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WATER STRESS AND SCARCITY IN AFRICA TRIGGERS CONFLICTS OF PROPELS DEVELOPMENT?

BY

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EXECUTIVE SUMMARY

Since the beginning of life on our planet Earth, human life has never been threatened as much as it is at present. The very existence of mankind depends on the availability of adequate water resources. For this reason alone, the water crisis needs to be addressed urgently if man is to continue life on earth. Apart from its life-giving properties, water is the major element for socio-economic development.

Although 70% of the earths surface is covered with water only 3% of it is in the form of fresh water. Out of this 79% is as ice-caps covering the two poles of the earth. 20% is inaccessible groundwater and only 1% is fresh water as in rivers, lakes and wells.

When one calculates the amount of fresh water available for human use, what counts is not the total sum of global fresh water resources but the rate at which fresh water resources are renewed or replenished by the global hydrologic cycle.

Despite the fact that water is the most abundant resource in Africa, only a minimal amount can currently be used as a viable fresh water source. It is predicted that by the year 2025 many African countries will experience water scarcity. (Fig.1)

Several of the African rivers and lakes have been undergoing marked reductions in flow rates and surface areas. Other sources of water such as groundwater wells are constantly threatened by desertification and their consequent depletion accelerates the migration of pastoralists into marginal lands. The encroachment of poor people into forest surroundings and the cutting and clearing of these forests causes deforestation and subsequent soil erosion, resulting in the deterioration of water quality and shortening the life spans of reservoirs.

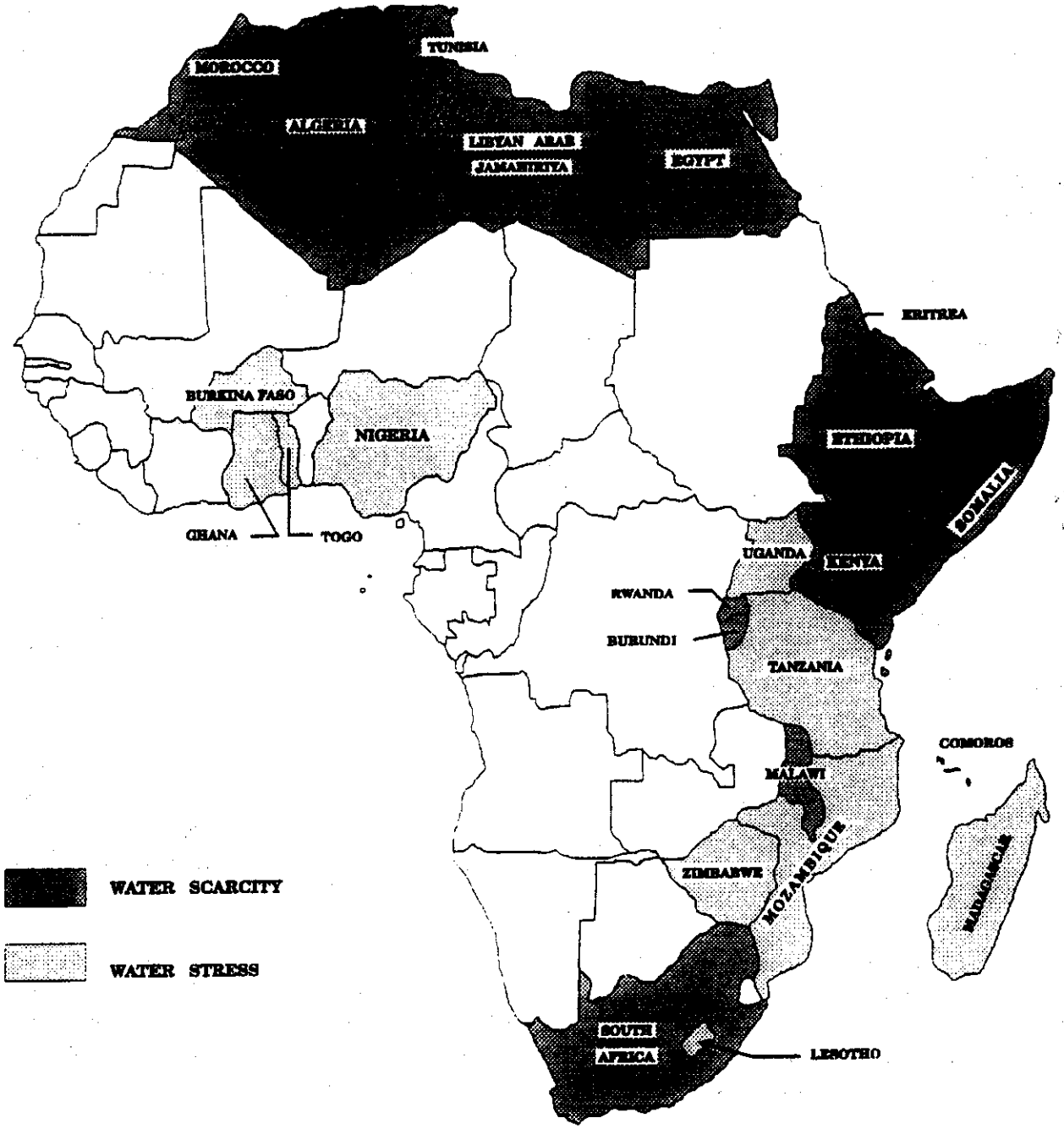
The establishment of water supply and sanitation services in Africa trails far behind the rate of population increase. Majority of the African people reside in rural areas where potable water supply is virtually non-existent. At present, large numbers of African people do not have access to adequate and safe drinking water and sanitation facilities.

Due to the frequency of severe and prolonged droughts, water resources of the African continent have greatly diminished in the last 20 years. Added to this is the fact that the water quality is degraded due to the poor planning of development projects. Pollutants from industry, urban run-off, sewage and agro-chemicals are ever increasing and their uncontrolled entry into the available water resources further deteriorates water quality and quantity.

Seasonal water shortages in most african countries induce a negative impact on the continent's economy. Floods, desertification and man-made conflicts have been major catastrophes for numerous African countries. Such disasters are to blame for the tragedy of hundreds of thousands of displaced refugee populations. This has interrupted and indeed set back the entire development process and added to the devastation of the economy.

Fig. 2

COUNTRIES PROJECTED TO EXPERIENCE WATER STRESS OR WATER SCARCITY BY 2025



Source : Population Action International ,1993.

The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

Challenges facing Africa are far too many. Population growth and poverty are may be the major ones. Population growth has to be curbed in order to reduce human demands on the finite water resources available.

The current water crisis has serious implications for economic development and food security in several sub-regions of Africa. As the demand for water for industrial needs grows, the amount of water available for agricultural purposes decreases.

Lack of clear policies and legal instruments to support actions in guaranteeing effective management of inland water resources is to blame for the drastic reduction in food production. This in turn causes regression in the rural economy of Africa.

The quality of available water is very important as poor quality threatens human life and negatively affects the manpower available for development. For this reason, quality control measures for water resources management need to be established and strengthened throughout the African continent.

In sub-saharan Africa, there are more than seventeen international rivers and lakes with a total catchment area exceeding 100,000 sq.km. Several of these rivers and lakes are currently undergoing marked reductions in flow rates and surface areas. These factors coupled with the gradual destruction and aggravated pollution of the fresh water resources, create vulnerable situations in a water crisis which can result in armed conflicts. The main components of such conflicts due to a water crisis can be the quality and quantity of water resources as well as the land fertility degradation factor.

There are several concepts of water induced conflicts; the economic context where water has an economic value, the environmental context where water quality deterioration is equivalent to the reduction in the quantity of available water. The political context of conflicts is when transboundary rivers can be potential sources of co-operation or conflicts. The legal context is of course a comprehensive package covering all issues related to co-operation and development.

Most countries consider their own preconceived political and economic self interests when dealing with water problems. Presently, legal codes are not enough to resolve all such problems There is an overall need to establish suitable modes in order to solve inter-party disputes. This can be achieved by the creation of an atmosphere of co-operation and by confidence building. The establishment of institutional frameworks can further aid in the diffusion of conflicts at an early stage.

African leaders and politicians need to think regionally and act locally so as to serve their own interests as well as the interests of other riparian countries. Countries sharing the water resources from international water bodies should have the willpower to manage such river/lake basins in an integrated manner with equitable water shares. Dialogue and co-operation are vital for integrated development of the riparian countries. Africans should aim for regional co-

operation and development. The UN and the OAU should play major roles in establishing suitable mechanisms for regional co-operation and conflict resolution. The UN and the OAU should also mitigate in water-induced conflicts.

There is a great need for the formation of a forum for African countries to discuss the water crisis and its implications in maintaining peace and encouraging development of the continent. Such a forum can establish the guidelines for the implementation of the continent's development plans for the benefit of the African people as a whole.

I. INTRODUCTION

1. It is a well known fact that water sustains life on planet earth. The cycle of life depends on water, air and food. Furthermore food production is directly linked to water, making water an invaluable and indispensable ingredient of life. In fact earth is the only planet in the universe where water is found in liquid form.

2. Water has always played a major part in the history, and civilization of mankind and with time this role will be increased manifold. Availability of this precious commodity can either enhance our living standards or on the other hand erase life altogether.

3. In principle, the fact that water can be circulated constantly on space ships could be applied to the limited water resources on earth but in reality this is impossible due to the fundamental problem of water scarcity especially in Africa and the high costs of such a process.

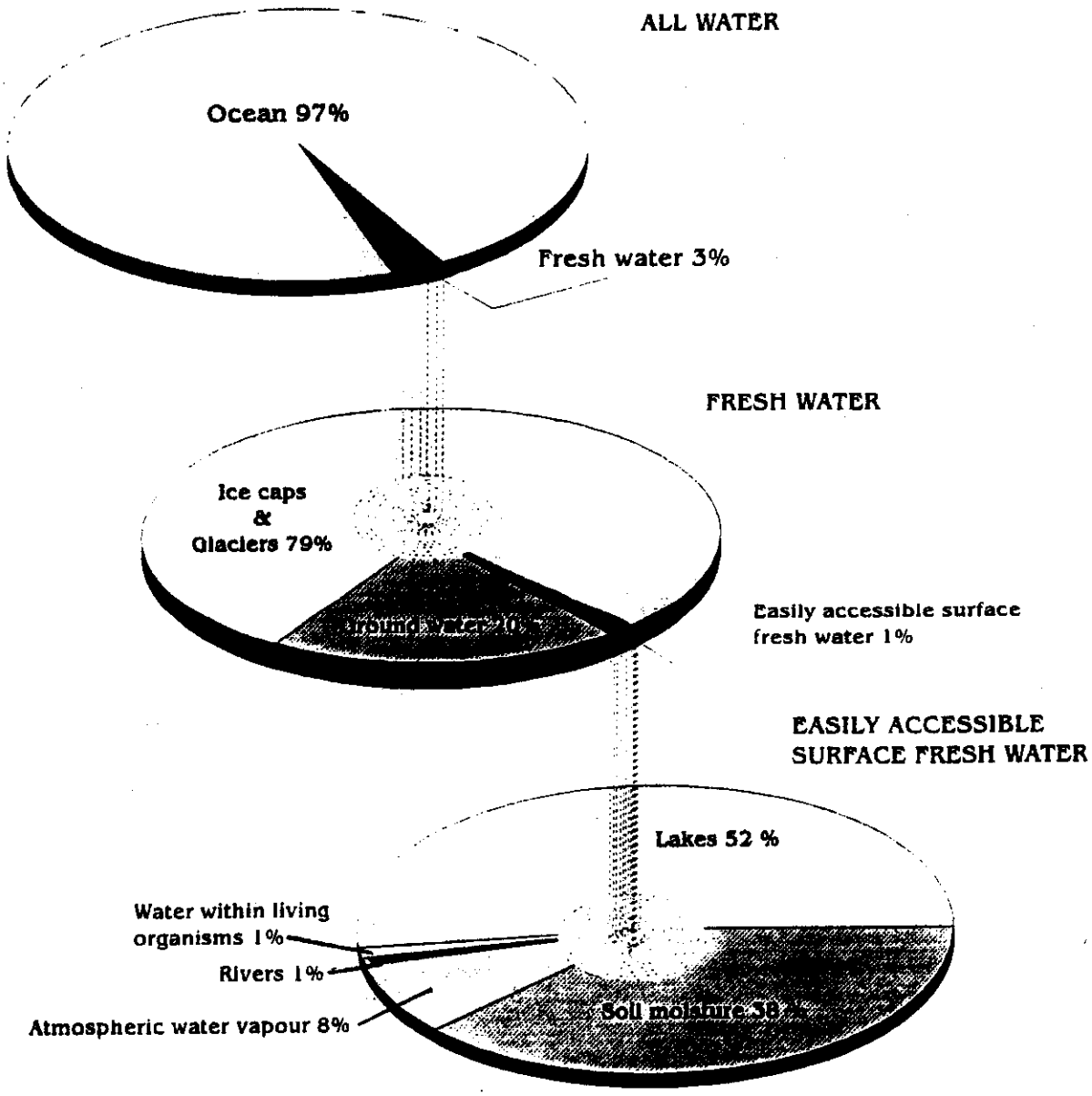
4. Let's ask the question: How much water can be mobilised towards supporting socio-economic development? In theory there is more than enough water to meet all our needs but is unevenly distributed on earth. More than two-thirds of the earth's surface is covered with water. While the oceans of the world may seen abundant, the amount of fresh water actually available to people is finite. Although 70% of the globe's surface is covered with water, less than 3% is actually fresh water. Of this 79% is as ice caps covering the two poles of the earth, 20% is inaccessible groundwater and only 1% is fresh water as in lakes, rivers and wells. (Fig.2)

5. Water pollution renders water supplies unfit for human use. Contaminated water is the main cause of death of at least 2,500 people daily, mainly in Africa. Industrial wastes, sewage and agricultural run-offs poison rivers, lakes and water sheds with chemicals and pollutants. Often one country's wastes run into another's drinking water and its public water projects cut off another's supplies. Cutting down forests up-stream cause floods and shortages downstream. From over 200 river basin systems shared by two or more countries, many have caused international conflicts. About 40% of the world's population depend on water from a neighbouring country. The Zambezi river for example flows through eight countries and over 20 million people share its water. Only about a third of this have access to safe drinking water and sanitation and many areas are subject to drought and desertification. All countries concerned would benefit greatly if they share experiences to further mutual interests.

6. Safe drinking water is taken for granted in the developed world but for about half the people of the developing countries, especially in the rural areas, it is a luxury.

7. Development of water resources is essential for the economic and social growth of any nation. Water is one of the most highly valued natural resources of the world. It exerts an enormous influence on a nation's economy and almost every aspect of development is closely linked to the proper control and adequate supply of water. The importance of water for human life is summarised in the expression "water is a measure of man's social, economic and health development."

DISTRIBUTION OF WORLD'S WATER



8. It is difficult to imagine how sustainable development will proceed if renewable fresh water is in short supply. About 5% of the world's consumption of water is domestic, 75% is used for irrigation (in Africa it is 88%) and the remaining 20% in industry. The average person in an industrialised nation uses up to 70 times more water than an average person in a developing country.

9. Fresh water resources in Africa are under severe natural and social pressures which directly effect the continent's economy. Natural conditions and human activities have over the years affected the quality and quantity of available water. Many of these activities consume water supplies without any consideration for future generations.

10. Africa's socio-economic problems stem from the lack of sufficient fresh water needed for sustaining life, food security and maintaining health for economic development. Lessons learnt from past decades ought to provide solutions to enable accelerated development and enhance water management.

11. Fresh water in Africa is unevenly distributed with chronic seasonal shortages further aggravating the situation. Faced with the rising demand for water for social and economic development of a growing population, African countries are becoming aware of the careful management of African water resources. All African countries are committed to new measures focusing on their needs and converting them into suitable action programmes for implementation, taking into consideration a wealth of indigenous talents and resources. Based on this fact, the W.M.O. and the ECA organized a joint conference on "water resources policy and assessment" in March 1995 to assist the African countries in meeting their challenges by the formulation of a strategy and action plan by African experts.

12. African leaders should find solutions for their socio-economic problems and improve the quality of life and enhance food security, despite the environmental constraints of hydroclimatically induced water scarcity and the continuous fluctuation of natural fresh water supplies. If action is delayed, African countries will be faced with major problems even before they reach the limits of the resource. They should think regionally and act locally to avoid and diffuse any conflicts over water rights which could easily escalate into a global crisis. This can only be achieved by dialogue and collective action amongst all the countries with the final goal of sustainable and equitable use of the limited water resources.

II. BACKGROUND

13. Water is the key element in both environmental and developmental problems and as such should be addressed for action based on an integrated approach to land use, water supply and waste management. With due attention to all the parallel uses of water in nature and society as well as the evident linkages between the upstream land and water use and the downstream opportunities, the most evident unit of such integration should be the catchment or river basin.

14. Given the uneven distribution of water resources globally, it is evident that water scarcity is not a global problem but a regional one. Africa is the driest continent, having over 45% of

the world's desert area. (Fig.3) Over 50% of its land area is either covered by the hottest desert land or is prone to drought. The problem is further aggravated by intensive cultivation of marginal lands as well as reduced amounts of rainfall. Under such conditions continuation of rain-fed agricultural schemes and livestock activities are virtually impossible. These problems along with the shortage of potable water and poor sanitation facilities have increased cases of water-borne diseases and deteriorated health standards of the African people.

15. Although water is abundant in some parts of Africa, only a small amount can currently be used as a viable source. Due to rapid population growth, it is likely that industrial and domestic water use in Africa will sharply increase by the next century, putting pressure on available water supplies. Challenges in this regard are very serious. Realistic and serious actions are therefore required to be taken by decision-makers, to curb the crisis and therefore avoid economic collapse and social distress.

16. Water resources are generally recognised as a major determining factor for the socio-economic development of any country. In view of the various accompanying functions which water plays in a number of economic sectors (agriculture, forestry, energy, industry, environment, health, recreation, employment, education etc.) water related issues are fundamentally intertwined with most sectors of the national economy. Therefore, water should not be viewed as an isolated factor by itself. Efficiency in the use of water will become an increasingly crucial issue with population increases and will remain an area of great concern.

17. The economy in Africa has been dramatically affected by water shortages due to climatic changes. High temperatures and decreased precipitation lead to decreased water supplies and increased water demand. They might also cause deterioration of the quality of fresh water supplies thus putting strain on the already fragile water supplies.

18. Some factors which can contribute to a water crisis are, the increased demand for water by increasing populations, increased economic activities, misuse of water resources, financial, technical and institutional constraints and the deterioration of the quality and quantity of water.

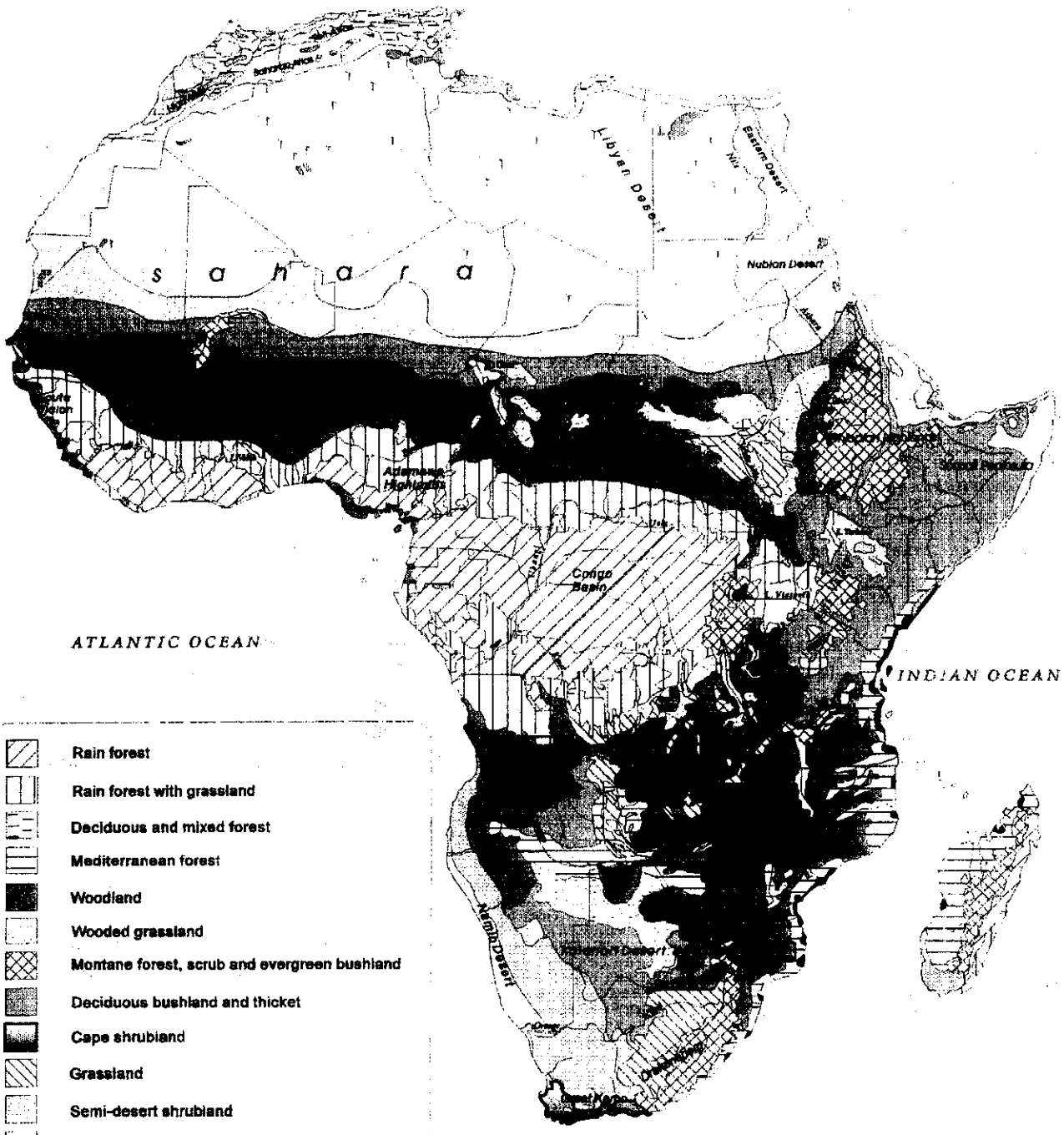
III. WATER CRISIS: WATER STRESS AND SCARCITY

19. The present food supply and environmental crisis is probably the most serious crisis ever faced by humanity and its main cause is the water crisis.

20. The threat to regional food self-reliance and overall food security is particularly serious because it seems to be poorly acknowledged. Africa is suffering from both - complex water scarcity and large-scale land degradation.

Figure 3

AFRICA - NATURAL VEGETATION



21. Water availability is a resource constraint to which countries could be classified as either water surplus, water vulnerable, water stressed or water scarce, based on the annual per-capita availability of fresh water resources in cubic metres and annual withdrawals as percentage of that availability as shown in the following table:

Annual per-capita availability of fresh water resources (M^3)	Annual Withdrawal as percentage of annual availability			
	< 15	15 - 25	25 - 50	> 50
< 500	Stressed	Stressed	Scarce	Scarce
500-1000	Vulnerable	Stressed	Scarce	Scarce
1000-2000	Surplus	vulnerable	Stressed	Scarce
> 2000	Surplus	vulnerable	Stressed	Scarce

Table (1) state of fresh water resources as function of annual availability and withdrawal.

22. The water stress index is based on the approximate minimum level of water required per capita to maintain an adequate quality of life in a moderately developed country in an arid zone.

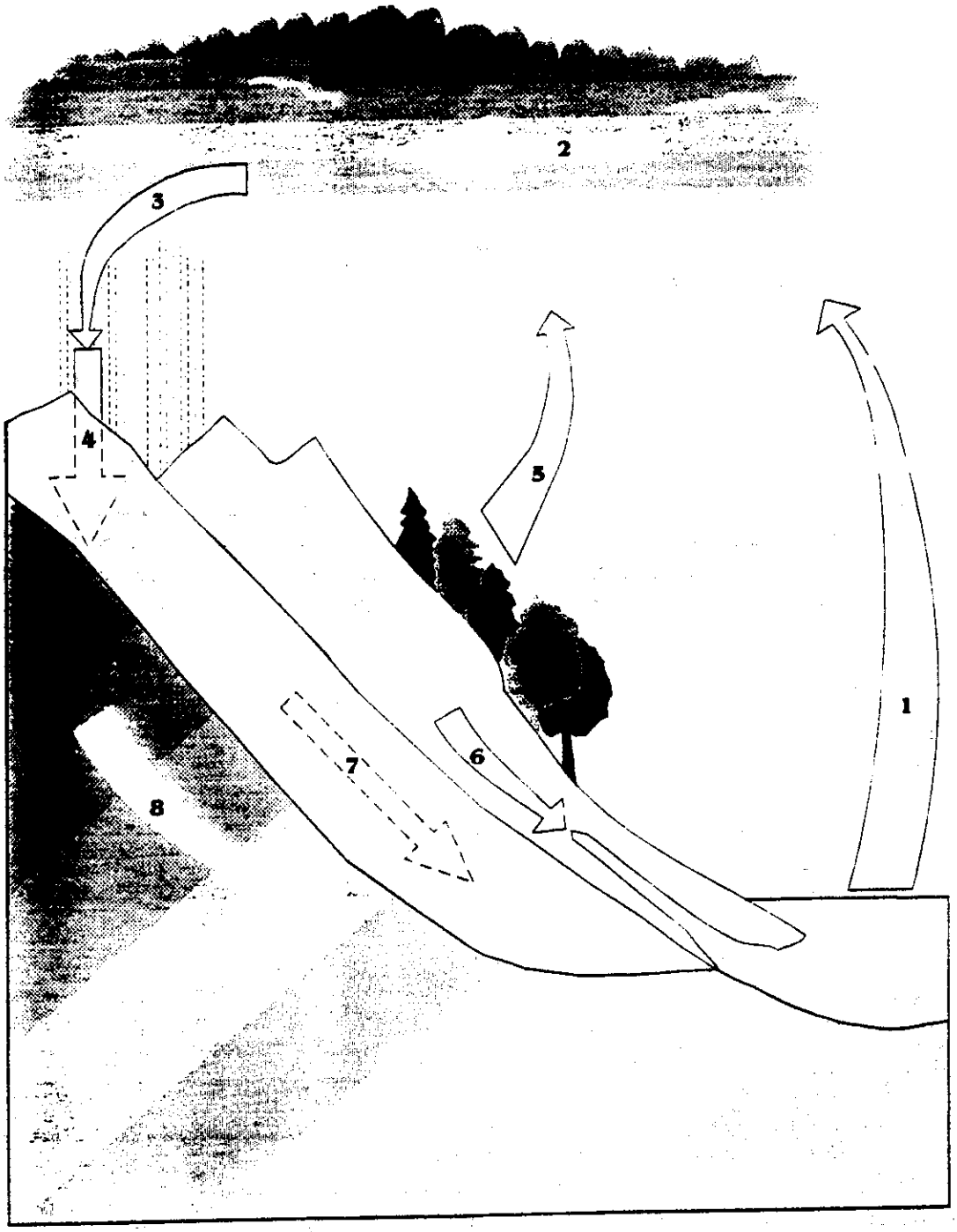
23. Malin Falkenmark, a widely respected Swedish hydrologist began with the calculation that approximately 100 litres per day is the minimum per capita requirement for basic household needs to maintain good health. The 1000 cubic metre benchmark has been accepted as a general indicator of water scarcity by the World Bank, which represents the approximate minimum necessary for an adequate quality of life in a moderately developed country per person per year.

24. Renewable water: It is continuously renewed water within reasonable time spans by the hydrological cycle such as that in streams, reservoirs or other sources that refill from precipitation or run-off. The renewability of a water source depends both on its natural rate of recharge and the rate at which the water is withdrawn for human needs. To the extent when water is withdrawn faster than the source being recharged, it cannot be considered renewable.

Recharge water Q
Withdrawn water W
Renewable water when $Q \geq W$

25. Hydrological Cycle: It is the cycle by which water evaporates from oceans and other water bodies, accumulates as water vapour in clouds, and returns to oceans and other bodies of water as rain and snow or as run-off from this precipitation or as ground water.(Fig.4)

HYDROLOGICAL CYCLE



1. EVAPORATION

2. MOVEMENT OF MOISTURE IN THE ATMOSPHERE

5. EVAPORATION & TRANSPIRATION

6. SURFACE RUN OFF

7. THROUGH FLOW

26. Water Stress: Water stress (W_s) exists when the annual availability of renewable fresh water (W_r) is less than 1667 and greater than 1000 cubic metres per person of population.

W_s when $1667 \geq W_r \geq 1000$

27. Water Scarcity: A situation when the annual availability of renewable fresh water is 1000 cubic metres or less per person per year. (Table 2).

Water Scarcity when $W_r < 1000$

IV. WATER RESOURCES ASSESSMENT IN AFRICA

28. Water resources assessment including the identification of potential sources of fresh water is of primary importance. The determination of water sources, their extent, dependability and quality as well as the impact of human activity on available water is crucial.

29. In order to assess the level of water scarcity data is needed on the gross amount of water available to a country from the global water cycle.

30. Unfortunately the data on total water availability in terrestrial water systems i.e. renewable water supply; in different African countries is extremely scarce and therefore does not allow comparison throughout the continent. Since most of the African countries have poor hydrological networks, only a handful have been able to make large scale resource assessment as a basis for national water master plans and development plans in general. The rest are applying traditional methods for water balance estimations based on generalised hydrological information from existing observation networks. Such estimates have limited precision but instead function as first indicators for the need of more detailed national studies to estimate overall water availability. Such studies might provide early warning signs to countries headed towards chronic water scarcity.

31. Part of the water annually available to any country from the global water circulation system enters the exogenous supply in cross-boundary aquifers and rivers from upstream countries and the rest is provided as endogenous water supply via precipitation over the territory.

32. In calculating the amount of fresh water available for human use, what counts is not the sum total of global fresh water supplies, but the rate at which fresh water resources are renewed or replenished by the global hydrological cycle. Powered by the sun, each year, this cycle deposits about 113,000, cubic kilometres of water on the world's continents and islands as rain and snow. 72,000 cubic kilometres evaporates back into the atmosphere. The balance of 41,000 cubic kilometres per year replenishes aquifers or returns to rivers and other run-offs leading to the oceans. This amount is enough to cover the United States to a depth of 4.4 metres. Moreover not all of this 41,000 cubic kilometres can be captured for human use. More than half of it flows unused to the sea in flood waters and as much as an eighth falls in areas too far from human habitation to be captured for use. Some water experts estimate that the world's available renewable fresh water lies between 9,000 to 14,000 cubic kilometres only annually.

Table 2

Annual Renewable Fresh Water Available
Per Person in Some African Countries

Country	1955	1990	2025 Medium (projected)
Djibouti	147	23	9
Tunisia	1,127	540	324
Kenya	2,087	636	235
Burundi	1,339	655	269
Algeria	1,770	689	332
Rwanda	2,636	897	306
Malawi	2,839	939	361
Somalia	2,500	980	363
Libya	4,105	1,017	359
Morocco	2,763	1,117	590
Egypt	2,561	1,123	630
South Africa	3,249	1,317	683
Comoros	5,256	1,878	620
Cape Verde	1,184	551	258
Mauritius	3,854	2,047	1,575
Ethiopia	5,073	2,207	842
Lesotho	5,039	2,290	1,057
Zimbabwe	7,061	2,312	1,005
Nigeria	8,304	2,838	1,078
Tanzania	8,525	2,924	1,025
Burkina Faso	6,980	3,114	1,237
Madagascar	8,476	3,331	1,185
Togo	8,485	3,398	1,280
Ghana	9,204	3,529	1,395
Uganda	11,880	3,759	1,437
Mozambique	8,601	4,085	1,598
Mauritania	9,855	4,387	1,778
Senegal	12,451	4,777	2,049
Sudan	11,899	4,792	1,993
Benin	12,316	5,625	2,105
Niger	16,362	5,691	2,067
Côte d'Ivoire	22,974	6,177	1,950
Namibia	15,900	6,254	2,399
Mali	15,853	6,729	2,522
Chad	13,389	6,843	2,944
Zambia	34,872	11,797	4,576

33. If 100% of the available water is not utilised, the option for meeting the water demand is the development of water resources but in case of 100% utilisation of the renewable supply the options for meeting the demand are recirculation, sequential reuse, non conventional sources and water transfer.

34. As can be seen from table 2, available fresh water in Africa has greatly diminished in the last 20 years. This sharp decline in supply is visible even in the Congo-Zaire basin which receives about 50% of the total water supply of the entire continent. Consequently there are chronic as well as seasonal acute water shortages in most of the African countries faced with increasing water demand due to population growth, urbanisation, industrialisation and irrigation needs. The situation of water balance in Africa in general continues to worsen.

35. Water resources assessment considers a number of parameters which are briefly described below:

A. Rainfall

36. The primary source of fresh water is precipitation. A considerable variation in the distribution of rainfall in several parts of the world, contributes to creating conditions of acute water scarcity in several regions. For example countries like Canada and New Zealand have a daily run-off of about 300m^3 per person while countries in Africa like Kenya and South Africa have only 1.8 and 4.00m^3 per person/day respectively to satisfy their domestic, industrial and agricultural needs.

37. Distribution of water in Africa exhibits an abundance of rainfall over equatorial areas contrasted by extensive and extreme aridity of the Sahara in the north and the Kalahari desert in the south. Between these two extremes are the semi-arid zones where rainfall fluctuates yearly and even seasonally.

38. In the extreme north of the continent, the Maghreb and certain coastal parts of Libya and Egypt and in the extreme south, the Cape region have rainfall of the Mediterranean type (winter rains). The very wet equatorial regions to the south of 10° latitude N, have two rainy seasons i.e. when the sun is high above the horizon, generally from March to June and from September to November. From the 10th to the 15th parallel N, the tropical regions have only one rainy season i.e. from May to October. Lastly the subtropical desert region i.e. the whole of the north with the exception of the Mediterranean zone, receives only occasional and irregular showers.

39. The annual rainfall is two to six metres along the West African coast, from Conakry to Abidjan and from the Niger delta to Liberville in Gabon. One to two metres in some mountainous regions of the Maghreb and south of the line from Dakar to Mogadishu, 500 to 1000mm in the high Atlas and coastal regions of Algeria and Tunisia and in a strip 300 to 500 km wide to the North of the line mentioned above, less than one metre to the North of the line from Nouakchat to Port Sudan. With the exception of the Maghreb, the majority of this region

receives less than 20mm.

40. The coefficient of evaporation in Africa is the highest in the world. Run-off factor is only half that of the world average. In zones with rainfall under 250mm, the amount of infiltration is closely related to rainfall intensities. In areas with rainfall between 250-1000mm, the potential evapotranspiration is a deciding factor (over 75%). In areas with rainfall exceeding 1000mm, a substantial part of the rainfall goes towards infiltration into the ground.

41. The number of basic hydrological stations are in general inadequate to satisfy even the minimum needs. Only a few countries now have services which can be compared favourably to those existing 10 to 20 years ago. No African country has a service which is adequate as a basis for sustaining the many water development projects which are anticipated in the region in the coming years.

B. Surface Water

42. Rivers are the main suppliers of fresh water. 40% of the world's population depends on fresh water from rivers and about two-thirds of this population lives in the developing countries. As this population increases relative to available water resources, the maximum per capita demands that a country can support, decreases correspondingly.

43. Worldwide there are fifty two major international rivers with catchment areas exceeding 100,000 sq.km. of which seventeen are in sub Saharan Africa. There is wide disparity in the distribution of water resources in the continent. About 50% of the total surface water resources in Africa are in one single river basin, namely the Congo basin and 75% of the total water resources are concentrated in eight major basins, namely Congo, Niger, Ogadugue (Gabon), Zambezi, Nile, Sanga, Chari-Longone and Volta. [Fig. (5), Table (3)]

44. The major rivers of sub-saharan Africa derive their run-off mainly from highland areas that form the upper catchment. Once they leave the hills, little inflow is contributed from tributaries other than those that are generated in the highland areas. An exception to this generalisation is the region in and around the Zaire basin where the heavier and less seasonal rainfall creates and ensures a pattern of perennial water courses. Several of these rivers and lakes in Africa are undergoing a marked reduction in flow rates with Lake Chad facing the most serious problems. In less than one hundred years, this lake has been reduced to only a 10% of its original water surface.

C. Groundwater

45. There is almost no place in Africa where ground water doesn't exist at one depth or another. It constitutes about 20% of the total water resources of Africa. Groundwater provides limited supplies for drinking water and for very small scale irrigation schemes. In some countries it is their main water resource.

46. Present knowledge of groundwater availability is not adequate to permit a quantitative appraisal of the resource. However it is generally known that ground water exists in almost all

parts of the region, more in some places than in others. Most ground water occurs in non-sedimentary precambrian crystalline rock formation whose water holding capacity is not good except where there are fissures, joints and faults. In the great sedimentary formations in the interior of the continent, groundwater yields can be important, but these are often deep and costly to extract.

47. Along the coasts in West, Central and Eastern Africa, ground water exists in sedimentary formations. These formations have better yield but are affected in some cases by intrusion of saline water.

48. The exploitation of this resource is marked in North Africa where more data and information are available and hydrological maps have been prepared. In general programmes and networks for ground water monitoring are far less adequate than hydrometeorlogical and hydrological networks.

49. In Libya despite increasing use of desalination and water recycling rapid growth in the country's demand for water has led it to rely on ground water mining. The country's southern area, a desert region with fewer inhabitants overlies two of the largest ground water basins in the world. The Libyan government has used oil revenues to fund one of the world's largest water engineering projects in which giant sized pipelines will carry water from those reserves to the more densely populated north.

INTERNATIONAL RIVER BASINS IN AFRICA

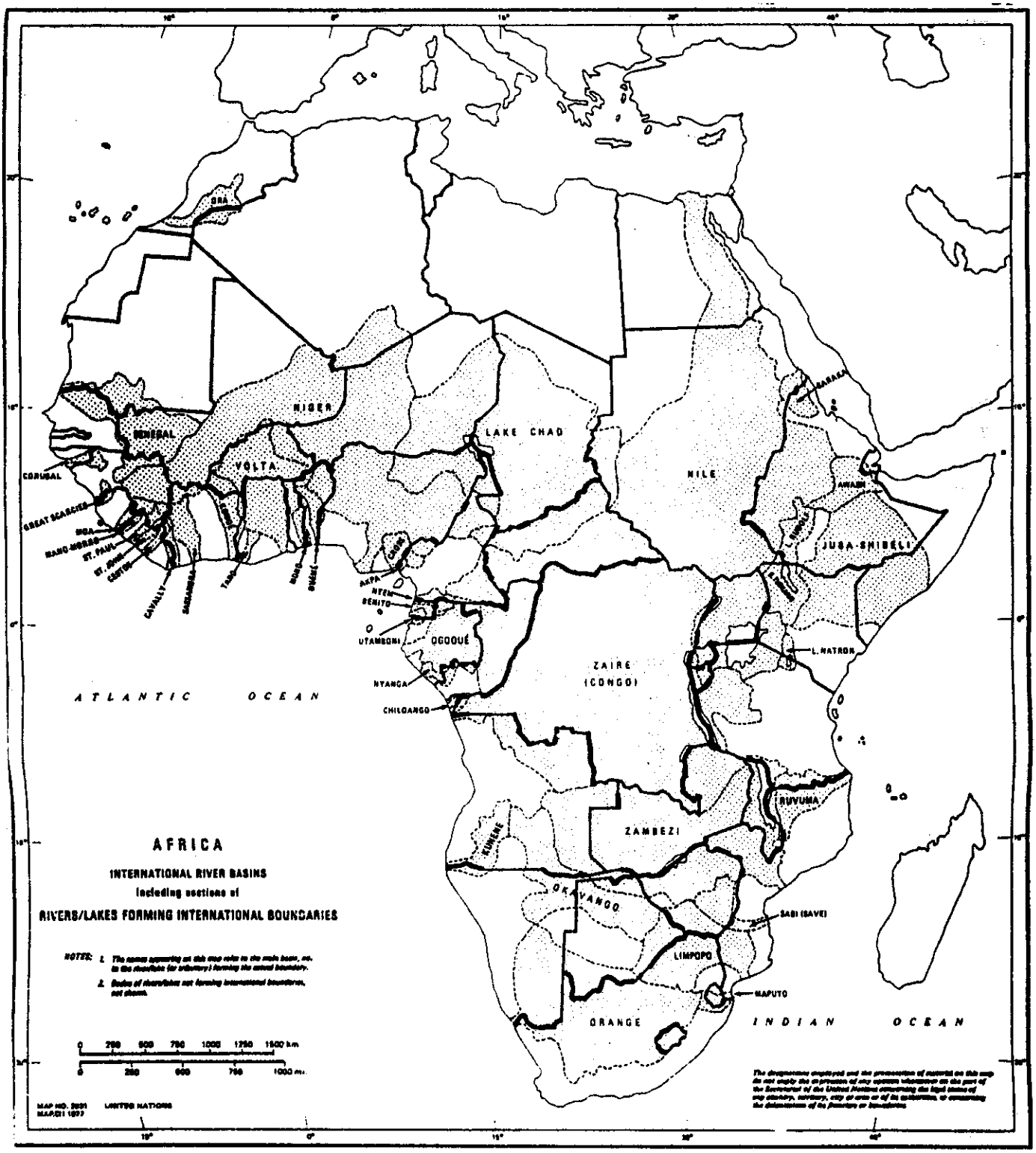


Table 3
International drainage basins of sub-Saharan Africa
"Catchment in excess of 100,000km²"

Name of Basin	catchment Area (000km²)	Average Annual Discharge (billion m³)	Number of States	Countries sharing catchment Area
Zaire (Congo)	3690	1250	9	Zaire, C.A.R. Congo, Angola, Cameroon Burundi, Rwanda, Tanzania, Zambia
Nile	2850	84	10	Egypt, Sudan, Ethiopia, Rwanda, Uganda, Kenya, Tanzania, Burundi, Zaire,* Eriteria
Niger Benue	1990	180	9	Niger, Nigeria, Mali, Guinea, Burkina Faso, Cote d'Ivoire Benin-Cameroon, Chad
Zambezi	1290	230	6	Zimbabwe, Zambia, Angola, Mozambique, Malawi, Tanzania*
Volta	390	37	6	Ghana, Burkina Faso, Togo, Cote d'Ivoire, Benin, Mali
Lake Chad	2370	IDB	6	Chad, Cameroon, Niger, C.A.R., Niger, Sudan*
Lake Rudolph	500	1DB	4	Ethiopia, Kenya, Sudan Uganda*
Senegal	490	25	4	Senegal, Mauritania, Mali, Guinea
Limpopo	400	NA	4	Botswana, Zimbabwe, R.S.A., Mozambique
Ogooue	220	NA	4	Gabon, Congo, Equatorial Guinea, Cameroon
Okavango	320	8	4	Botswana, Angola, Zimbabwe, Namibia
Orange	800	9	2	Namibia, Angola
Juba-shebli	827	9	3	Somalia, Ethiopia, Kenya
Ruvuma	140	NA	3	Tanzania, Mozambique, Malawi
Cunen	100	NA	2	Namibia, Angola
Awash	120	3	2	Ethiopia, Dijbouti
Sabie	103	NA	2	Mozambique, Zimbabwe

* Very minor share IDB Inland Drainage N.A. not available

Source: Water for sustainable development in the 21st century (Water Resources Management Series)

50. Mineral water and thermo mineral springs abound in the African continent in the fracture zones. They constitute a major potential resource which has been explored and exploited only in a few places. There is a large potential for geothermal energy in the Rift Valley which is currently exploited especially in Kenya.

V. CHALLENGES FACING AFRICA

51. In 1994 Africa has witnessed its fastest economic growth rate but on the whole, Africa's share of aggregate world economic output has continued to shrink. On the other hand the rate of increase in population has been roughly double than in the rest of the world. The region as a whole has fallen behind the rest of the world in matters of development.

52. Some African countries have been prospecting for water from inaccessible and remote sources when they could easily develop water transfer schemes to provide local relief. The Congo basin is one example where the rich water resources could be developed for long term relief. The only set-back to such a water transfer scheme is the lack of trained manpower. Most African countries are lacking behind in advanced technology and the required co-ordinating capacity even when financing is possible.

53. In the meantime though most of these countries will have to rely on alternative water strategies to support their development plans. It is therefore evident that Africa is facing great challenges, especially in its economic sector. The most important one is the mobilisation of the available water resources to support socio-economic development of the continent.

Some of the challenges faced by Africa are summarised below:

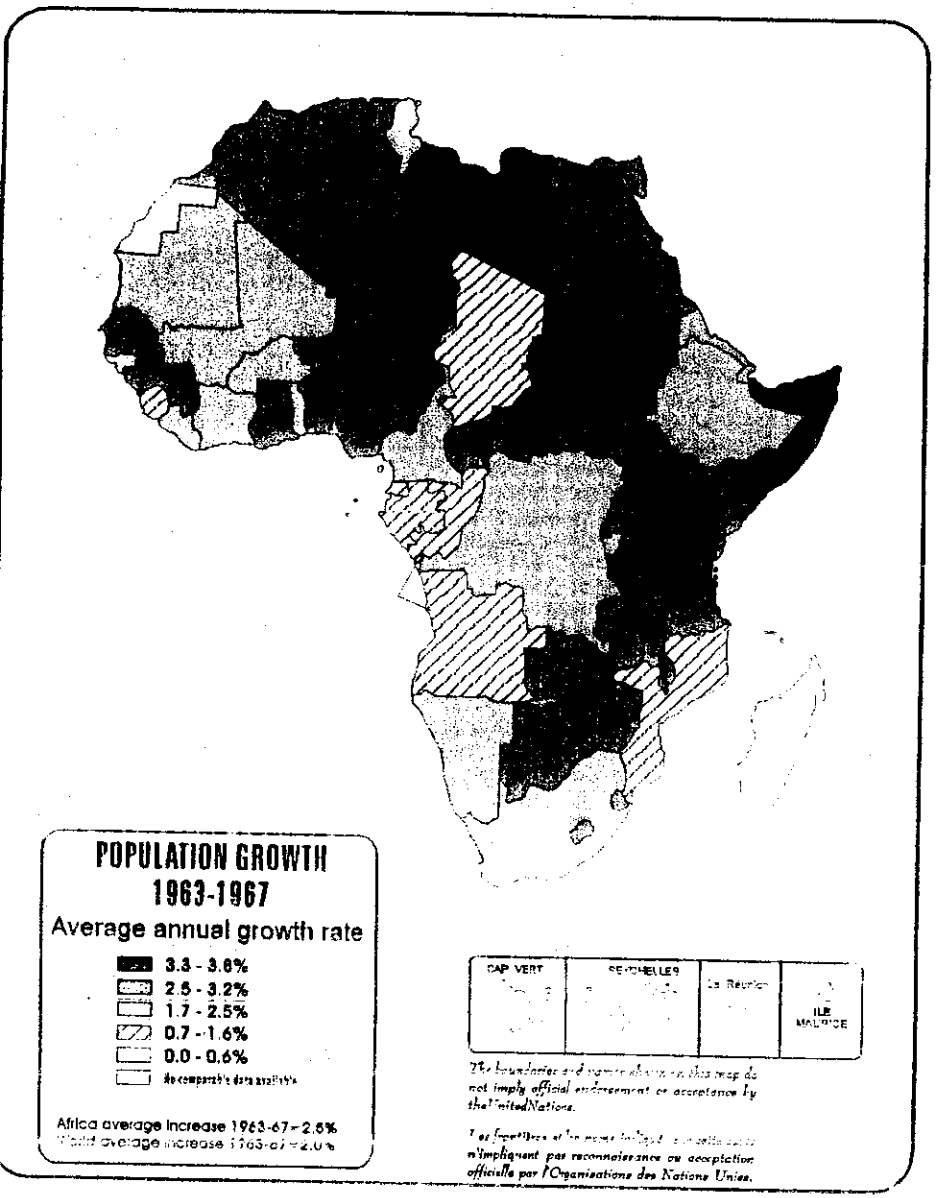
A. Population Growth and Poverty

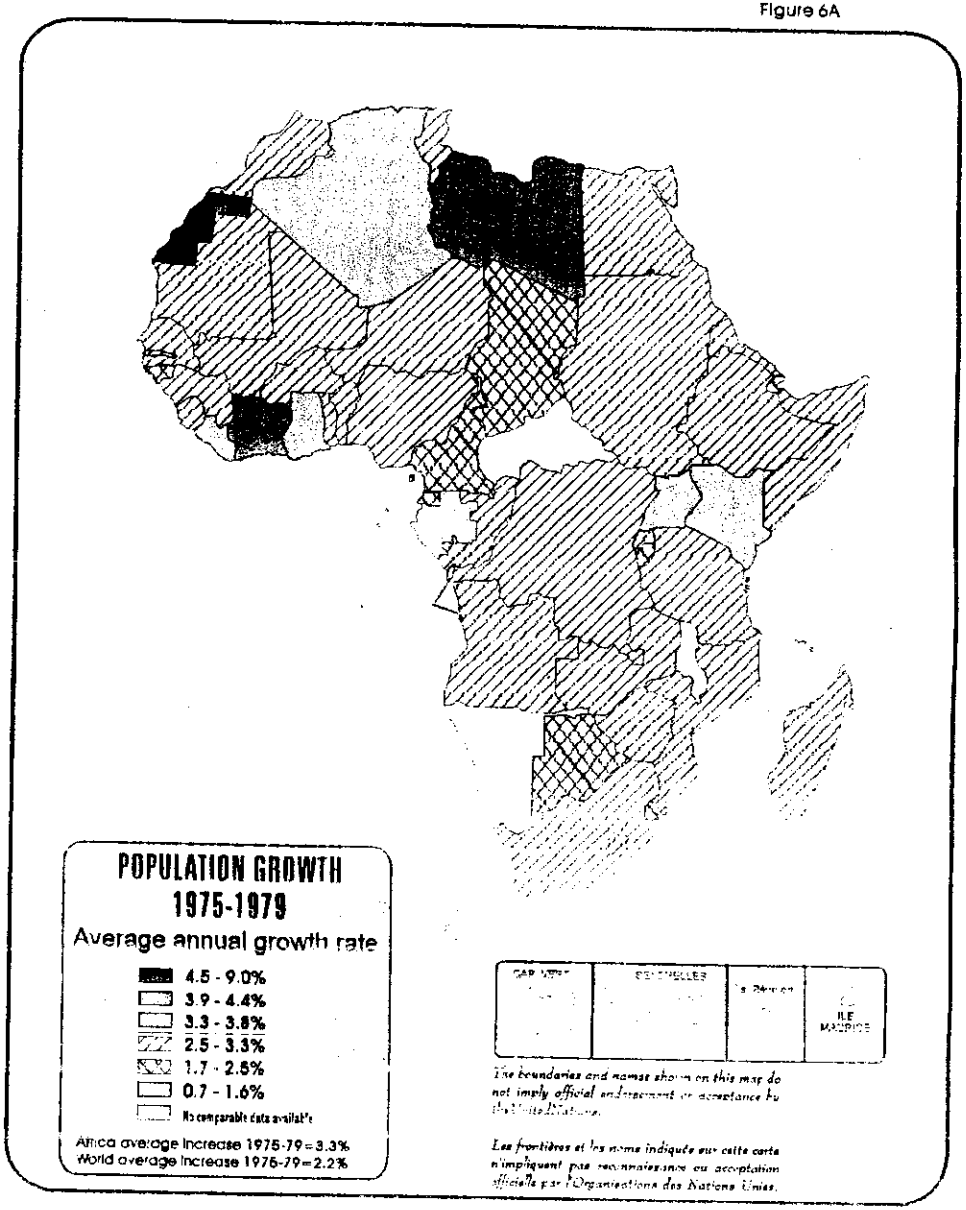
54. Africa has a quarter of the land area of the world and hosts over 12% of the world's population. The continent's population continues to grow rapidly at the rate of 3% per annum. It outstrips average annual rates of economic growth and food production which were 2.8% and 2.1% respectively in 1994. In 30 years (1950-1980) the African population has more than doubled; from being 220.3 million to 470 million and it is expected to reach 1115.6 million by the year 2010. This fact is very alarming and Africa's growth rate should be curbed before the end of the century.(Fig.6)

55. A dozen or more countries are trying to balance their water supplies with the demands of the rapidly growing population. Out of the twenty African countries that have faced food shortages in recent years, half are either already stressed by water shortages or are projected to fall into the stress category by 2025. Lacking financial resources and technology to improve management of scarce water resources or gain access to more renewable supplies, these countries are in desperate need of improvement in the development and management of renewable fresh water resources. They include war-torn Somalia, as well as Algeria, Kenya, Malawi and Rwanda. (Fig.7) (Table 4)

AFRICA Population Change

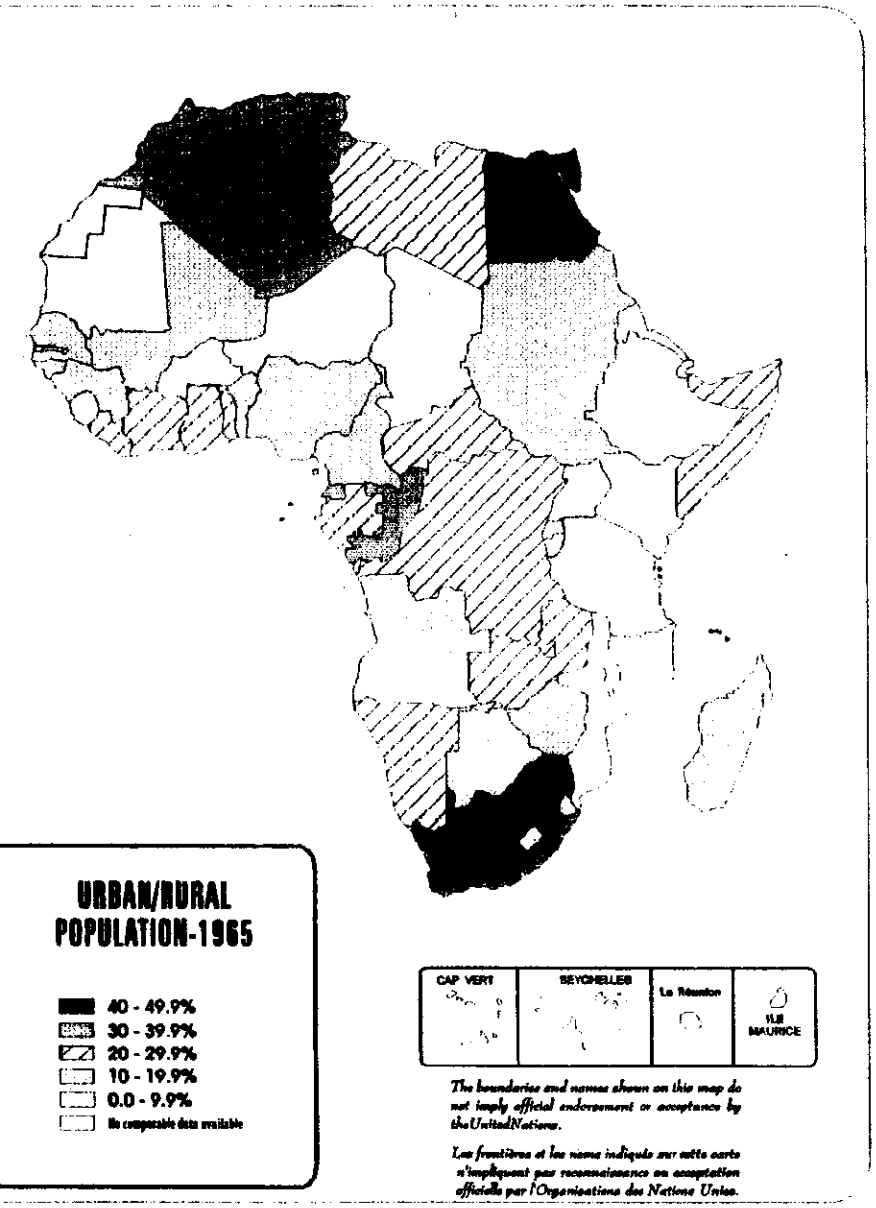
Figure 6A





AFRICA Population Change

Figure 68



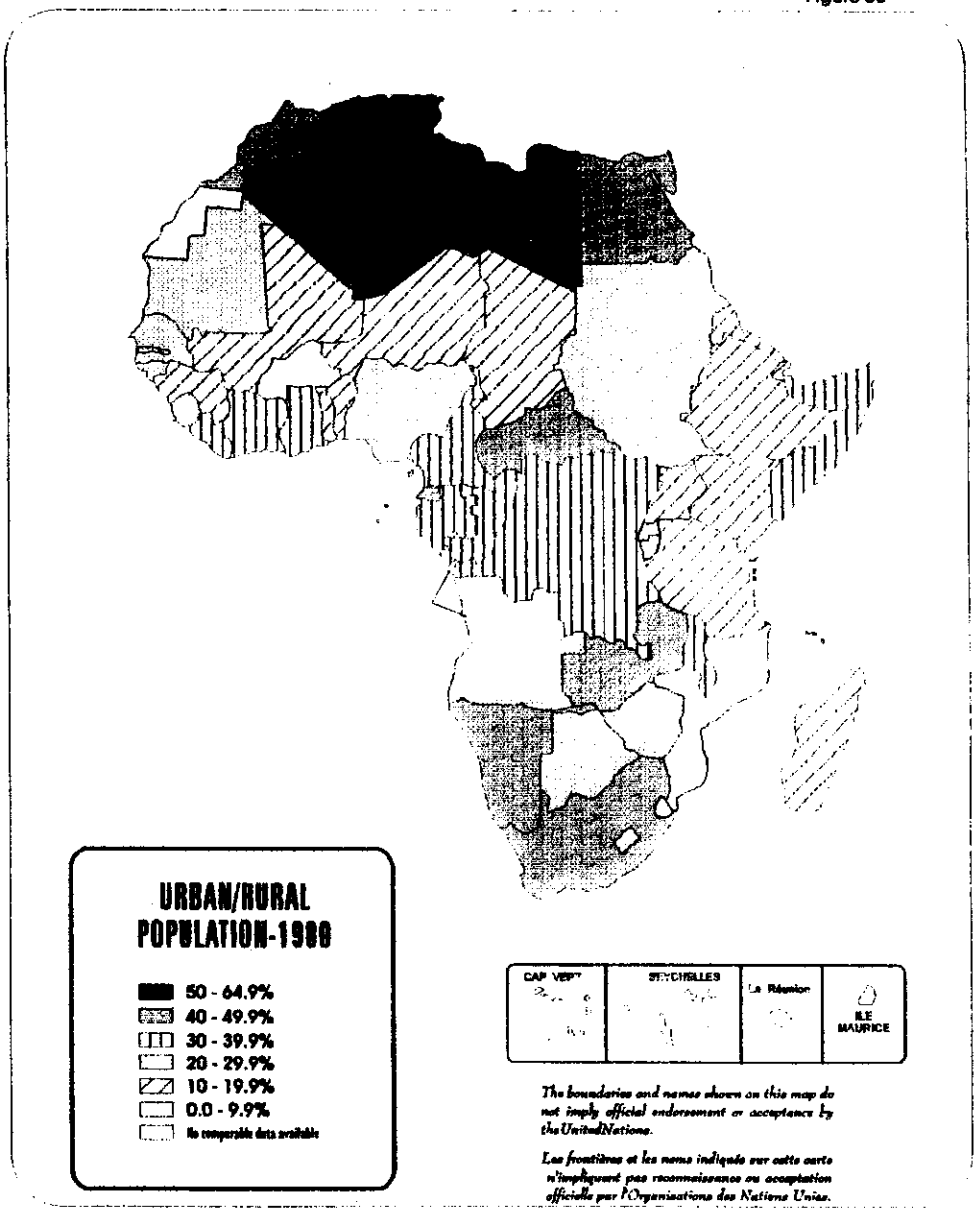


Fig. 7a

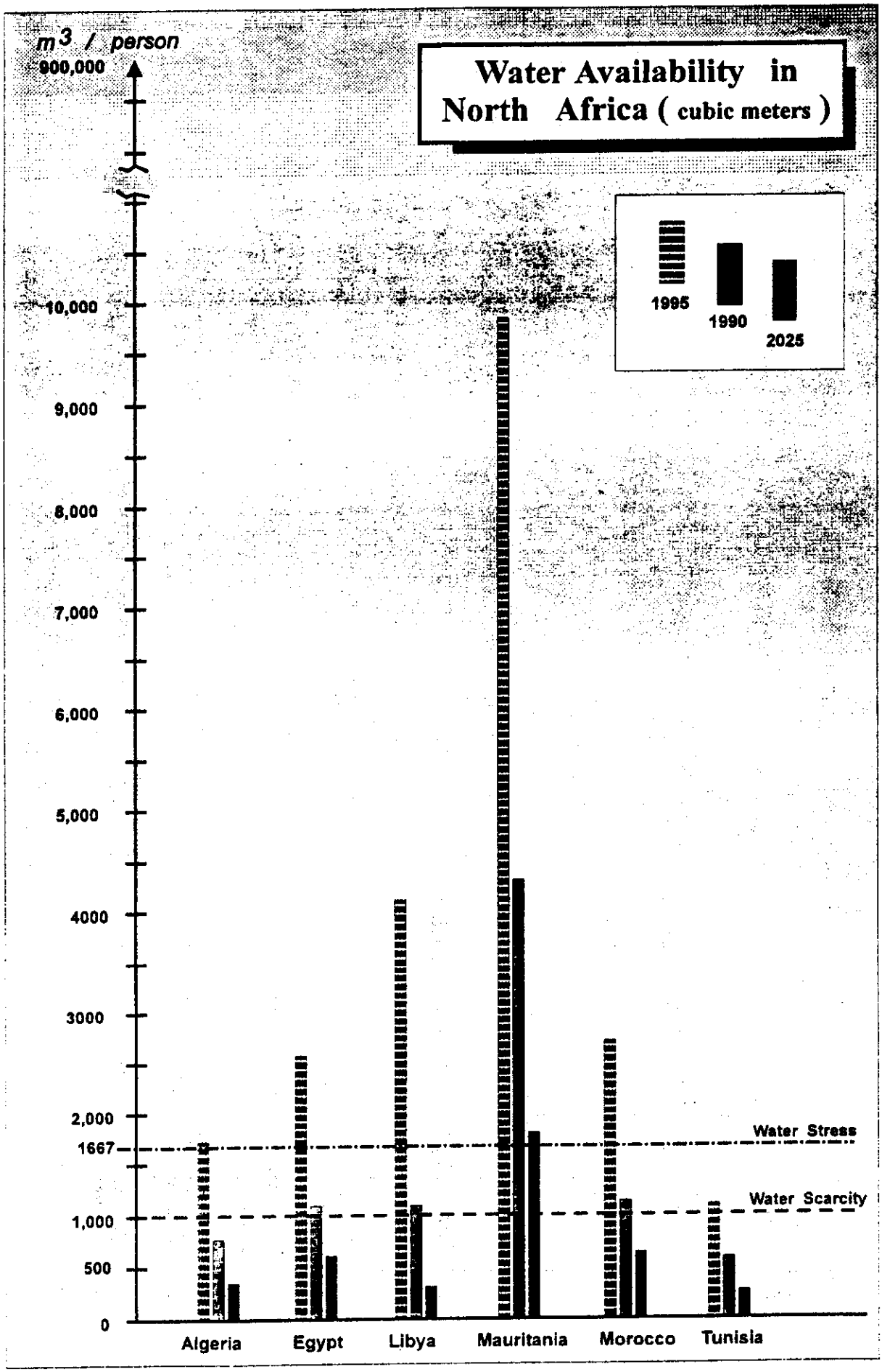

m3 / person
900,000
10,000
9,000
8,000
7,000
6,000
5,000
4000
3000
2,000
1667
1,000
500
0
Water Availability in North Africa (cubic meters)
1995
1990
2025
Water Stress
Water Scarcity
Algeria
Egypt
Libya
Mauritania
Morocco
Tunisia

Fig. 7b

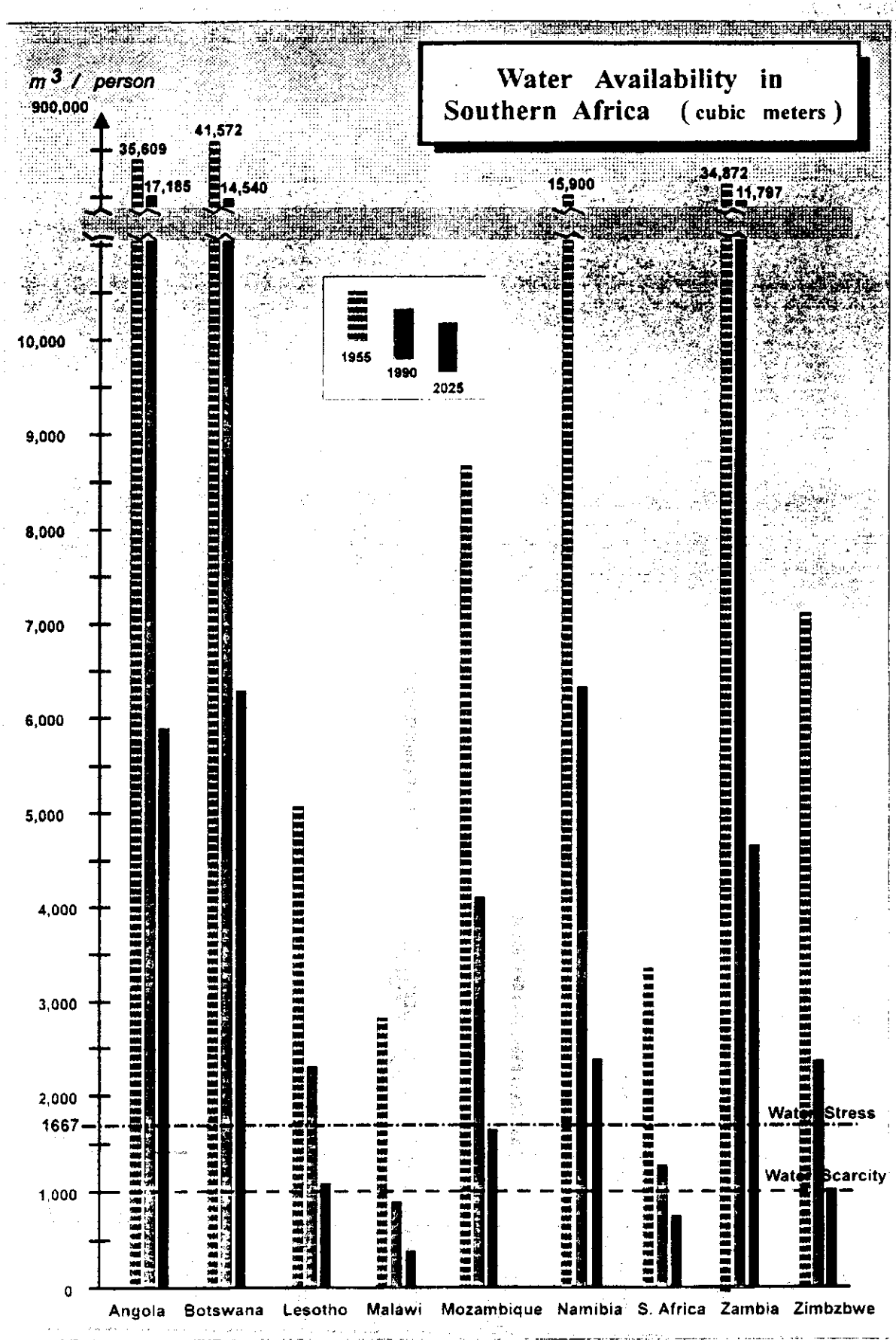

Water Availability in Southern Africa (cubic meters)
m 3 / person
900,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1667
1,000
0
35,609
17,185
41,572
14,540
15,900
34,872
11,797
1955
1990
2025
Water Stress
Water Scarcity
Angola
Botswana
Lesotho
Malawi
Mozambique
Namibia
S. Africa
Zambia
Zimbzbwe

Fig. 7c

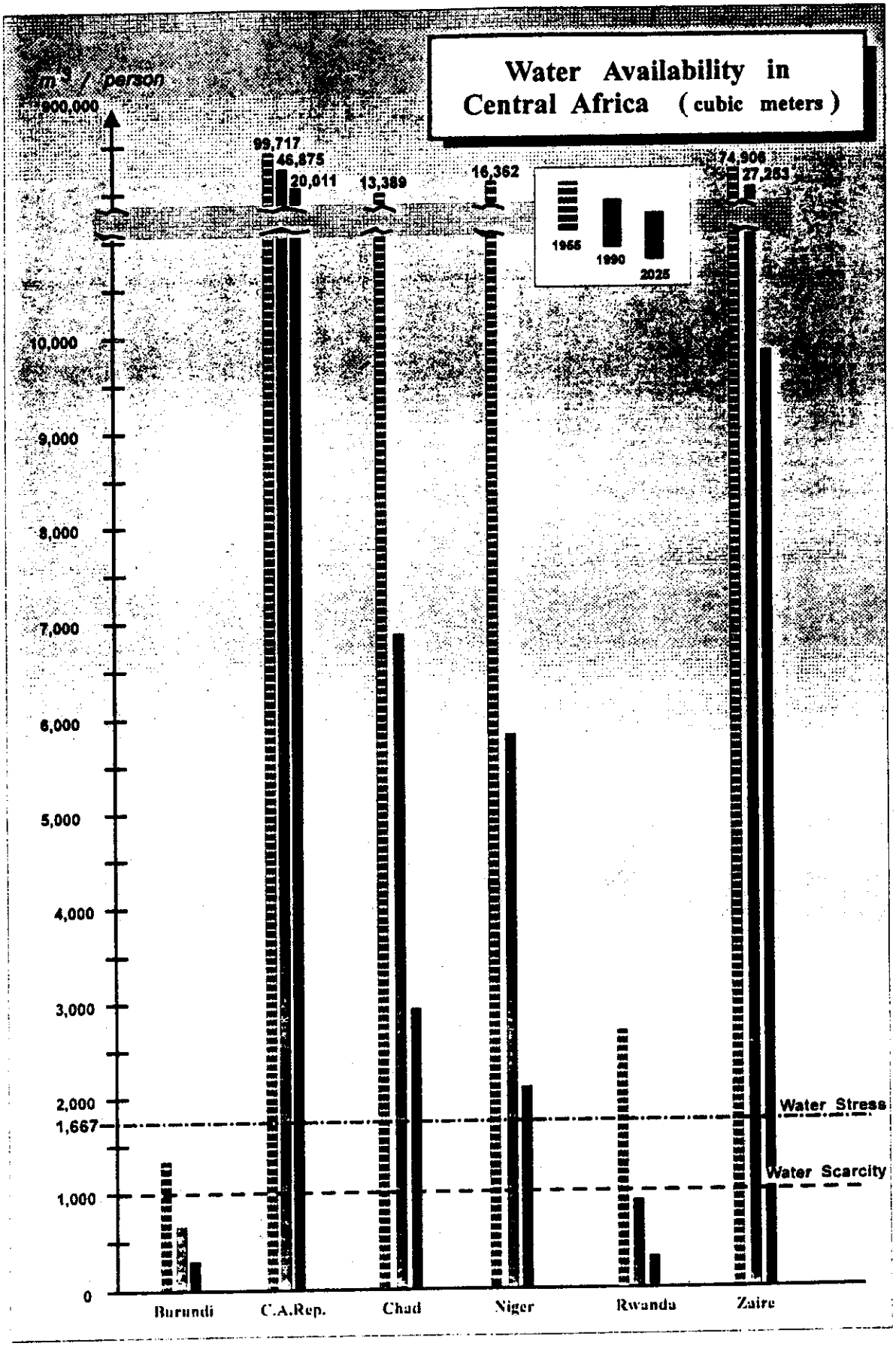

Water Availability in Central Africa (cubic meters)
m³ / person
900,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,667
1,000
0
99,717
46,875
20,011
13,389
16,362
74,906
27,253
1955
1990
2025
Water Stress
Water Scarcity
Burundi
C.A.Rep.
Chad
Niger
Rwanda
Zaire

Fig. 7d

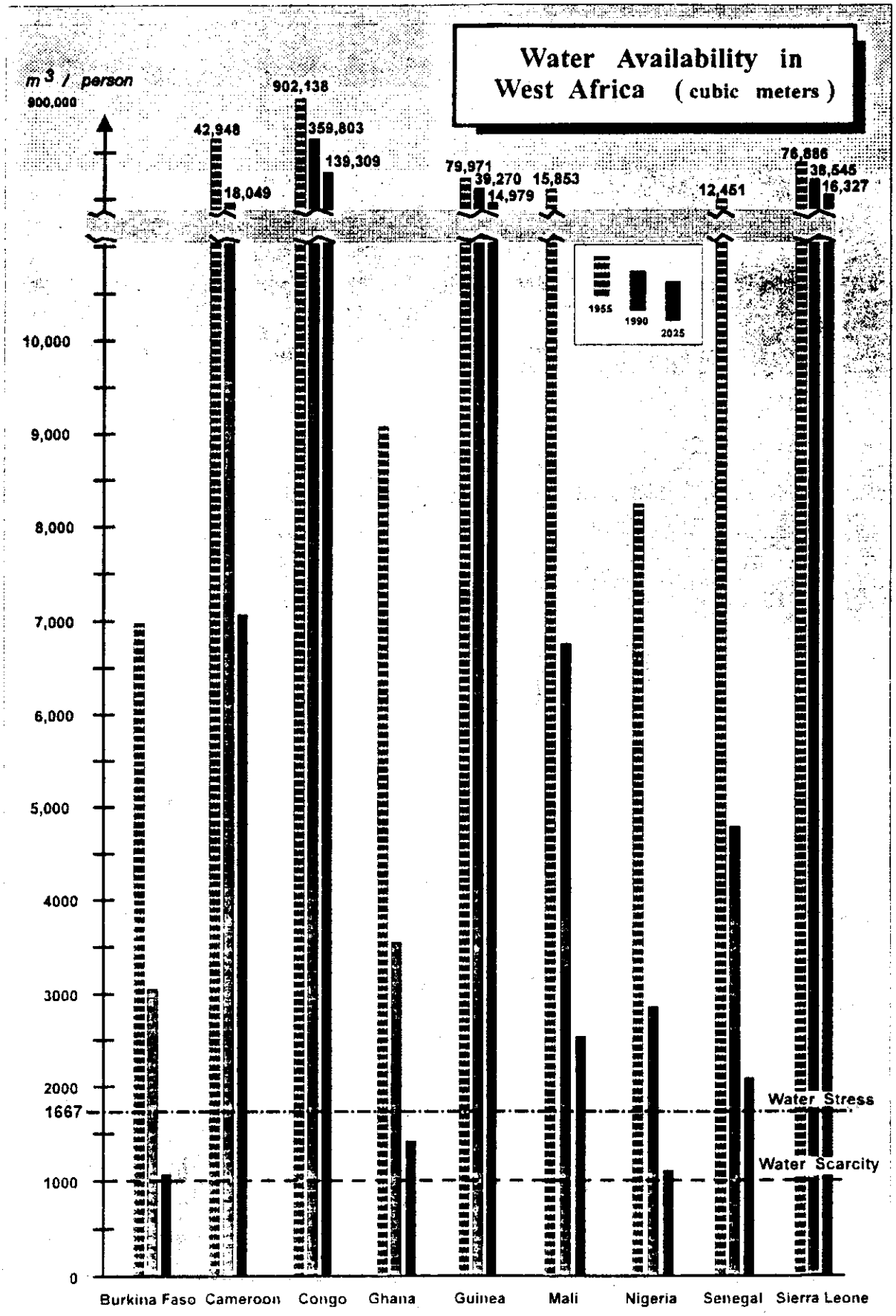

Water Availability in
West Africa (cubic meters)
m 3 / person
900,000
10,000
9,000
8,000
7,000
6,000
5,000
4000
3000
2000
1667
1000
0
42,948
18,049
902,138
359,803
139,309
79,971
39,270
14,979
15,853
12,461
76,886
38,545
16,327
1955
1990
2025
Water Stress
Water Scarcity
Burkina Faso
Cameroon
Congo
Ghana
Guinea
Mali
Nigeria
Senegal
Sierra Leone

Fig. 7e

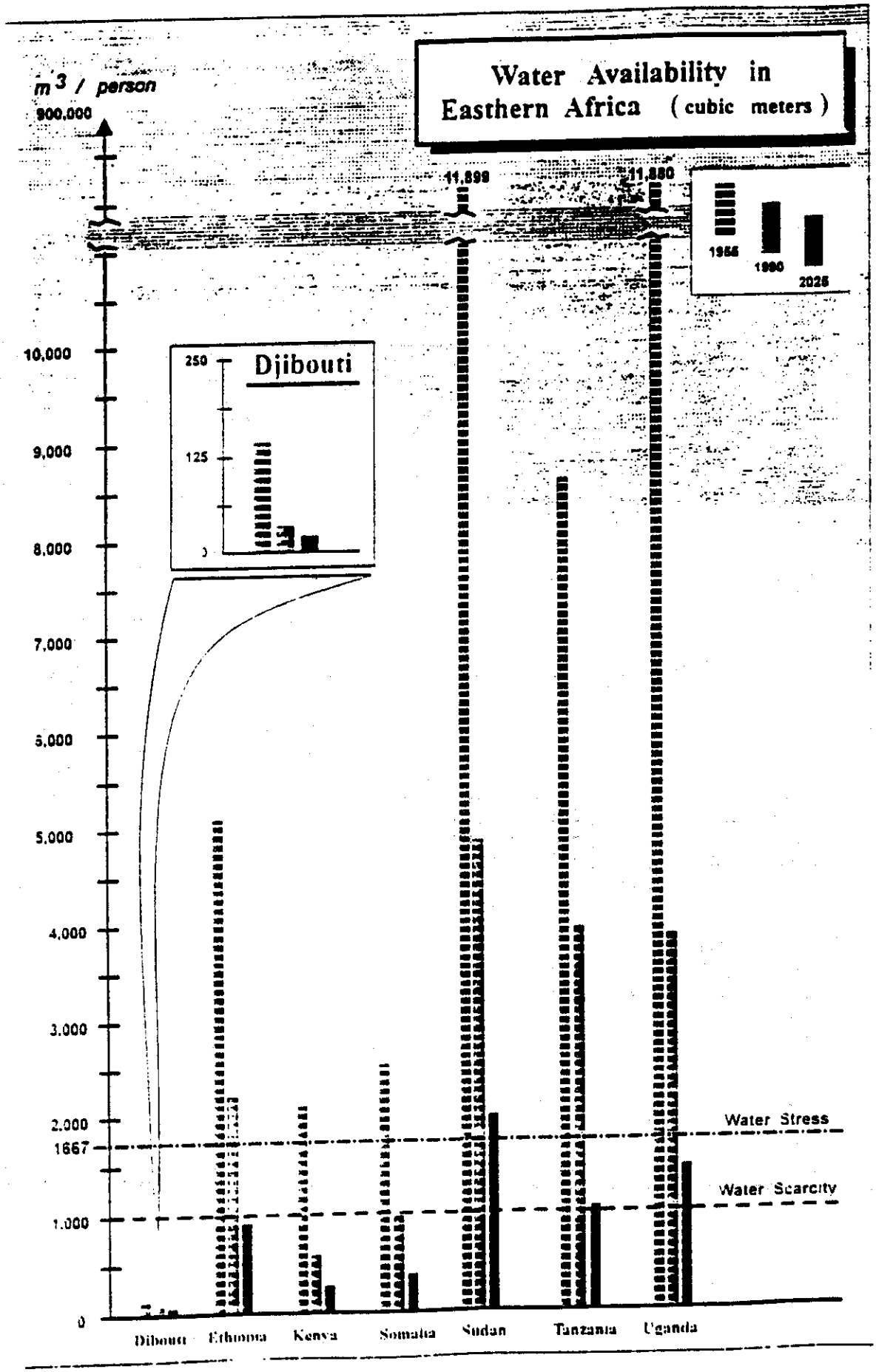

Water Availability in
Easthern Africa (cubic meters)
m 3 / person
900,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1667
1,000
0
11,899
11,880
1955
1990
2025
Djibouti
250
125
0
Water Stress
Water Scarcity
Djibouti
Ethiopia
Kenya
Somalia
Sudan
Tanzania
Uganda

Table 4

POPULATION AND ANNUAL RENEWABLE FRESH WATER AVAILABILITY IN AFRICA (1955,1990 AND 2025)

A. Total annual renewable fresh water available by country (millions of cubic meters)
B. Population (thousands)
C. Water availability per capita (cubic meters)

L.P. Low Projection, M.P. Medium Projection, H.P. High Projection

Country	1955			1990		2025 L.P		2025 M.P		2025 H.P	
	A	B	C	B	C	B	C	B	C	B	C
Algeria	17,197	9,715	1,770	24,960	689	47,914	359	51,630	332	55,659	309
Angola	157,999	4,437	35,609	9,194	17,185	24,265	6,511	26,619	5,936	28,721	5,501
Benin	25,999	2,111	12,316	4,622	5,625	11,337	2,293	12,354	2,105	13,245	1,963
Botswana	18,001	433	41,572	1,238	14,540	2,686	6,696	2,853	6,309	3,020	5,960
Burkina Faso	28,004	4,012	6,980	8,993	3,114	20,853	1,343	22,633	1,237	24,154	1,159
Burundi	3,597	2,687	1,339	5,492	655	12,336	292	13,392	269	14,295	252
Cameroon	207,997	4,843	42,948	11,524	18,049	28,121	7,397	29,262	7,108	30,394	6,843
Cape Verde	200	169	1,184	363	551	720	278	774	258	893	224
Central African	141,000	1,414	99,717	3,008	46,875	6,459	21,830	7,046	20,011	7,551	18,673
Chad	37,999	2,838	13,389	5,553	6,843	11,851	3,206	12,907	2,944	13,817	2,750
Comoros	1,020	194	5,256	543	1,878	1,493	683	1,646	620	1,783	572
Congo	802,001	889	902,138	2,229	359,803	5,295	151,464	5,757	139,309	6,153	130,34
Côte d'Ivoire	74,000	3,221	22,974	11,980	6,177	34,693	2,133	37,942	1,950	40,795	1,814
Djibouti	10	69	145	440	23	1,065	9	1,159	9	1,240	8
Egypt	58,874	22,990	2,561	52,426	1,123	86,483	681	93,536	630	100,797	584
Equatorial Guinea	30,000	238	126,050	352	85,227	732	40,984	798	37,594	854	35,129
Ethiopia	109,977	21,680	5,073	49,831	2,207	119,618	920	130,674	842	140,381	784
Gabon	164,000	477	343,815	1,159	141,501	2,541	64,542	2,869	57,163	3,203	51,202
Gambia	22,000	313	70,288	861	25,552	1,799	12,229	1,875	11,733	1,951	11,276
Ghana	53,006	5,759	9,204	15,020	3,529	36,575	1,449	37,988	1,395	41,123	1,289
Guinea	225,999	2,826	79,971	5,755	39,270	13,726	16,465	15,088	14,979	16,204	13,947
Guinea Bissau	31,000	522	59,388	964	32,158	1,815	17,080	1,978	15,672	2,107	14,713
Kenya	15,000	7,189	2,087	23,585	636	60,830	247	63,826	235	66,870	224
Lesotho	4,001	794	5,039	1,747	2,290	3,017	1,106	3,783	1,057	3,953	1,012
Liberia	232,000	914	253,829	2,575	90,097	6,598	35,162	7,234	32,071	7,772	29,851
Libya	4,622	1,126	4,105	4,545	1,017	12,257	377	12,673	359	14,036	329
Madagascar	40,005	4,720	8,476	12,010	3,331	31,117	1,285	33,746	1,185	36,005	1,111
Malawi	8,997	3,169	2,839	9,582	939	22,588	398	24,923	361	27,025	333
Mali	62,001	3,911	15,853	9,214	6,729	22,413	2,766	24,580	2,522	26,384	2,350
Mauritania	8,879	901	9,855	2,024	4,387	4,597	1,932	4,993	1,778	5,340	1,663
Mauritius	2,201	571	3,854	1,075	2,047	1,287	1,709	1,397	1,575	1,515	1,452
Moroco	27,993	10,132	2,763	25,061	1,117	43,865	638	47,477	590	50,977	549
Mozambique	58,007	6,744	8,601	14,200	4,085	33,510	1,731	36,290	1,598	38,693	1,499
Namibia	9,000	566	15,900	1,439	6,254	3,409	2,640	3,751	2,399	4,054	2,220
Niger	43,997	2,689	16,362	7,731	5,691	19,363	2,272	21,287	2,067	22,944	1,918
Nigeria	308,042	37,094	8,304	108,542	2,838	274,613	1,122	285,623	1,078	297,019	1,037

Table 4 (continued)

Country	A	1955		1990		2025 L.F		2025 M.F		2025 H.F	
		B	C	B	C	B	C	B	C	B	C
Rwanda	6,303	2,391	2,636	7,072	697	18,844	334	20,595	306	22,156	284
Senegal	35,001	2,811	12,451	7,327	4,777	16,386	2,136	17,078	2,049	17,715	1,976
Sierra Leone	160,000	2,081	76,886	4,151	38,545	8,944	17,889	9,800	16,327	10,484	15,261
Somalia	8,503	3,401	2,500	8,677	980	21,379	398	23,401	363	25,239	337
South Africa	49,992	15,385	3,249	37,959	1,317	68,927	725	73,211	683	77,590	644
Sudan	120,773	10,150	11,899	25,203	4,792	58,584	2,062	60,602	1,993	65,402	1,847
Tanzania	76,004	8,915	8,525	25,993	2,924	68,002	1,118	74,172	1,025	79,540	955
Togo	11,998	1,414	8,485	3,531	3,398	8,522	1,408	9,377	1,280	10,063	1,192
Tunisia	4,351	3,860	1,127	8,057	540	11,934	365	13,425	324	15,019	290
Uganda	66,008	5,556	11,880	17,560	3,759	41,677	1,584	45,933	1,437	49,736	1,327
Zaire	1,019,017	13,604	74,906	37,391	27,253	95,323	10,690	104,530	9,748	112,627	9,048
Zambia	96,004	2,753	34,872	8,138	11,797	20,246	4,742	20,981	4,576	21,716	4,421
Zimbabwe	22,997	3,257	7,061	9,947	2,312	21,625	1,064	22,889	1,005	24,157	952

56. The ever increasing population growth, the devastating pollution of rivers and streams coupled with human activities that affect the hydrological cycle have resulted in a sharp rise in the human requirements for fresh water and has therefore made water resources management more urgent than ever. This is further proved by the fact that population increases contribute to unsustainable water resources development which in turn accentuates poverty.

B. Ethnic Conflicts and Civil Wars

57. Ethnic conflicts and civil wars have resulted in the displacement of large populations in the region. In 1994 alone, about 7 million people, almost a third of the world's refugees were Africans. These large refugee populations exert enormous pressures on the scanty resources of host nations whilst depriving their countries of origin of needed labour.

58. In every area to which the refugees move, they need specialised health, education and rehabilitation services which are not only in short supply but also beyond the economic capacities of host countries. All this has a negative effect on the economic development of the border areas where most cross-border refugees are located, both in the short and long term.

59. Acute water shortages have already required extra ordinary measures in some countries like when thousands of refugees from Djibouti, the most water-scarce country in the whole world crossed into Ethiopia in 1993. The Red Cross had to send tankers up to 300 miles to find water for them.

C. Climate Change

60. Climatic changes are increasingly effecting the water and land resources of most African countries and therefore having a negative effect on most economies. High temperatures and decreased precipitation not only lead to decreased water supplies but also cause deterioration of the water quality of fresh water bodies. This together with land degradation has a serious impact on the already fragile water resources.

D. Natural Disasters.

61. Flood devastation results in loss of lives, widespread crop destruction and other economic disasters. Many parts of Africa are subjected to floods like the low-lying areas around the banks of the Niger in Mali, causing damage to crops, homesteads and cattle. Recurring floods are also experienced in the Kano plains of western Kenya when the river Nyando overflows its banks. The Shire in Malawi produces freak floods in the rainy season with catastrophic results. In Tanzania the rivers Rufigi, Wami and Maragaraz are prone to flooding. In Sudan incidences of flood damages to irrigation projects can be cited on the Tokar and Gash projects.

62. Drought and desertification are threatening the ecological survival of the Sudano-Sahelian region of Africa. The main causes of desertification are the human activities such as the over cultivation of poor soils, overgrazing by animals on fragile rangelands, excessive cutting of fuel wood in drylands etc. Drought also encourages desertification.

63. The severe drougats which afflict Africa lead to the starvation of millions and leave scars on the land which will require years to heal. Apart from the human suffering, the other loss is to the water sheds, part of which are left at the mercy of the climate after the natural vegetation has been stripped.

64. Drought is not a new phenomena in Africa. The region has been experiencing devastating drought occurrences which claimed numerous human and animal lives. For many countries the prevalence of droughts means a crippled economy and a downward trend in development. The 1984-85 drought generated international attention by the United Nations for supplies of food and other relief activities to reduce famine in some twenty African countries. In 1987 a new drought took its toll in Ethiopia. Even today many countries in Africa are experiencing severe drought on an annual basis. Although its not exactly clear how often droughts occur, it is obvious that the downward trend in rainfall will result in droughts. Areas which are at risk are those faced with failure of seasonal rainfall and those that are vulnerable to human and animal stress like those of the Sahel and the semi-arid regions of South Africa.

65. The frequent occurrences of drought have resulted not only in the lack of water resources but also in great numbers of environmental refugees. This picture contradicts the idea of Africa being a continent rich in water resources.

VI. WATER CRISIS IMPACT ON THE AFRICAN ECONOMY

66. Water being the main element of human life, plays an important role in the socio-economic development of Africa. It has a direct impact on all the economic sectors be it agriculture, industry, power, transportation or anything else. At the same time it also requires control measures to avert consequences of floods and drought.

67. The current water resources situation has serious implications for economic growth and food security in several sub-regions of Africa. Water may well become the limiting factor for economic development in many African countries. As the demand of water for industry grows, water for agricultural purposes will become increasingly scarce. It is a well known fact that water is a major determinant in the development of agriculture and animal husbandry. The incidence of drought therefore is the major factor in lack of food security in the African continent.

68. The irrigation sector is the largest consumer of water resources. Some 70 - 80% of all water uses are attributed to irrigation. The socio-economic benefits from irrigation schemes are enormous as irrigation constitutes a major facility for ensuring high food yields and so securing food supplies. (Table 5)

69. Inadequate or lack of clear policies and legal instruments to support and stimulate effective actions in scarce inland water resources management has led to drastic reduction in food and agricultural production and a serious regression in the rural economy of Africa.

70. Another threat comes from the degradation of water supplies upstream like pollution, water logging and salinisation which all result in decreased land productivity.

71. Of course population growth (3% per annum) is also imposing an increased pressure on water availability. Urban growth being the major factor. Nearly 75% of the rural population have no access to clean and reliable water sources and nearly 20% have inadequate sanitary facilities. This results in 80% of all illnesses due to water borne diseases. Incidences of improper health facilities in turn directly affect the manpower and economy of the African countries.

72. The increased population and urban growth rate threaten the daily household water supply. This results in increased pollution in existing water supply systems with cases of complete collapse of water supply systems in some African cities.

73. Water quality plays a major role in the industrial development of any country. Pollution of the water resources of course impoverishes any vulnerable industry. Good quality water is therefore a basic necessity for industrial growth.

74. About one third of the world's potential hydropower is in Africa. The installed capacity stands at less than 10% of this potential. It is estimated to be about 300,000 mw in sub-saharan Africa excluding the Republic of South Africa. The limited number of power stations in Africa are facing major problems arising from soil erosion which shortens the life-span of reservoirs and reduces the water volume and efficiency of the station. (Table 6)

75. Hydropower energy supply depends on the river flow and any reduction in the flow upstream will directly effect the production of hydropower downstream. As a result down stream areas will have less hydropower and therefore a negative impact on industrial growth.

76. The exploitation of aquifers has become a major problem in arid and coastal zones. Aquifers have been unsustainably exploited. In certain areas excessive pumping has lowered the water table to such an extent that polluted water enters the aquifer, and thereby permanently damages the water resource.

77. Frequent prolonged and severe droughts have resulted in the lowering of water levels in major rivers and lakes of East Africa. As river navigation and fisheries are the two major economic activities of some river basins, these changes in water levels can directly affect the region's economy.

Table 5

Irrigation Potential in Africa

Country	Irrigation Potential (000 ha)	Country	Irrigation potential (000 ha)
Angola	1000*	Mali	350
Benin	90	Mauritania	150
Botswana	100	Mauritius	100
Burkina Faso	50	Mozambique	100
Burundi	50	Namibia	100
Cameroon	250	Niger	120
Central African Republic	100	Nigeria	2000
Chad	600	Rwanda	50
Congo	350	Senegal	350
Ethiopia	650	Sierra Leone	100
Gabon	100	Somalia	200
Gambia	70	South Africa	2000
Ghana	120	Sudan	3300
Guinea	100	Swaziland	90
Guinea Bissau	70	Tanzania	1500*
Côte d'Ivoire	150	Togo	90
Kenya	350	Uganda	400
Lesotho	10	Zaire	1000*
Madagascar	1200	Zambia	2000
Malawi	300	Zimbabwe	400
Total			21,010

* The figures are very approximate due to the scarcity of data
Source: FAO report 111/85 CPSSA2

78. Drought has also affected the wildlife population in the national parks of Africa. As the parks are a major source of tourism and vital economic income, this has negatively affected the economies of many African countries.

Table 6
Hydroelectric Power Potential in Africa

Country	Potential Capacity (1000 MW)	Remarks
Zaire	120	The Republic of South Africa and other countries which have less than 1000 MW potential and generally less than 500 MW are excluded from this table.
Angola	23	
Cameroon	23	
Gabon	18	
Mozambique	15	
Nigeria	13	
Ethiopia	12	
Congo	11	
Tanzania	10	
Madagascar	8	
Kenya	6	
Guinea	5	
Zimbabwe	4	
Cote d'Ivoire	3	
Sudan	3	
Egypt	3	
Central African Republic	2	
Equatorial Guinea	5	
Ghana	2	
Liberia	2	
Mali	2	
Sierra Leone	1	
Uganda	1	
Malawi	1	
Burundi	1	
Total	294	

VII. WATER INDUCED CONFLICTS

79. The word conflict can be defined in several general terms but the most explicit one is by Wallensteen where he defines conflicts as "social situations in which a minimum of two parties strive to acquire the same set of scarce resources at the same time". Scarcity is the necessity which fuels the conflict.

80. Conflicts may prevail on account of general conditions of mistrust, lack of understanding and suspicion to name just a few.

81. On the African continent, politicians are caught between the legacy from past mismanagement of natural resources on the one hand and future obligations to a rapidly growing population on the other. One of the most common causes of strife or conflict is lack or mismanagement of the finite water resources. If not averted in time such a water crisis can have severe repercussions on human health, food supply and nutrition, the eradication of poverty, human dignity, quality of life and environmental security and peace. All the above situations are potent ingredients for civil unrest.

82. Conflicts over water rights could easily culminate in a global crisis which could be avoided through direct dialogue. In this age of super power collaboration sanctions can easily be imposed on any aggressor, as preventative measures before any military confrontation takes place. Conflicts can be avoided if win-win solutions are found equitably, so that discussions and dialogue can take place in a peaceful environment. The fast depletion of water resources and the problems associated with its management can spark off armed conflicts due to the commodity's scarcity.

83. Fresh water supplies are less than plenty as the uses of water have doubled in the last fifty years and are expected to double again by the turn of the century. Studies conducted so far confirm that water scarcity is a major problem in developing countries. Given the current trend of "resource wars" in which water is a significant factor defines visions of a dangerous situation for all mankind. Decision makers in Africa should invest more in the development of water technologies than is being done currently. This can be achieved by better perception and understanding of the issues involved leading to an equitable solution.

84. The gap between the demand and supply of water is ever-increasing and therefore clear-cut policies and mutually agreed concepts should be worked out now, so as to form the basis of international guidelines for the use of global water resources in the future. National and regional demands for water uses in the future should be addressed as soon as possible in order to avoid water induced conflicts. The issue of water scarcity requires immediate attention as the potential for competition increases, leading to conflicts among riparian countries in Africa where demands of development impose additional pressures.

85. The Dublin Statement for the International Conference on Water and the Environment recognised that water has an economic value which is currently underscored. It is a basic right of all human beings to have access to clean water and sanitation facilities at an affordable price. In this regard, managing water as an economic commodity is an important way of achieving efficient and equitable use of this resource and thus encouraging its conservation.

86. The situation in a river basin shared by several countries is quite different. Here, there is an additional threat, namely upstream agriculture and forestry. These reduce the water flow in the downstream countries. Countries sharing the same river basin should not consider each other as rivals. Experience outside Africa has clearly shown that properly conceived management plans from international water bodies can result in a win-win situation for all concerned parties and the waters of international sources should be used optimally for the benefit of people of all concerned countries. To achieve this goal, African countries need to reconcile the interests of all riparian countries, monitor water quality and quantity, encourage exchange of information, develop concerted action programmes and conclude agreements for equitable rights of use.

87. The hydrographic pattern marks delineation of river basins whereas political boundaries define the number of countries sharing the same water resource. Dependency on international co-operation varies considerably between the two extremes represented by a small river basin in a dry climate region shared by many different countries, on the one hand and a large river basin in a humid region enclosed in one single country on the other. The problem of international water bodies can only be resolved through a multidisciplinary and holistic approach. International river basin organisations need commitment and support from both governments and donors if they are to achieve their objectives.

88. Networking and information-sharing among countries will help to stimulate water-sharing agreements. Informal get-togethers and formalised institutional arrangements both play parts in improving transboundary relationships. Co-operation can be further increased through joint projects (trans-boundary projects) training and applied research programmes; particularly those related to the management of shared resources.

89. A realistic strategy in relation to fresh water resources would be to think regionally and act locally. Governments should be encouraged to accept hydroclimatic and hydrographic constraints and to develop river basin action plans in which local activities and regional projects are seen as fundamental components.

90. Training and education are essential, but only if educated professionals are given the power to implement the management measures decided upon. Additionally awareness raising campaigns amongst the politicians and the general public are also called for. The public should be given a chance to understand the risks they are taking instead of merely left to do so.

91. Integrated river basin action plans offer opportunities for balancing different interests and achieving visions shared amongst different groups and thus avoid conflicts. Shared resources feature prominently in national water resources management plans in most African countries. Resources need to be assigned to the development of basin-wide agreements which require sacrifices but bring many gains.

Components of a Water Crisis

92. The four main components of a water crisis are, quantity, quality, supply and land fertility degradation.

93. Water Quantity Crisis: This is caused by the finite resource and fixed amount of available fresh water on one hand and the increased demand due to the rapid population growth on the other. This situation encourages disputes amongst the national and regional uses resulting in conflicts. The only long-term and permanent solution is to encourage food security and peaceful development.

94. Water Quality Crisis: This occurs because of the mismanagement of waste water from human activities which results in the pollution of the water resources and thus reducing the availability of clean freshwater supply. Discharge of waste from agriculture and industry sources coupled with human waste without proper treatment increases the morbidity and mortality and thus effects human and animal health and aquatic ecosystems in a degrading manner.

95. Water Supply Crisis: This is ever increasing due to urban growth which can create violence and social unrest.

96. Land Fertility Degradation Crisis: This has many water-related causes such as soil erosion, salinization and waterlogging from poorly managed irrigation and acidification.

Concept of Water Induced Conflicts

The Economic Context:

97. Water as a valuable commodity which should have an economic value in all its various uses and all humanbeings should have access to clean water and sanitation facilities at an affordable price.

98. Agenda 21 and the international conference on water and the environment recommended that water being an economic commodity should have an economic value as water is used for economic incentives. This principle can be implemented by the use of a reasonable tariff system and providing incentives for sound responsible uses whilst levying penalties against the misuse as excessive use of water above the necessary requirements.

The Environmental Context:

99. Deterioration of water quality can be considered equivalent to reflection in quantity of water available for various uses in the future. The pollution of water is one of the main concerns of many countries presently as human activities increase all the time and waste products contaminate the available sources of surface and groundwater.

100. Contamination of water resources is a transboundary problem as has been currently evident by the recent events in Rwanda. In this particular instance the disposal of countless dead bodies in Lake Victoria posed grave environmental problems for countries bordering the lake. Efforts at international levels have been mounted to address the issue of water pollution in various conferences which dealt with water issues. Regional co-operation is indispensable for overcoming such problems.

The Political Context of Hydropolitics

101. Geopolitical considerations and hydropolitical implications amongst the co-basin countries cannot be divorsed from technical, legal, economic and environmental issues.

102. Most of the African states depend greatly on renewable resources such as water, soil, fish and forests which sustain much of their economic activities. Transboundary river-water resources have the massive potential of bringing various states into conflicting situations. Almost all the major river systems which are the primary suppliers of water to mankind are shared by more than one country. Such situations mean that upstream withdrawal and pollution might lead to conflicts with down-stream countries.

103. Any transboundary river can be a potential source of co-operation or conflict. The possibilities of stability and peace among the riparian countries are intensely connected to development as there exists a fundamental interdependence among the countries. Consideration should therefore be given to the vulnerable geopolitical position of countries downstream. Accordingly the principle of no harm is high on the agenda of co-operation amongst the riparian countries.

104. However the uneven development of the states sharing the water resources coupled with historical relations and experiences of such countries has great effect on the level of mutual trust between some such countries. Consequently there is dire need to device reconciliatory measures against the contradictory interests and diverse attitudes and perceptions existing among the riparian countries.

Legal Context:

105. Whilst there are international principles that govern international river basins, these represent only broad guidelines. Studies undertaken so far indicate that progress in the legislative field is slower than desirable. However, sufficient progress has been made in what Alexander Kiss calls "The soft law" i.e. legal rules recommended by international organizations which are not juridically binding but which nevertheless have some moral weight.

106. The UN conference on water held in Mar-del-Plata, Argentina in 1977 failed to reach an agreement on how to strike a balance between sovereignty and responsibility on the part of neighbouring upstream countries on the one hand and downstream countries on the other; as well as the problem of confidentiality of water data and so forth. This lack of success reflects the differences between the perceptions of upstream and downstream states and the contradictory interests which are difficult to reconcile when such vital interests are at stake.

Methods of Diffusing Water Induced Conflicts.

107. Legal codes are not always enough for resolving all water problems as most of the countries consider their perceived political and economic self-interests, when considering such water problems. A suitable and acceptable mode should be sought among parties when solving water disputes and the international community should take an advisory role in such matters.

A. Creating an Atmosphere of Co-operation

108. By promoting sustainable co-operation amongst the riparian countries, areas of potential conflicts can be avoided. Strengthening co-operation over a long time period can have the added advantage of solving mutual problems as and when they arise.

109. Co-operation should also be institutionalised covering a wide range of interests (not only water), in which case it can support multinational discussion forums and offer joint approaches for the formulations of national and regional development policies. Co-operation in areas such as trade, communications and cultural interaction can aid confidence building among the riparian countries.

B. Role of International Law

110. The development and application of the international water laws is vital for strengthening and enhancing international co-operation. Such laws should not be in the classical format dealing with rights and obligations of all basin states. In fact it should be a comprehensive package covering all issues related to co-operation and development such as:-

a) The collection, exchange and standardisation of data.

b) Established criteria for identifying priority use.

c) Guidelines for basin-wide development plans.

d) Construction, operation and maintenance of works.

e) Settlement of disputes.

C. Mechanisms and Techniques for Confidence Building

111. It is very clear that water induced conflicts can never be sorted out through military action. On the contrary, experience has proved that any conflict can be sorted out by the creation of an atmosphere of confidence which can be achieved by devising mechanisms where mutually agreeable decisions can be reached.

Some of these mechanisms and techniques are as follows:

a) Negotiations among riparian countries can reconcile their conflicting interests and thus prevent conflicts, thus offering protection and development of natural resources.

b) Encouraging joint fact-finding missions to analyse specific issues of mutual concern and therefore build positive interactions amongst people concerned with water issues.

c) Designing any mechanism for conflict resolution should pay special attention to the environmental aspects and integrated ecosystems.

d) Use of the mass media is crucial in raising public awareness about depleting vital resources.

e) Concluding frameworks of co-operation which require the concerned parties to organise co-operation on the lines of conciliation of conflicting interests.

D. Institutional Framework

112. Establishment of new organisations and strengthening the existing ones as mechanisms for regulating potential conflicts. Such institutions can notify the riparian countries on new projects and obtain responses or objections to any such projects. Such institutions should have the necessary political and financial backing, to promote regional agreements.

VIII. UNITED NATIONS INITIATIVES ON WATER FOR AFRICA

113. The United Nations has always been greatly concerned about African development and has also played a major role in ensuring peace and stability in many African countries. The U.N. has always supported the socio-economic development of the continent through various programmes and in collaboration and co-ordination with other international organisations and potential donor agencies. Some of these initiatives are summarised below:-

a) The Secretary General's Initiative for Africa (1995)

114. The African continent is at a critical turning point in its history and it is also beset with economic and social crisis. At the same time it is also a continent on the march, full of promises. The former aspect has been the common perception about the continent with economic decline, falling per capita incomes and worsening social conditions. This has led many to characterise the 1980's as the "Lost decade" for Africa.

115. It is not fair to generalise this picture of African development as there are significant divergencies in economic performance between countries and across sub-regions. Increased population growth, political instability and civil wars have negatively impacted sustained economic growth in some countries and sub-regions. Over the years the UN has launched various initiatives in favour of Africa. The United Nations Programme of action for African Economic Recovery (UN-PAAERD) and its successor, the United Nations new agenda for the development of Africa in the 1990's (UN-NADAF). There were also efforts to co-ordinate activities of the UN system in Africa through the system-wide plan of Action for African Recovery and Development.

116. Based on the challenges facing African development and to test international co-operation for development, the Secretary General of the Untied Nations launched the special initiative on Africa, so as to reinforce the previous initiative and avoid duplication.

117. This special initiative determined five priority areas as identified by African leaders to cover food security, water, social and human conditions, governance and resource mobilisation issues. It also gives the African countries guidelines for development through strengthening civil society and establishing peace. In this way it offers hope to coming generations of Africans.

118. The initiative's main objective is to identify and develop practical proposals to maximise the support provided by the UN system towards African development and to accentuate the priority given to Africa in the international agenda. Most of the funds for the special initiative will be used towards national programmes of action locally defined and managed. It will focus on issues of highest priority and mobilise and co-ordinate efforts by African governments and development partners in achieving developmental goals throughout Africa.

Agenda 21 Chapter 18 (UNCED 1992)

119. A global conference in Environmental and Development (UNCED) was convened in Rio de Jenerio in 1992 to raise awareness amongst the international community regarding environmental degradation and its impact on mankind.

120. One of the outcomes of the conference was chapter 21 which provides a new challenge to all those concerned with global and local environmental issues, fresh water and other natural resources management. Attention focused on fresh water reserves is identified in Chapter 18 which focuses on fresh water resources.

Chapter 18 of Agenda 21 proposed programme areas for the fresh water sector as follows:-

a) Integrated water resources development and management.

b) Water resources management

c) Protection of water resources, water quality and aquatic ecosystems.

d) Drinking water supply and sanitation

e) Water and sustainable urban development

f) Water for sustainable food production and rural development.

g) Impact of climatic changes on water sources.

121. Chapter 18 covers each programme intensively by giving guidance to member states on the basis of action, objectives, activities and means of implementation. In the end it encourages each country to formulate its actions according to its individual needs.

C. Follow-Up for Agenda 21 (UNEP 1995)

122. Agenda 21 doesn't specifically refer to the regional context of environmental problems and their management. Since regional co-operation is vital in the implementation of Agenda 21, UNEP and the ECA initiated a forum for government designated experts to discuss the implementation of Agenda 21 for the integrated management and use of water resources.

123. Participants presented their country papers focusing on and highlighting the progress made as well as the constraints encountered in the implementation of Chapter 18 of the Agenda. Implications of the implementation at regional levels were thoroughly discussed and in the end

it was concluded that their recommendations should be considered in regional plans at regional and national levels.

WMO/ECA Conference on Water Resources Assessment (1995)

124. Following the findings and recommendations of the UNDP/ World Bank Sub-Saharan Hydrological Assessment Project and the UNESCO/WMO evaluation of water resources assessment and in line with the principles of Chapter 18 of Agenda 21, the WMO and the ECA jointly organised a regional conference for representatives of the water resources agencies of Africa. The aim of the conference was to prepare a strategy and action plan to rehabilitate, build and/or adapt the institutional, financial, manpower and technological capacity of the relevant services of the countries and regional bodies concerned, so as to enable them to assess water resources within the context of integrated and comprehensive development and management for socio-economic benefits on sustainable basis. The outcome of the conference was in the form of a document entitled "Policy, Strategy and Action Plan for water resources assessment in Africa."

125. The strategic actions recommended by this conference are in the areas of management, capacity building, promotion and creation of awareness of the capacity of the hydrological services and the value of hydrological data, attainment of sustainable financial capacity, integrated water management, regional and subregional initiatives and responses and a new role for external support agencies. This strategy was endorsed by the ECA's conference of Ministers and the WMO Governing Council. The ECA and the WMO then took a leading role to promote the strategy to appropriate authorities at national, sub-regional and regional levels and also to external supporting agencies.

World Bank's African Water resources Strategy

126. Two workshops with the theme "Water Resources Management in Africa" were sponsored by the World Bank recently. They covered areas of challenges and opportunities for sustainable development focusing on partnership and promotion of efficiency and equitable use of the water resources in Sub-Saharan Africa.

127. The first workshop was held in Nairobi in February 1996. Twenty one countries from eastern and southern Africa participated in the workshop. The second workshop also in February 1996 was for twenty countries from western and central Africa. Representatives from UN agencies,bilateral donors and non-governmental organisations were represented at both conferences.

128. The workshops brought together a range of stake holders like governments, NGO's, UN agencies and bilateral donors. The aim of the workshops was to convert the analysis and action-orientated recommendations in the strategy paper into results which will improve the living

conditions of all Africans. The process needs to be continued with discussions with more stakeholders like the private sector, community groups, academic and research institutions.

129. The World Bank is intending to set its own agenda by integration of the African perspective into its analysis in the implementation of its African Water Resources Strategy.

Interagency Group For Water in Africa IGWA (1992)

130. Co-operation, harmonisation and liaison with international organisations, UN agencies, regional and subregional, intergovernmental, and non-governmental organisations on water development and management activities has been one of the priority areas of activities covered by the ECA. For this reason, in 1992 the ECA took the lead role in establishing a consultation mechanism for interagency collaboration called "Interagency Group for Water in Africa" (IGWA). The ECA was designated to serve as the IGWA secretariat.

131. The main objective of IGWA is to promote dialogue amongst all bodies dealing with water activities in Africa by holding annual meetings.

The duties of the group are:

(i) Co-ordination and harmonisation of water resources activities by member agencies in Africa at the sub-regional and regional levels through exchange of information about their water programmes.

(ii) Promoting collaboration and joint activities and providing the necessary assistance in working out modalities for implementation.

(iii) Dissemination and compilation of information on activities in water resources management in Africa.

(iv) Interagency co-operation through training, capacity building and the management of river and lake basins.

Other International Programmes

132. Some of the international programmes currently addressing water related issues are:

(i) The United Nations Convention to Combat Desertification in countries experiencing serious drought in Africa. It focuses on soil problems in dry regions with water scarcity, land based sources of marine pollution and it also draws attention to water and its role as a mobile carrier of pollution from land to river and coastal waters.

(ii) The debate on the world food security programme stresses the key role of water in food production.

(iii) The United Nations water Conference (Mar del Plata 1977) focused on safe drinking water and sanitation facilities. Efforts have been made to ensure safe drinking water and sanitation facilities though, the net effect of the conference has been slightly off-set by population increases.

IX. CONCLUSIONS

133. The current food security and environmental degradation crisis is probably the most serious threat faced by humanity. The main cause of all this is the water resources crisis.

134. The threat to regional food self-reliance and overall food security is particularly serious though it is poorly acknowledged globally.

135. Africa is a continent suffering from both, a complex water scarcity and large-scale land degradation. Africa needs to increase its food production through a revolution more serious than the Green revolution. In some areas of the continent, industrial development may be delayed due to problems of water supply, escalating pollution and groundwater over exploitation. In other areas, competing claims for additional water may be incompatible, such as when upstream use expands at the expense of the downstream uses, or when urban supplies are favoured at the expense of rural citizens.

136. Acute shortages of water are currently experienced in Africa. These wide-spread scarcities coupled with gradual destruction and aggravated pollution of the fresh water resources create vulnerable conditions which could result in a serious crisis of this finite resource. Pollutants have been introduced into water bodies which causes water quality degradation.

137. The progressive encroachment of incompatible activities that are characteristic in most parts of Africa have always pointed towards the need to plan optimum utilization under stable policies and programmes for development and management of water resources.

138. The potential for water resources development in Africa hinges on appropriate policy reforms and legal instruments being put in place. The Earth Summit in 1992 was only to raise awareness. Policy and action plans were left to individual countries to decide. It is high time, the African countries realised that they cannot depend on external support always. They should prove their independence and strengthen their technical co-operation through exchange of experience and technology as well as the utilization of their human resources to gain confidence and support from donors.

139. A combination of technology advances, conservation measures and population growth control will yield more desirable results in the fight against water resources depletion. New technological methods are to be considered in the transfer of water from surplus areas to deficit areas and also to reuse and recycle water indefinitely. Water purification techniques also have a role to play since they facilitate water recycling and reuse. By investing in technology Africa would be addressing future water resources needs and avoid conflicts arising from consumers.

140. African countries need to be the driving force in implementing any new Agenda and their determination and commitment will be the cornerstone of its success.

141. Opportunities to share information like those provided through regional and specialist groups are a key part of the development process.

142. Land-use manipulations of water flow determinants have caused changes in flow regimes. Similarly manipulation of soil and vegetation in regions with vulnerable soils have caused desertification in some areas of the continent. At the same time, poor management of irrigation systems has caused water-logging and salinization of fertile soils.

143. Water administration is fragmented in all aspects with different water issues being addressed by different authorities. There is an overlying lack of communication amongst the various departments resulting in lack of proper legislation.

144. There is a strong desire among the African countries sharing waters from international rivers to achieve national and equitable share of the water and to manage the river basins in an integrated manner.

145. Clear policies and strategies are prerequisite to addressing problems facing African countries so as to achieve sustainable integrated management of the water resources.

146. Management of water resources can be made more effective by looking at it in a long-term perspective and considering national projects on regional basis rather than as individual projects which lead to fragmentation and inefficiency in the utilisation of the resources.

147. Political and environmental problems in Africa hinder the ambitious water resources development plans.

148. Raising awareness of the value of water and the need to conserve water quality and quantity are issues requiring urgent attention.

149. Better farm water management through the employment of sprinkle, drip irrigation, recycling irrigation water and levelling of fields could yield as much as 50% of water savings.

150. Conflicts over water rights could easily explode into a global crisis which can easily be avoided through direct dialogue. To sort out any water induced conflict, an atmosphere of co-operation, adherence to the rules and principles of international law, special mechanisms and techniques of confidence-building and an effective institutional framework are prerequisite conditions.

151. Solving water induced conflicts requires an integrated and holistic approach dealing not only with the narrow aspect of rights and obligations in legal terms, but also with water issues in a wider context by considering economic, environmental, political and legal issues of jurisdictional nature.

152. The development and management of international river basins is becoming an increasingly critical issue. Considerable efforts at national and regional levels are needed in order to achieve its goals.

153. Economic instruments and conservation measures for demand-management approaches are an important part of strategies to extend the life of existing resources and offer acceptable solutions towards the implementation of projects.

154. Water pricing has always been a sensitive political issue but it has to be recognized that it offers a way of achieving useful and equitable use of water supplies. In this way it ensures the prime aim of extending water services to the urban and rural areas and at the same time recovering costs for the production and maintenance of such services. It also offers initiatives for taking up new water projects.

155. Both men and women have vital roles to play even though they have different roles. The gender issue is very important and African countries should use approaches which take into consideration the gender issue. This is one way of ensuring the programmes to be more effective.

X. RECOMMENDATIONS

156. There is an urgent need for Africa to take the necessary action in order to improve the water situation and thus avoid water related conflicts. The development of the African water resources will not only enhance the well-being of the countries but it will also serve to build-up adequate social and economic conditions, with the final result of self-sufficiency. The following actions are recommended in order to achieve sustainable development and thus prevent any water-related conflicts.

157. An effective action plan should at least cover the following features:-

a) Clear-cut objectives

b) Potentials should be developed in a well-defined time period. Phases should be introduced with acceptable and realistic progress towards realistic goals.

c) The physical, socio-economic, environmental and institutional systems influencing final objectives should be considered.

d) The disciplines involved in the formulation of action plans with the necessary implementation and monitoring of progress achieved.

e) An inventory of all relevant factors in the existing situation as starting and reference points.

f) Clear indicators to monitor the progress.

g) Clear description of actions and appointments of people involved in implementation processes.

158. The future of water resources management strategies should be based on country-driven approaches making optimum use of indigenous resources and limiting the external technical assistance to plugging capacity gaps of the individual countries. There is also an urgent need for increased awareness amongst the African leaders so that necessary strategies can be worked out for development under conditions of severe water scarcity. Such strategies would curb the present multi-risk spiral from producing repeated collapses during recurrent drought seasons in many African countries.

159. Regional political involvement at the highest level of government is needed to articulate national water resources strategy that is fully integrated into national planning. Networking and information sharing among countries will help to stimulate water-sharing agreements.

160. Informal get-togethers and formalised institutionalised arrangements both have parts to play in improving trans-boundary relationships. Co-operation can be further increased through joint projects, training and applied research programmes, particularly those related to the management of shared water resources.

161. African countries should adopt the concept of "think regionally, act locally" to ensure equitable sharing of fresh water for the benefits of all the people in the riparian countries. Governments should be encouraged to accept hydroclimatic and hydrographic constraints and to develop river basin action plans in which local activities and regional projects are seen as fundamental concepts.

162. Regional co-operation is a challenge facing the whole of Africa and there should be suitable mechanisms for regional co-operation and conflict resolution. A permanent body should be set up under the auspicious of the OAU with a suitable steering committee from all the UN bodies, international donors and river-basin organisations to look into problems, identify priorities and monitor funds for development projects.

163. The UN should encourage regional understanding and strengthen regional co-operation on the integrated management and development of transboundary water resources. The UN and the OAU should pursue their deliberations on the question of water and conflicts in Africa. Appropriate steps should be taken to raise the awareness of states of the finite water resources as well as the prevention of conflict by staging an African conference addressing the particular issue this conference to be organized by ECA and OAU in close collaboration with other UN agencies and international donors with the theme "Peace and development" and to discuss all the issues related to development in Africa. The conference could lay the basic guidelines and principles of securing peace in the region. Such guidelines could then be implemented in the future.

164. The UN should assist and encourage research on survival issues such as intensification of rain-fed agriculture in dry climate regions with a rapid population growth. Also the UN should assist the African countries in the formulation of development strategies for sustainable development and in the evaluation of integrated national and regional action plans.

165. The Interagency Group of Water for Africa (IGWA) should be more effective and the member agencies should work more closely in implementing their programmes in Africa. IGWA can and should be strengthened further by encouraging all the UN agencies, bilateral and multilateral donors to join the group. All the river basin organisations of Africa should also be encouraged to participate in the IGWA deliberations.

166. Co-ordination amongst national and regional water authorities should be strengthened for effective and efficient services. Water institutions at national, regional and subregional levels require capacity building.

167. Political will to co-operate on transboundary water bodies at the sub-regional and regional levels should be enhanced and backed by concrete actions and direct linkages should be established amongst all the water resources management strategies in the region.

168. Since shared resources feature prominently in national water resources management strategies in Africa. Such resources need to be assigned to basin-wide development agreements which involve tremendous sacrifices but bring gains to all concerned.

169. Irrigated agriculture consumes almost two thirds of the water supplies from rivers, lakes and aquifers. To ensure sustainable water use, top priority should be given to irrigation efficiency by applying improved irrigation techniques.

170. To promote efficiency in water departments, financially viable systems are needed as well as policy structures that allow flexibility towards changing economic situations and avoiding duplication of responsibility.

171. New approaches are needed with donors to provide support on a multisectoral and multicountry basis to encourage effective joint management of the water resources. It must be ensured that the African development is compiled by Africans for Africans and implemented for the indigenous needs of the Africans.

172. Africa must evaluate its responsibilities towards maintaining sustainable development along realistic lines. Policies promoting political goals may have to be shelved or forgone in favour of viable existence of the African countries.

173. Construction of water works which might interfere with other countries water supplies should be undertaken with prior consultations.

174. Training and education of water resources personnel is essential. At the same time public campaigns to raise the people's awareness is also called for. This would result in a better public understanding of the finite water resources and how best to use them.

175. In areas where water is scarce, the demand must be minimised and water productivity must be maximised.

176. Integrated river basin action plans offer better opportunities to balancing different interests and achieving shared visions. In this way water-induced conflicts can be avoided.

177. Undertaking land/water orientated action plans to achieve balanced development of river basins, taking into account the relevant factors such as demographic, economic, ecological and the agronomic potentials of the basin. Careful attention to be directed towards urban/rural and upstream/downstream competition for water.

33. Realism and the time dimensions should be introduced when thinking of development plans. It is necessary to be aware of the limited mechanisms and tools available to Africa presently and in the next few decades.

178. Identification of technologies available to increase the actually accessible potential of water i.e. water reuse, ground water storage, dams etc. Potential availability such as desalination, water transfer should be increased as well as irrigation efficiency. Water consumption to be decreased as much as possible.

179. Water in aquifers, rivers and lakes needs to be shared along three complementary levels:

a) Local sharing amongst water dependant sectors and users such as households, industries and irrigated agriculture.

b) Urban/rural sharing.

c) Upstream/downstream sharing by sequential sharing through strategies including deliberate methods of pollution avoidance.

180. Water availability has to be assessed as a basis for long-term national water master plans - analyzing the optimal use of limited water supply available for socio-economic development.

181. A general national water strategy for socio-economic development has to be formulated, based on the availability of water, constraints emerging from and permitting a household supply. Additionally low water-use for agriculture and industry to be encouraged.

182. Top-level autonomous national authorities for integrated land and water management have to be established. The concerned countries together with donor agencies and the UN have to face this alarming threat with extreme urgency.

183. The mechanisms applied to the planning, development and management of water resources and other economic development sectors should integrate the main groups of society related to such activities with emphasis on women's role. This requires the establishment of partnerships between the public sector, NGO's, private sector and community organisations to make efficient use of all the capacities available at local levels.

184. Efforts are needed to reduce water pollution, improve water quality, particularly drinking water and curb the spread of water borne diseases. Waste water should be recycled and utilised where feasible for agricultural purposes. Low quality water such as brackish water should be used for agriculture.

185. In Africa, water strategies have to be truly multisectoral and should be integrated into the broader economy. An integrated approach to the planing and arrangement of water resources is needed so as to treat water resources as an integral component of economic management. Definitive links between water issues and other sectoral activities should be established. Overall strategies to achieve sustainable socio-economic development are also needed to work at the whole water cycle, including conservation of resources, operation and management of water supply, waste water treatment and disposal facilities and the interaction of land use in maintaining a sound environment. It is also necessary to achieve the interaction of the ecological system within the package of natural resources development and management.

186. There is a great need for developing ways of drought proofing, rain-fed agriculture in semi-arid marginal lands, developing methods for rain water harvesting and soil moisture management. One way of combating drought and desertification would be to impound and store part of the annual water flow wherever possible using surface reservoirs and underground water basins. For example 4,200 million cubic metres of river water and groundwater in Africa return to the sea each year. Utilization of only 10% of this water would enable the irrigation of 13 million hectares of land.

187. New regulatory measures and economic incentives are required to support sustainable industrial development. Energy and water pricing policies can encourage industries to use water more efficiently and thus promote rational use of the water resources.

188. There is need to incorporate flood control and protection in development schemes. It is also necessary to improve structural and non-structural measures such as flood warning and forecasting systems.

189. Countries should improve their climatological, meteorological and hydrological services. Existing networks should be refurbished regularly to allow surface and ground water quality and quantity assessment. Data procured should be analyzed regularly and the up-to-date knowledge of these resources should be emphasized for its economic value for prospective investors.

190. The existing river/lake basin organisations should be strengthened in order to ensure successful integration of the land and water within the basin. Where river/lake basin organisations don't exist, they should be created to promote co-operation and thus ensure sustainable basin-wide development.

191. Inter basin transfers may be the answer for long term solutions to drought hazards in certain parts of Africa. By establishing links between basins, large volumes of water could be retained within the African continent, especially in the interior basins which are currently drying up . Ground water recharge could help increasing irrigation potentials and thereby curb the impacts of drought. Excellent benefits can be derived from regional basin transfers involving a number of countries. Of course the problems of national, bilateral and multilateral policy issues will have to be looked into so as to enhance co-ordination in the management of the inter basin transfer systems.

192. Rainfed farming represents the majority of subsistence farming and when there is no rain, drought and famine occur. There is an abundance of untapped ground water in the continent which can be utilised to solve water problems in different countries.

193. Only 2% of cultivated land is under irrigation in Sub-Saharan Africa. This is insignificant compared to the total amount of Africa's possible irrigated land which is equivalent to 15.7% of its arable land. If Africa's arable land could be cultivated, the continent could attain food self-sufficiency and for export purposes.