to exceed the existing supply by at least 2.00 billion cubic metres and 4.00 billion cubic metres above likely supply. In the period


11 Ibid.

12 Ibid., p.5.

13 Waterbury, n.3, pp.233-234.
<table>
<thead>
<tr>
<th>Sector</th>
<th>Area (000 feddans)</th>
<th>Water Consumption (millions m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BLUE NILE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream Sennar</td>
<td>164</td>
<td>976</td>
</tr>
<tr>
<td>Gezira-Managil</td>
<td>2,052</td>
<td>7,598</td>
</tr>
<tr>
<td>Pump Schemes Upstream Sennar</td>
<td>452</td>
<td>1,595</td>
</tr>
<tr>
<td>Rahad, Phase 1</td>
<td>300</td>
<td>1,139</td>
</tr>
<tr>
<td>Evaporation, Sennar Reservoir</td>
<td>-</td>
<td>669</td>
</tr>
<tr>
<td><strong>WHITE NILE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Schemes Including Melut</td>
<td>620</td>
<td>2,840</td>
</tr>
<tr>
<td>Asalaya, Kenana</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MAIN NILE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Schemes, Downstream Khartoum</td>
<td>420</td>
<td>1,603</td>
</tr>
<tr>
<td><strong>ATBARA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khashm al-Girba</td>
<td>372</td>
<td>1,700</td>
</tr>
<tr>
<td>Evaporation Khashm al-Girba Reservoir</td>
<td>-</td>
<td>139</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>4,380</td>
<td>18,259</td>
</tr>
</tbody>
</table>

1975-76 total surface irrigated land in the Sudan was about 3.8 million feddans with a total water demand of 13.692 billion cubic metres. By 1986, irrigated land is estimated at 5.951 million feddans which will demand 27.151 billion cubic metres (Table 4). Rough estimates for non-agricultural and industry water consumption are put at 550 million cubic metres.\textsuperscript{14} Added to this is the fact that the Arab Fund\textsuperscript{15} envisages to bring 9 million feddans under irrigation by the year 2000. Going by the water duty of 4,000 cubic metres per feddan per year, the agricultural demand for water in the Sudan will then have touched a staggering 36 billion cubic metres.

Tentatively, therefore, it could be concluded that the Sudan, like the Arab Republic of Egypt, is faced with a water deficit of varying magnitudes. This conclusion is more plausible considering that the upstream Nile states are also contemplating agricultural and industrial projects that would draw heavily on the Nile water resources, resources which seem to be substantially committed in the two lower riparian states (Table 5). As stated from the outset, data on the East African states - Uganda, Kenya, Tanzania, Ruanda, Burundi - is not available to

\textsuperscript{14} Ibid., p.235.
\textsuperscript{15} Ibid., p.236.


TABLE 4
Sudan: Water Supply and Demand, 1975-76 and 1985-86 (billion m³)

<table>
<thead>
<tr>
<th>Supply</th>
<th>1975-76</th>
<th>1985-86</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QUANTITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As per 1959 Agreement</td>
<td>20.50</td>
<td>20.50</td>
</tr>
<tr>
<td>Jonglei, Phase 1</td>
<td></td>
<td>+2.40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>20.50</td>
<td>22.90</td>
</tr>
<tr>
<td><strong>DEMAND</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>13.692</td>
<td>27.151</td>
</tr>
<tr>
<td>Conveyance Loss 10%</td>
<td>1.369</td>
<td>2.715</td>
</tr>
<tr>
<td>Domestic and Industrial</td>
<td>0.275</td>
<td>0.550</td>
</tr>
<tr>
<td><strong>STORAGE LOSSES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jebel Auliya</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Sennar-Roseires</td>
<td>0.700</td>
<td>1.000</td>
</tr>
<tr>
<td>Khashm al-Girba</td>
<td>0.190</td>
<td>1.190</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>17.226</td>
<td>32.609</td>
</tr>
<tr>
<td><strong>SURPLUS/DEFICIT</strong></td>
<td>+3.274</td>
<td>-9.706</td>
</tr>
</tbody>
</table>

TABLE 5

Water Balances in the Egyptian-Sudanese Nile, 1985-90 (billion m$^3$)

<table>
<thead>
<tr>
<th>Country</th>
<th>Optimistic</th>
<th>Cautious</th>
<th>Pessimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>+15.8</td>
<td>-6.8</td>
<td>-14.1</td>
</tr>
<tr>
<td>The Sudan</td>
<td>-3.2</td>
<td>-8.2</td>
<td>-9.7</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>-1.0</td>
<td>-2.0</td>
<td>-4.0</td>
</tr>
<tr>
<td>System deficit/surplus</td>
<td>+11.6</td>
<td>-17.0</td>
<td>-27.8</td>
</tr>
</tbody>
</table>


the present writer. This constraint aside there are indications that in all these countries, some of which are among the most underdeveloped and are facing acute food shortages, there are plans to put the Nile system waters into large scale use by the year 2000. Beginning from 1957 and with the United States assistance, Ethiopia undertook a survey of the Blue Nile, including the Atbara, Akobo, and Baro Rivers. From these surveys projects have so far been identified on the Blue Nile that would impound water for the generation of 30 billion kWh of electricity per year and irrigate 4.60 feddans. Other projects, though comparatively small, have been located on the Baro and the Taccaze, a tributary of the Atbara. In the short-
run 225,000 feddans on the Blue Nile and an additional 71,000 feddans on the Baro are being executed. Over the medium term, Ethiopian experts project their irrigation needs from the Blue Nile and the Atbara to be of the order of 4.00 billion cubic metres per year.

Although the exact needs for the other riparian states is not yet known, the following general observations are pertinent in this respect. The largest portion of Uganda receives seasonal rainfall, unevenly distributed and which, moreover, has proved unreliable in the recent past. Some regions of Uganda are as arid as Egypt, notably Karamoja district in the north-east corner of the country. Periodically, several parts of Uganda experience severe drought creating famine conditions. A point in case is the 1979-80 drought that hit the whole of Uganda leaving several thousands of people and livestock dead. In addition to this, Uganda's population has considerably increased in the past two decades. At independence in 1962, Uganda's population was about 7 million. In 1980 it had reached 13 million, and by the year 2000 it is certain to have doubled. Consequently, Uganda will resort more and more to irrigated agriculture for an assured food supply to support its rapidly growing population. Obviously, the Nile system provides easily accessible water supply.
As early as the mid-sixties, Uganda put up a plan to divert part of the Nile waters for a multipurpose project in the semi-arid region of Karamoja. The execution of the plan was interrupted by adverse political events in the 1970s. There is no indication that the present Government in Uganda has abandoned the idea. On the contrary, there is all the more reason to suggest that the project is likely to be a high agenda item after the Recovery Programme, i.e., by 1985-86. This would appear so because the plan in question was floated by the Uganda Peoples Congress which is the ruling party. Secondly, the 1979-80 drought sounded a sense of urgency since Karamoja was the most affected.

Besides agricultural needs, power production and industrial water demands would draw considerably on the Nile waters. Uganda is considering a series of sites on the Nile for hydro-electric power generation. One such possibility is an underground hydroelectric power on the Murchison Falls on the Albert Nile. Various industries: textiles, cement, mineral extraction rely on the Nile waters though their demand is currently modest. Similar arguments are true for Tanzania, Ruanda, Burundi and Kenya and need not be repeated. However, the point to underline here is that the next one and half decades will witness both extensive and intensive pressures on
the Nile water resources. This emerging scenario could have far-reaching political implications in the Nile system. What, for example, could happen in the event it is found that the lower riparians have already exceeded their equitable share in the Nile waters? Would the nine riparians be ready for a global negotiation in which various interests are traded-off and adjusted? To these questions must be added the environmental-developmental dimension of water resources development.

11. ENVIRONMENTAL-DEVELOPMENT SCENARIO IN THE NILE RIVER SYSTEM: A PERSPECTIVE

Development of water resources and protection of the environment are two crucial aspects of a wide spectrum of issues that have posed great challenges to the international society. In general the crucial question is how to achieve the maximum benefit from utilization of shared water resources without detrimental effects to the environment. Clearly, these two fundamental objectives can and do compete and conflict with one another as approaches to balance them have often foundered at the bedrock of national sovereignty. While claims for development are fairly well-understood, claims for environmental quality are only of recent recognition and concern. Expressions “development”, “underdevelopment”, are catch
phrases that have brought into sharp focus the dilemma arising out of widespread and intensified industrialization, often highlighting a crisis in responsible decision-making seeking to balance considerations underpinning them.

Admittedly, industrialization, or the application of technology to production processes, is a key to social welfare in the modern world. And yet, it is also true that unbalanced industrialization and poverty are the greatest threat to the quality of the environment. In the Nile Valley region, as elsewhere in the Third World river basins, questions of poverty are more urgent than a threat of ecological catastrophe.

However, the problem of environmental degradation is a real one and is not confined to the industrialized countries. Hence, the developing states should not be complacent about it. Apart from radio-active pollutants, the negative effects of modern chemical revolution to water, air and land have come out clearly. Toxics and other pollutants emanating from the industrial-chemical

effluents discharging into lakes and rivers are now recognized as serious health hazard to a degree not fully appreciated or politically not accepted even in 1972 when the United Nations Conference on the Human Environment was held in Stockholm. Striking impact of these sources of pollution have been felt in water systems such as the Rhine River, Lake Constance, Baikal Lake, the Great Lakes systems and elsewhere.

After the Stockholm Conference on the Human Environment and the 1977 Mar del Plata Water Conference,


19 Ibid.


Awareness has been generated about searching questions of the dangers to environment and potential pitfalls of indiscriminate application of technology. Importantly, though ambivalently, there emerged a general acceptance, at least to a large degree, of the earth as a single biosphere, an integrated ecosystem where the interaction of water, air, land use, technology and man has effects beyond notional boundaries.

This highlights the need for perspectives on water resources development to encompass environmental quality component. Consequently, the interrelationship between development on one hand and environmental conservation on the other, are being blended into a modern broader concept of "development and environment" or "development without destruction". It is against this global perspective that the discussion below focusses environmental issues arising out of the utilization of the Nile water resources.

The use of the Nile River water resources in this century has entered its radical phase setting in a stage for wide ranging environmental problems. A series of

23 UNEP, "Draft Principles of Conduct in the Field of the Environment for the Guidance of States in the Conservation and Harmonious Utilization of Natural Resources shared by Two or More States" (UNEP/Cc.6/17, 1978).
storage dams have been constructed the most important of which are in a tabular form on page 452. To these must be added the Owen Falls Dam at the outlet of the Nile at Jinja in Uganda. The dam, opened in 1954, raised the level of Lake Victoria by 3 metres thus turning it into the largest reservoir in the world with a capacity of 200 billion m$^3$. On the Kagera River the Kishanda Valley hydroelectric power project deserves mentioning. The planned project involves diversion and impounding of water from the Kagera into the Kishanda creating an artificial lake one hundred and sixty kilometres long.

The exact extent of adverse local and transfrontier effects are only beginning to be felt and studied. However, it is generally known that the backing up of a river changes the physical, chemical as well as the social life within and beyond the local area. These include the species and numbers of indigenous flora and fauna; the fertility of soil; the pressure on the earth's crust and tendency to earthquakes and landslides. The Aswan High Dam is reported to have affected the sardine population in the Mediterranean by eliminating their vital...

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24 Useful bibliography may be found in Oscar Mann, *The Jonglei Canal Environmental and Social Aspects, Report for the Environment Liaison Centre* (Nairobi, 1977), pp.61-68.
<table>
<thead>
<tr>
<th>DAM</th>
<th>Year of Opening</th>
<th>Area of Reservoir at T.W.L. (Km²)</th>
<th>Altitude at T.W.L. (m)</th>
<th>Max. Depth (m)</th>
<th>Capacity (million m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aswan</td>
<td>1973</td>
<td>-</td>
<td>121</td>
<td>5.3</td>
<td>5.3</td>
</tr>
<tr>
<td>High Dam</td>
<td>1971</td>
<td>5000</td>
<td>185</td>
<td>90</td>
<td>164</td>
</tr>
<tr>
<td>Sennar</td>
<td>1925</td>
<td>160</td>
<td>422</td>
<td>17</td>
<td>0.9</td>
</tr>
<tr>
<td>Jebel Aulia</td>
<td>1937</td>
<td>600</td>
<td>377</td>
<td>15</td>
<td>3.5</td>
</tr>
<tr>
<td>Khashm el-Girba</td>
<td>1964</td>
<td>150</td>
<td>478</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>Rosaries</td>
<td>1966</td>
<td>290</td>
<td>480</td>
<td>50</td>
<td>3.0</td>
</tr>
</tbody>
</table>

food supply. Studies carried out by Egyptian experts reveal that the total fish catch along the Egyptian Mediterranean coast decreased from 37,832.2 tons in 1962 (before the High Dam) to 13,586.2 tons in 1968 (after the dam). The most affected fish species are those that feed on the dense phytoplankton bloom during the flood. Thus, the total sardine catch of 18,166 tons in 1962 dropped to 464 tons in 1968.

Water pollution is potentially the greatest threat to the Nile River. Although there is no accepted standard of pollution, for the purpose of this discussion water is deemed as polluted when there is an alteration of its characteristics and conditions such that it is rendered inadequate or unsuitable for any use at all; it cannot meet the purposes to which it is destined if it were in its natural state. This definition of water pollution refers to the alteration of its physical, chemical, and biological properties or to the introduction of any matter or substance which may be dangerous.


26 Ibid., p.314.
to public health and limits its application to various other uses such as domestic, industrial, agricultural, recreative etc. 27

The main sources of pollution of rivers and lakes are the uncontrolled discharge of effluents coming from sewers, industries and farms with the addition of rapid growth in the use of fertilizers, pesticides, herbicides, especially after the second World War. Among the most applied family of insecticides are the organochlorines - DDT, heptachlor, aldrin, dieldrin and BHC. These compounds were originally valued because they are lethal to a large range of pests and because, being resistant to chemical breakdown, they remain in the soil for years. Few organisms can metabolize them and the first few stages of breakdown often produce compounds that are also toxic.20 DDT for example is metabolized

27 This is more or less the same definition adopted by the International Law Commission in Draft Article 22, GAOR, Report of the International Law Commission on the work of its Thirty-fifth Session, supplement No.10 (A/38/10), (New York, 1983), p.175.

28 It has since been realized that these characteristics, along with the high solubility of organochlorines in fats cause damage to the animal populations. This concern has led to banning or restricted use of several organochlorines insecticides in the United States and other industrialized countries. Their use in the developing world continues unabated. See, for instance, T. Dunne and L. S. Leopold, Water in Environmental Planning (San Francisco, 1978), p.761.
to toxic DDE and DDD. The half life of these substances in soil is about fifteen years.

Invariably, these substances find their way into lakes and rivers. Due to their solubility properties in fatty substances, organochlorines are concentrated within phytoplankton in the water. As the phytoplankton are eaten by zooplankton or fishes, the pesticide is dissolved by fatty substances in the gut and is stored within the body. As these organisms are eaten by larger organisms, the concentration of pesticides in the body of the predator increases because the organochlorine dissolves in fats rather than being expelled to the water. Besides pesticides, fertilizers nutrients and herbicides used indiscriminately are also risky to man's health through their incorporation into water. Runoff nitrates entering water bodies produce nitrites that kill aquatic fauna. Concentrations of nitrites can exceed 100 mg. per litre and have been linked to methemoglobinemia or "blue-baby syndrome" among infants drinking the water.

Mercury, chromium, nitrates and nitrites, cadmium, chlorine and organic compounds, including

diphenyle, polinuclear aromatic hydrocarbons, detergents (alkylphenylbenzenesulphate), and chelates are some of the chemical bodies now recognized as agents of a morbidity that ranges from acute and chronic diseases such as Minamata disease (mercury), Itai-Itai (cadmium), dengue fever to certain teratogenic, mutagenic, carcinogenic effects. The gravity of these effects has justified the emergence of new disciplines like epidemiotoxicology and ecotoxicology.

30 This disease takes its name from Minamata City, Japan where pollution disaster due to mercury from Chieso Chemical Company occurred in the most horrifying form. For several years the Company had drained its waste into Minamata Bay, wastes containing substantial amounts of methyl mercury. About 1956 local cats began to exhibit signs of madness. Soon after the inhabitants succumbed to terrifying aberrations: loss of hearing and speech, convulsions and tremors, gnarled limbs, and chronic mental disturbances. Children born with the disease in 1958 were shown to be congenital. Mercury had reached man through the food chain of local marine life. For details see, Kelley, n.19, especially pp.192-194. For the most eloquent evocation of this pollution disaster, see, W. E. and A. E. Smith, Minamata: Words and Photographs, (New York, 1975).

31 So dubbed after the tormented cries of those unfortunate enough to contract it. The disease decalcifies the bones, thus promoting skeletal deformation and disintegration. Eventually all body movement becomes agonizing and the victim dies from inability to sleep or eat. This kind of pollution is at a high degree in Japan where cadmium has polluted the Jinzu River. Since farmers draw its water for growing rice, cadmium-bearing rice has become a national problem. see Ibid., Kelley, pp.90-91.
Turning to the Nile River system, it could be argued that these problems are irrelevant since pollution in the Nile River is of negligible degree. Such a view which perceives environment only as a provider of natural resources and a capacious dump of refuse, fails to see trends in water resources exploitation in the region. By the twentieth century the use of chemical fertilizers - nitrogeneous and phosphates - had assumed ever-increasing proportions as the method of agriculture changed from inundation to perennial irrigation in Egypt and the Sudan. In 1952-53 Egypt alone was already consuming 648,000 of nitrates. This rose to 1.2 million tons in 1964-65. During the same period phosphate fertilizer consumption rose from 92,000 to 320,000 tons. With the construction of the Aswan High Dam which eliminated the natural silt carried by the river and with the drive for "food security", the amount of chemical fertilizers has certainly increased many-fold. A similar trend is found in all the other riparian states. Besides, salinity problems already acute in the lower part of the river, pollution effects of nitrates are bound to increase in the foreseeable future.

32 Waterbury, n.3, p.130.
33 Ibid.
In addition to pollution sources due to agricultural practices, the entire Nile system is witnessing widespread industrialisation and urbanization. All the industrial and urban centres in this region are located on one part or the other of the Nile (see Map). The most recent proposals relate to multisectoral development of the Kagera Basin, the uppermost sub-system of the Nile River-Lake Victoria system of the waters. For this purpose a multinational agency, designated Kagera Basin Organization, was established by the 1977 Agreement. Kagera Basin Organization, in collaboration with Austrian-led consortium of donors plan, have identified a wide range of infra-structure, agricultural, industrial and mineral extractive activities. Industrial activities will most probably encompass processing of minerals - copper, nickel, uranium, iron ore, cement - and agro-based industries, such as sugar cane, fertilizers, paper. In other portions of the Nile basin, mention may be made of the imminent rise of oil and petrochemical industries on Lake Albert in Uganda where oil deposits are reported to exist in quantities not yet made public or known. Oil extraction is already going on in Southern Sudan.

These are all activities crucial to the economic and social well-being of the states concerned. Their
development must, however, be viewed in the context of resulting environmental effects. The impact of the Kagera Basin Organization on Lake Victoria fisheries and domestic water supply for the urban areas around it, cannot be overstated. Lake Victoria and the Nile system provides all the three landlocked states (Burundi, Ruanda and Uganda) with fishery foods. Large populations of parts of the other states - Kenya, Tanzania, Sudan, Zaire, Egypt and Ethiopia depend on the Nile fisheries for their livelihood. True, Lake Victoria is not yet threatened by pollution, but that it is getting more and more exposed is undeniable. Thus policymakers must draw lessons from experience elsewhere.

The case in point is the dramatic fate of Lakes Constance, Baikal, the Black Sea, the Great Lakes and including a number of important watercourses of which the Rhine, the Ruhr, the Volga and nearly all of Japan's rivers are but illustrative, of the gravity of the issues involved.

Environmental degradation arising out of the deve-

34 Except a six-kilometer distance downstream the Victoria Nile form the outlet. The source of this pollution is from the town of Jinja with a population of about 100,000 and a growing industrial centre. The level of pollution is not indicated. See, Oglesby, River Ecology and Man (New York, 1972), pp.188-189.
Development of the Nile basin resources is to be viewed not only from its hazardous effects to human health but bearing in mind the important fact that the Nile basin, especially its upper half, supports probably Africa's largest and most varied wild life. Reckless exploitation of the River's water resources may endanger and lead to extinction of some of the rare animal and plant species.

Creation of large artificial lakes, such as the High Dam and extensive draining of swamps, are known to affect the existing climatic equilibrium to a degree not yet fully understood by scientists. Jonglei Diversion Canal in the Sudan is a classic case which has generated a controversy locally and within the concerned international community. The debate has centred around environmental and social effects of the project. It is pointed out by the opponents of the Jonglei Diversion that tempering with the natural system could have very grave ecological repercussions that ultimately could spread to neighbouring countries, even to the extent of altering weather patterns over the nearby

35 The Jonglei Diversion is a project aimed at draining the Sudd - the largest swamp area in the world the area of which ranges from 6,000 Km². see, Oscar Man, n. 24, p.14. The purpose of the project is to "cave" an estimated 4.7 billion m³ of water lost through the swamps. Ibid., p.1.
Nile and Congo watersheds, and thus affecting the quantity of water carried by these rivers. One such fear is initiation of desertification process southwards to the northern parts of the East African plateau. Although these apprehensions are not backed by conclusive scientific data, investigations carried out within and outside the Sudd so far tend to support the environmentalist point of view. Due to the reduced area of the swamp, and hence the decreased amount of water vapour at critical times, the fear is that the movement of the Inter-Tropical Convergence Zone (ITCZ) may be weakened or shifted elsewhere. Consequently, this may cause progressively decreasing rainfall and could trigger the desertification of lands which are now only inundated seasonally. Keith Thompson speaking at the First International Conference on Ecology said: "There is still insufficient data available on the influence of swamps on climate and ground water resources to widespread reclamation (of the Sudd) at this stage".

36 Ibid., pp.18, 56.
37 Ibid., p.18.
Similarly the UNDP though in guarded terms expresses the opinion that: "It is not possible from analysis of meteorological observations accumulated over barely a century, to deduce specific conclusions concerning general climatic trends in Africa". The Jonglei Investigation Team\(^{39}\) had earlier acknowledged the fact that the swamps do have a localised effect. The Sudanese authorities, however, do refute these statements. Representative of the government point of view is the statement made by the Commissioner for the Jonglei Development Project that: "As to the climatic effects of the project on the neighbouring countries, this is far-fetched. Let me assure you that the diversion of 20 million m\(^3\) per day through the Jonglei Canal does not even have a local effect".\(^{40}\) Phase 1 of this important and controversial project is, however, nearing completion.

From this brief discussion it is quite clear that degradation of the environment as the cumulative impact of intensive agriculture and various industrial processes will make themselves felt in the foreseeable future.

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40 Quoted in Oscar Mann, n.24, p.25.
Coping with this degradation presents one of the greatest challenges to the Nile System Community. The balancing of competing state interests for a limited amount of water on the one hand, and environmental-developmental claims on the other, entail integrated planning on fairly sophisticated level and calls for the rarest political will-power among the nine sovereignties. Elsewhere it has been indicated that the existing legal and institutional regime of the Nile is deficient at all levels and too fragmented to resolve the current issues and face the diverse challenges of optimum water resources management within an equitable framework. Thus the urgent need for new perspectives.

III. A SUGGESTED APPROACH

The harmonious development of water resources of any given international river is a complex process which calls for the creation of bilateral or multilateral continuous negotiating instrumentalities. Several water treaties and agreements have long recognized the need, if not the essentiality, of joint expert agencies whose powers, functions and structure vary from basin to basin. There is neither uniformity of authority conferred upon these agencies nor their composition. Some commissions have authority to plan and to execute
plans; some with authority to plan and gather information but without authority to implement them; some are purely technical and consultative agencies; and others gather data, monitor or verify data so gathered.

As of writing there is no general agreement regulating the uses of the Nile waters. On the institutional level two separate institutions are at present in operation: The Kagera Basin Organisation on the uppermost section of the Nile River System; and the Permanent Joint Technical Commission which is authorised "to draw up the working arrangements for works... implemented in territories outside the Sudan by agreement with their concerned authorities". Agreement with the authorities outside the Sudan and Arab Republic of Egypt does not seem to have been concluded. The relevant authority in this respect would have been either the Kagera Basin Organisation or the Ethiopian government. However, there is no evidence of such an agreement having been reached. Under these circumstances whatever contacts there may be between the Kagera Basin Organisation and the Permanent Joint Technical Commission are only diplomatic but not institutionalised. Arrangements of this nature are inherently inadequate to tackle satisfactorily the various issues and challenges in the cooperative utilization of the Nile water
resources and the related environmental problems they entail.

It is suggested here that the Nile system states could adopt the following principles:-

1. A regional agreement be concluded in accordance with Draft Convention of the International Law Commission.

2. This in essence means the establishment of an instrumentality which the system states trust can help gather data and evaluate alternative schemes and uses for the optimum development of a shared water resource.

3. Underlying the above is the principle of common fact-finding and common fact-sharing and joint evaluation. This is so because this principle is indispensable to any fair and objective decision-making by the riparian states concerned. At best this procedure would leave controversial and complex decision-making to the joint agencies concerned. At its worst, such an institution can at the very least provide information gathered in common and therefore to be relied upon as
neutrally - determined, fact-oriented framework within which decisions can then be negotiated and agreed upon, on the merits, by the riparians.

4. The Nile Authority in its fact-finding process to be successful, must base its work on field and laboratory investigations that are truly shared, with national studies always incorporated into, and subordinated to the Nile Authority. There is no alternative to international fact-sharing, and the riparians cannot expect to plan successfully together, if they are not willing to share facts and fact-evaluation through an institution that can be trusted to undertake studies and evaluate them with the highest technical competence and the maximum of professional impartiality. Unless the Nile states are willing to go this far it is very difficult to envisage joint planning that is meaningful or that will be trusted by co-riparians to be affected by any structures or operations envisaged, or insisted upon by one or more riparians.

5. The merit of impartial fact-finding in an
institutionalized format is that it depoliti-
cizes issues by concentrating first on the
engineering, scientific, economic and envi­
nmental data involved. Once there is agree­
ment at the technical and scientific levels by
joint study teams, the movement from the tech­
nical to the policy-political, to decision-
making becomes more feasible. Given the rea­
lities of nation-states relations, plans for
joint river basin activities and the optimum
use of the basin must rest upon a body of
engineering and scientific facts as well as
similarly perceived pattern of benefits to
all the state riparians and plan-makers.

6. The Nile Authority should be capable of bring­
ing to the notice of any riparian government
any factors or developments which may threaten
its national interest. Such power to alert
becomes a necessary, indeed indispensable,
device to prevent emerging disputes even prior
to the notice of and consultation process it­
self. Furthermore, it is important that a
future Nile Authority, or by whatever name it
may be called, whether conferred general
powers to plan or not, should at least be granted dispute settlement procedures either of an investigative, recommendatory or arbitral type, but most preferably all the three. In this respect it is advisable to incorporate such concept as "any other matters" that may arise since it does provide a ready forum to deal with matters in a global manner even if they do not directly involve the use of the Nile water resources.

7. In order to tackle environmental problems effectively, the riparian states should incorporate a provision in a future Nile Convention requiring parallel national legislation on environmental quality standards. The United Nations Environmental Programme could be of great help in this regard.

8. It is also suggested that when granting concessions to external agencies and when receiving external aid, such concessions and aid should contain environmental protection components.

The principles suggested above are in conformity with the doctrine of equitable apportionment and would
go a long way to facilitate optimum utilization of the Nile water resources.