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REVIEW OF PROGRESS ON WATER-RELATED ISSUES

## Water resources: progress in the implementation of the Mar del Plata Action Plan and of Agenda 21 on water-related issues

## Report of the Secretary-General

SUMMARY

The present report to the Committee on Natural Resources at its second session has been prepared in accordance with Economic and Social Council resolution 1993/302. The report endeavours to provide an updated overview of conditions prevailing with regard to the assessment, development and use of water resources in the context of the interrelation between population, land and water resources, and the constraints with regard to sustainable development arising from widespread poverty. The report indicates that water shortages are becoming a common occurrence in industrialized and developing countries alike, and that the world may be reaching a water crisis situation of global proportions.

With regard to water resources assessment, this report concludes that serious problems persist in developing countries. With regard to water supply and sanitation, the report voices serious concern about trends in water-supply coverage in urban and rural areas of Africa, and about urban sanitation in Africa and both urban and rural sanitation in Asia. The available information also suggests that Governments are subsidizing services to the better-off population at higher levels rather than to the urban low-income population and

* E/C.7/1994/1.

rural areas, and that priority investment continues to flow into the urban sector, the bulk of it being directed towards the better-off population. As far as water for agriculture is concerned, this report presents estimates for the expansion of agricultural production to the year 2000, as well as cost figures related to those estimates.

As regards the management of water resources, the available information suggests that while a number of countries are endeavouring to implement recommendations stemming from Agenda 21, 1/ organizational fragmentation and lack of integration with the economic planning process persists. This report concludes by suggesting that if significant progress in all areas of water resources assessment, development and management is to be achieved, Governments need to give attention to the establishment of a dynamic interactive, iterative approach to water resources management, and that Governments that have not done so need to undertake a diagnostic assessment of their institutional arrangements and human resources capacity as a first step towards formulating a strategy and action plan for the years to come.

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# INTRODUCTION

1. The present report is submitted to the Committee on Natural Resources at its second session in accordance with Economic and Social Council resolution 1993/302, in which the Council approved the provisional agenda and documentation for the second session of the Committee.

2. Given the short time that has elapsed since the United Nations Conference on Environment and Development, and the even shorter time that has elapsed since the first session of the Committee on Natural Resources, little new information is available that would permit an in-depth evaluation of developments and trends in response to the relevant recommendations of the United Nations Conference on Environment and Development as contained in chapter 18 of Agenda 21. 1/ At the time of the writing of this report, some countries had provided information concerning the implementation of chapter 18 of Agenda 21 in their country reports in connection with the second session of the Commission on Sustainable Development. Some additional information was obtained from the regional commissions and from various organizations of the United Nations system.

3. This report provides an updated overview of conditions prevailing with regard to the assessment, development and use of water resources as background for the consideration of specific policies and programmes that may be required to implement the recommendations of the Mar del Plata Action Plan 2/ and those of chapter 18 of Agenda 21. To the extent that information is available, the report also endeavours to provide information about recent institutional responses to Agenda 21, and policy developments that indicate the emergence of new approaches to pressing water resources development and management issues.

# I. CRITICAL ISSUES FOR THE 1990s

## A. Poverty, development, land, urban growth, water and population

4. The concept of water as a finite and vulnerable resource stands out as the very basis of the International Conference on Water and the Environment, held in Dublin, Ireland, in January 1992, and of chapter 18 of Agenda 21. The importance of that concept can best be grasped through the observation by the World Commission on Environment and Development that global water use, which had doubled between 1940 and 1980, would redouble by the year 2000, and that some 80 countries, with 40 per cent of the world population, were already suffering from serious water shortages. 3/ The world population, which in 1990 totalled 5.3 billion people, is expected to increase by approximately 1 billion people by the year 2000. Approximately 93 per cent of the increase will take place in developing countries, particularly in Asia (61 per cent) and Africa (23 per cent).

5. The bulk of the population increase is taking place in urban areas. In fact, in Latin America and the Caribbean as a whole, and in the more developed regions, rural population is expected to decrease. In Asia, approximately 73 per cent of the total population increase will take place in urban areas, while in Africa the corresponding estimate is 54 per cent.

6. The magnitude of the problem concerning urban growth in developing countries is indicated by estimates that show that while in 1980, 19 of the 30 largest urban agglomerations were located in developing countries, by the year 2000 the total is expected to increase to 22, with each having an estimated population ranging between 6.7 million and 22.6 million people. While there were 2 cities in Asia (including Japan) with a population exceeding 10 million in 1980, there were 7 such cities by 1990, and it is estimated that their number will grow to 13 by the end of the century. The number of people in Asia living in those mega-cities by the end of the century will be over 5.5 times larger than in 1980. The number of inhabitants in cities with 1-5 million people will more than double, and the number of those living in cities with 1 million people or less will nearly double. By the year 2000, some 24 million people in Africa will be living in one or the other of two cities with population exceeding 10 million, and the population in cities with 1-5 million people will have grown by more than 350 per cent since 1980. In Latin America and the Caribbean, the population living in cities with 500,000-1 million people, 1-5 million people or over 10 million people will more than double over this 20-year period.

7. As mentioned in the report of the Secretary-General to the former Committee on Natural Resources at its twelfth session, held in 1991 on strategies and measures for the implementation of the Mar del Plata Action Plan in the 1990s (see E/C.7/1991/8, para. 16), the availability of safe water in urban centres is fast becoming one of the most important factors limiting socio-economic development, and is a crucial indicator of the quality of life in urban development. The rapid growth of urban centres also brings with it a general demand for more food production, with its implications of intensified cropping and increased competition and conflicts among various water uses.

8. The pressures on land and water resources from increased urbanization and increased demand for food production are illustrated by estimates of the Food and Agriculture Organization of the United Nations (FAO) that 110 million hectares (ha) of land with agricultural potential in all developing countries, excluding China, will need to be claimed for human settlements and agricultural use by the year 2010. FAO further states that while these requirements would appear to be small when compared with a figure of 1.8 million ha. of land with agricultural potential not occupied by either of these two uses, "land scarcities are very acute in some countries and regions, namely South Asia and Near East/North Africa. Even the small increases foreseen for them are a significant part of their still unused land. For example, the increments for these two uses would claim about 40 per cent of the still unused land with agricultural potential in South Asia". 4/ FAO further estimates that, "additional land for agriculture in South Asia will be needed even after allowing for further intensification. The latter could raise cropping intensities from 100 to 120 per cent and double the fertilizer use rate per ha". 5/ FAO concludes that constraints vis-à-vis the availability of water for agriculture will be even more severe than land constraints. According to FAO, "the increasing claims on agricultural land for non-agricultural uses are minor when compared with those placed on water resources, because the per caput non-agricultural use of water tends to rise very rapidly with urbanization and industrialization". 6/

9. While in the past there was a tendency to regard water problems as being local or regional in nature, there is now a growing recognition that their increasingly widespread occurrence is quickly adding up to a crisis of global magnitude. As shown in figure I, water scarcity relative to demand is no longer a problem in arid or semi-arid areas alone, but is now a common occurrence in both developed and developing countries alike. Furthermore, the waste/assimilative capacity of freshwater bodies adjacent to many urban agglomerations is being outstripped, and there are few parts of the world that are still exempt from problems of degraded water quality and the pollution of surface or groundwater sources.

10. In Agriculture: Towards 2010, FAO states that overextraction of groundwater, while most acute in the Near East, is a growing problem in many areas, and is also a problem in large areas of South Asia, where food is heavily dependent on irrigation. According to FAO, "overpumping in these areas is causing water levels to fall beyond the reach of shallow tube wells, with the risk that irrigation may eventually become too expensive or physically impractical". 7/

Figure I. Per capita water availability, by region, 1950-2000

(Thousands of cubic metres)

11. Under pressure from population and economic growth, it is expected that problems related to food production will be exacerbated by a deterioration of water quality, and a degradation of existing irrigation systems to the point where they have to go out of use. Degradation of soils is estimated to affect some 1.2 billion ha of land world wide, of which 450 million ha are in Asia, 320 million ha are in Africa, 227 ha are in the American continents and 158 million ha are in Europe. Deforestation and overgrazing are each estimated to account for about one third of the total area affected, while the bulk of the remaining area affected is attributed to mismanagement of arable land. 8/

12. While problems are becoming increasingly global in scope, their solutions are far from uniform, depending on the level of income of the population. For a large part of the world, the issue of sustainable land and water resources development is intimately related to that of poverty. To the very poor, who may barely eke out a living in rural or periurban areas, concerns about the degradation of the environment, if any, will take a back seat to concerns about day-to-day survival. The modern sector and mass poverty coexist in the vast majority of developing countries. Both elements bring with them obstacles to the sustainable development of land and water resources. Without a concerted effort to deal with economic growth, poverty and a more equitable distribution of income, developing countries will not be able to cope with issues related to the long-term sustainability of land and water development. Sustainable land and water resources development is inextricably linked to the formulation of socio-economic policies and programmes aimed at economic growth and poverty reduction.

## B. Water resources assessment

13. Water resources assessment of surface water and groundwaters, including their quantity and quality, remains an essential prerequisite of the sustainable development and management of water resources. It is fundamental to virtually every use of water, whether that use be for drinking-water supply or irrigation, hydropower production, or the dilution and carriage of wastes. In addition, the data produced contains signals regarding how sustainable the activities are that are carried out around the basins being sampled. Yet at a time when demands for water are rising rapidly and the need for sustainability is gaining increasing recognition, hydrologic services, particularly in the developing countries, are becoming less capable of assessing national water resources.

14. A description of issues and recommendations concerning water resources assessment is contained in the report of the Secretary-General to the former Committee on Natural Resources on strategies and measures for the implementation of the Mar del Plata Action Plan in the 1990s at its twelfth session (E/C.7/1991/8). That report was based on the findings of regional surveys carried out by the World Meteorological Organization (WMO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) as part of a United Nations Development Programme (UNDP)-financed project to assess progress in the implementation of the Mar del Plata Action Plan. A more detailed description of the findings is contained in the WMO/UNESCO report entitled "Water resources assessment: progress in the implementation of the Mar del Plata Action Plan and strategy for the 1990s".

15. Since the 1991 report of the Secretary-General, there has been little evidence to indicate that major positive changes have taken place or that progress has been achieved. The situation in Africa continues to be critical. The UNDP-financed World Bank project aimed at evaluating the status of existing hydrologic data-collection systems of the countries of the Southern African Development Community (SADC) concluded that "the overriding constraints are financial and managerial. Few countries now have services which can be compared favourably with those existing 10 and 20 years ago. No country has a service which is adequate as a basis for sustaining the many water developments which can be expected in the region in the coming decades". 9/ The study went on to conclude that "manpower is rarely sufficient to allow data-collection agencies to meet their obligations, with establishments being too small and manpower skills insufficient for the workload". 9/ Latin America and the Caribbean, as well as Asia and the Pacific, continue to face considerable problems. In addition, conditions in Eastern Europe and successor States of the former Union of Soviet Socialist Republics (USSR) have recently worsened to the extent that many nations in Eastern Europe and Central Asia have suffered serious reductions in their hydrologic services.

16. The above-mentioned WMO/UNESCO regional assessment indicated that there was a direct relationship between levels of economic development, the importance attached to water resources assessment and the budgetary resources allocated for that purpose. In general, however, water resources activities tend to lack sufficient recognition in developing countries even at relatively high levels of per capita income. According to one author, "there seems to be little recognition that the design and operation of projects involves more risk the less hydrological data are applied to them." 10/ In this respect, the situation is particularly acute in Africa.

17. In response to the needs expressed by the International Conference on Water and the Environment and the recommendations contained in chapter 18 of Agenda 21, UNESCO and WMO, with the support of the World Bank, are promoting a major long-term initiative to improve knowledge of the hydrologic cycle through the development of a World Hydrological Cycle Observation System (WHYCOS). The initiative aims to alleviate the deficiencies that exist at the national, regional and global levels with respect to data required for effective water resources management and sustainable development. The proposal envisages the creation of a world-wide network of key stations linked by satellite with an associated quality-controlled database. WHYCOS would employ existing measuring stations where these met specifications, as well as upgraded and new ones. The WHYCOS network envisages the measuring of river flow and water-quality variables, as well as on-bank temperature, humidity, radiation, wind speed, barometric pressure, precipitation and several related variables. The proposed WHYCOS programme would employ the existing WMO World Weather Watch system where applicable, and would in turn contribute data to it, as well as to the Global Climate Observing System (GCOS) and to the Global Terrestrial Observing System (GTOS).

18. The initial focus of attention of the WHYCOS programme would be in Africa, in view of the seriousness of the situation in the African region. The estimated funding needed for this purpose would be about US$ 14 million for the initial 6-year period of a 20-year programme. Similar approaches are being

developed for Latin America and the Caribbean, for countries bordering the Mediterranean Sea and for the basin area of the Aral Sea.

## C. Drinking-water supply and sanitation

19. Improved information concerning water supply and sanitation coverage at the country level is being obtained through the WHO/UNICEF Joint Monitoring Programme, which aims to assist Governments in monitoring their water and sanitation sectors. The Programme has yielded improved information in 82 countries, and permitted some update of the information presented to the General Assembly at its forty-fifth session in the report of the Secretary-General on the achievements of the International Drinking Water Supply and Sanitation Decade, 1981-1990" (A/45/327).

20. Based on the information received by the Joint Monitoring Programme from countries in the African region, the percentage of the urban population with safe water-supply and adequate sanitation in 1990 was significantly lower than had previously been estimated. More than 25 per cent of the people in Africa have no access to safe water-supply, and more than 40 per cent do not have adequate sanitation. Under such conditions, the lack of coverage expected by the year 2000 becomes alarming. The newly reported figures for rural water-supply, representing about 59 per cent of the total rural population of the region, also indicate a lower coverage than had been reported initially (35 as against 42 per cent). By contrast, the percentage of rural inhabitants with adequate sanitation appears to be higher (33 as against 26 per cent).

21. In the case of the region of Asia and the Pacific, the new data indicate that in urban and rural areas there is a higher proportion of people with safe water-supply than was reported initially (83 as against 77 per cent, and 74 as against 67 per cent, respectively), but there is a lower proportion of people with adequate sanitation services (62 as against 65 per cent, and 49 as against 54 per cent, respectively). Consequently, the decreasing trend in relative urban sanitation coverage by the year 2000 remains a cause for serious concern. The number of countries providing information in the region of Latin America and the Caribbean and in Western Asia do not constitute a sufficiently representative sample of the regions' total population to allow a revision of the previous data.

22. With regard to levels of funding for operation and maintenance, the 1993 report of the Joint Monitoring Programme indicated that it had been found that "Governments are subsidizing water systems and sanitation services to the better-off populations by around 70 per cent of recurrent costs, as compared to approximately 50 per cent towards the lower levels of service provided to the urban low-income and marginal areas, and less than 40 per cent of the much lower operation and maintenance costs (O & M) in the rural areas". 11/ It was also noted that "in urban areas, Governments provide a larger proportion of the costs of running the systems than either the communities themselves or the external support agencies. Communities appear to contribute most to O & M in rural areas where external support agencies are also most active". 11/ In terms of funds allocated to operation and maintenance, the Joint Monitoring Programme has found that, even though information is meagre, "it is clear that unless funds are

increased significantly, systems sustainability will not be attained in most instances". 11/

23. The report of the Joint Monitoring Programme also dwells on the differences in service levels provided to populations with high-income and low-income levels. According to the Programme's findings, globally about 40 per cent of the population with access to safe water-supply have in-house connections. Of these, 64 per cent are high-income urban dwellers (constituting about 80 per cent of the total in this class), about 10 per cent are categorized as belonging to the low-income urban class (less than 20 per cent of low-income residents), and about 26 per cent are rural dwellers (less than 5 per cent of the rural residents provided with safe water). In addition, approximately 8 per cent of the total population are supplied through yard taps, 13 per cent through public standposts and about 39 per cent through protected dug wells, and boreholes with hand pumps. 11/

24. With regards to funding, the preliminary data obtained through the Joint Monitoring Programme leads to the conclusion that "priority investment in water supply and sanitation has continued in the urban sector. Moreover, the bulk of this funding has been directed towards the better-off population". 11/

## D. Agricultural water use

25. During the 1960s and 1970s, large-scale irrigation developments dominated efforts to bring new lands under irrigation. Often linked to flood control and hydropower generation, these schemes were developed with great enthusiasm and pride. The availability of water and land resources, favourable markets for agricultural products, the low cost of construction and relatively easily available external funds made those developments possible. Since the 1980s, however, many of these conditions have changed and this has resulted in a declining trend with respect to irrigation expansion.

26. During the past four decades, irrigated agriculture was responsible for a major part of the increase in production to meet population demands. By the mid-1990s, 36 per cent of the total crop production is expected to come from less than 15 per cent of the arable land that is irrigated. On a global basis, the average rate of expansion was about 1.5 per cent per year in the early 1960s, reaching a maximum of 2.3 per cent per year in the period 1972-1975. The rate of expansion began to decrease in the mid-1970s and is currently about 1 per cent per year (see figure II).

27. FAO reports that one of the most common causes for the decline in the rate of expansion was the high cost of irrigation. Construction costs have risen steadily and world prices for major cereals have fallen sharply. Furthermore, as much of the suitable land for irrigation development and available water-supplies are already developed, progressively less favourable and therefore more expensive areas are left for further expansion.

Figure II. Rate of increase in irrigated land, 1962-1987

28. FAO's projection (World Agriculture Towards 2000) 12/ of the expansion of irrigated land to the year 2000, based on previous trends and modified by land, capital and inputs required to meet future needs, is 2.25 per cent per year from the period 1982-1984 to 2000. According to this study, between the period 1982-1984 and 2000 about two thirds of the increase in arable lands will be accounted for by expansion of irrigation. 13/ The projected rate for developing countries is 2.4 per cent per year. The World Bank estimates that although it will take an average annual growth rate of 2 per cent in agriculture as a whole to feed a world population estimated to reach 6 billion by the year 2000, and 8 billion by the year 2025, the growth rate for irrigated agriculture will need to be 3 per cent per year.

29. Specifically, China needs to increase its annual food production from 400 million to 500 million tons by the year 2000. 14/ This would require increasing the irrigated land area by 1.4 per cent annually; modernizing irrigated lands; reclaiming waterlogged lands; increasing water conservation; and increasing the reservoir fish-farming area. India's irrigation potential has been increasing at a rate of about 2 million ha per annum and by the end of the seventh 5-year plan (1986-1990), the developed potential was in the order of 79 million ha. During that time, India was able to increase its food production from 50 million to 170.63 million tons. 15/ Turkey's potential for irrigated agriculture is about 8.5 million ha. By 1990, 1.65 million ha were under

irrigation, with a further 750,000 ha projected by 1994. 16/ Egypt projects a 2 per cent increase (125,000 feddans) in irrigated land over a five-year period, and predicts a change in water use from 49.7 billion cubic metres in 1990 to 59.9 billion cubic metres in 2000. Mexico has 20 million ha of cultivated lands, of which 6 million ha are irrigated, 17/ contributing 50 per cent of total production, and had a projected increase in irrigated area of 1,125,000 ha by 1994 (a 4.6 per cent annual increase).

30. FAO's recent studies 18/ indicate that it will be difficult to sustain a 2.4 per cent annual growth in irrigation expansion in developing countries as predicted earlier. Clearly, a major portion of the needed increase in food production must come from existing irrigated and rain-fed lands through increasing yield per unit area and yield per unit of water consumed. Thus, FAO's International Action Programme on Water and Sustainable Agricultural Development puts emphasis on increasing water-use efficiency through modernization and improvement of existing irrigation schemes, rehabilitation of waterlogged and salinized irrigated lands and promotion of small-scale water programmes aimed at supplementary irrigation, water harvesting and soil moisture conservation in rain-fed arable lands. At the same time, however, expansion should continue at a rate that can be justified in terms of meeting the goals of food security, increased farm income, improved rural development and conservation of the natural resource bases.

31. FAO's recent projections for new irrigated lands up to year 2000, based on current trends and taking into account agro-climatic conditions and availability of suitable lands and water, are given in table 1. These increases are conservative, as compared with the expansion planned by several countries. They are the essential minimum rates that should be sustained if major starvation is to be avoided. Increases in production from these new lands will supplement a larger portion of food that is expected to be derived from existing irrigated lands through modernization and adoption of improved water management and crop husbandry practices; reclamation of waterlogged and salinized areas; and improved moisture management in rain-fed areas.

32. The cost of irrigation development varies from country to country and depends on the scale of development. Preliminary estimates by FAO indicate that the total cost for the development of 15.2 million ha in 130 countries from 1993 to 2000 would amount to US$ 6.5 billion per year. These estimates were made on a regional basis, using existing cost data and assuming that a majority of the future developments will be medium-scale.

Table 1. Projection of irrigation expansion in developing countries, and related costs, 1993-2000

| | Total irrigated land - 1990 | Projected increases | Unit costs | Total costs |
|---|---|---|---|---|
| | (Millions of hectares) | | (US dollars) | (Billions of US dollars) |
| Asia (30 countries) | 132.1 | 12.0 | 2 400 | 28.8 |
| Near East (10 countries) | 9.5 | 0.4 | 5 800 | 2.32 |
| Latin America (40 countries) | 16.3 | 1.8 | 4 000 | 7.2 |
| Africa (50 countries) | 14.2 | 1.0 | 7 200 | 7.2 |
| Total (130 developing countries) | 172.1 | 15.2 | | 45.52 |

33. In order to achieve these objectives, FAO suggests that the scale of a new irrigation development should be appropriate to its being sustainable, with focus on medium-scale and small-scale developments, while large-scale developments must be considered as components of multiple-purpose projects. Regardless of size, the project area's basic water needs must be provided for, especially drinking-water and sanitation needs. All developments, however, must be subject to and must meet the stipulations of an environmental impact assessment at the planning stage before being pursued. In addition, during all phases of development, the relevant sectors of society should be involved and consulted, with especial importance being given to the involvement of women.

34. In most irrigation schemes, improvement to the physical system is important to increase water-use efficiency and to diversify cropping patterns. The modernization of existing irrigation projects is vital to increase yield, save water, make the project economically viable and arrest environmental hazards. This may involve, inter alia, canal-lining, additional and improved hydraulic control structures, better land development, and new irrigation methods. Targets and cost of modernization in 130 developing countries are presented in table 2. These estimates are based on the assumption that physical upgrading would amount to 10 per cent of the total irrigated area over a 10-year period, and that the cost of upgrading would amount to 25 per cent of the cost of new irrigation development.

Table 2. Estimated targets and costs for the modernization of existing irrigation schemes, 1990-2000

| | Total irrigated area - 1990 | Total area upgraded | Unit cost | Total costs |
|---|---|---|---|---|
| | (Millions of hectares) | | (US dollars per hectare) | (Billions of US dollars) |
| Asia | 132.1 | 13.21 | 600 | 7.9 |
| Near East | 9.5 | .95 | 1 450 | 1.4 |
| Latin America | 16.3 | 1.63 | 1 000 | 1.6 |
| Africa | 14.2 | 1.42 | 1 800 | 2.5 |
| Developing countries (130) | 172.1 | 17.21 | | 13.4 |
| Developing countries (130) for the period 1993-2000 | | 12.00 | | 7.38 |

35. According to FAO, an estimated 20-30 million hectares, globally, are severely affected by salinity and an additional 60-80 million are affected to some extent. FAO suggests that reclamation should be pursued at a minimum rate of 1 million hectares per year between 1993 and the end of the century. The major cost of reclamation is to be found in the provision of artificial drainage, including farm drainage as well as main drains, and suitable disposal or reuse facilities. The estimated cost for the provision of such drainage facilities would amount to US$ 7 billion over the seven-year period.

36. Agricultural requirements in the years to come will require the intensification of production in high-potential rain-fed lands where intensification does not result in overexploitation of the natural resource base or in environmental degradation. Improvements in rain-fed lands are proposed by FAO in the context of soil moisture conservation and the enhancement of food production under traditional rain-fed farming conditions. A total area of about 10 million hectares would be improved within the period 1993-2000, constituting 2.5 per cent of the total high-potential rain-fed lands, at an estimated cost of US$ 7 billion. FAO also estimates that approximately US$ 14 billion will be required over the same period for investments in aquaculture development.

37. The total cost of technical assistance required over this period, both from national and external sources, has been estimated at US$ 1,640 million, covering feasibility studies, the establishment or strengthening of databases and monitoring systems, adaptive research and technology transfer, institutional strengthening and human resources development, fisheries and aquaculture, environmental protection, and policy and strategy formulation.

38. Recognition is now emerging that conventional economic analysis methods, as applied to agricultural projects that do not take into account the degradation of the natural resource base, do not provide a suitable measure of long-term sustainability. Case-studies conducted by the World Resources Institute in

India, Chile, the Philippines and the United States led to the following general conclusions:

> "First, economic analysis that fails to measure changes in the productivity of natural resources will make farming practices that degrade the resources base look more valuable than those that conserve it. Second, when changes in the natural resource base are included in calculating farm income, resource-conserving production practices can compete economically and financially with conventional ones. And, finally, policies that encourage inappropriate natural resource use can cause significant economic and fiscal losses, as well as environmental ones." 19/

39. As stated in the report on these case-studies, "erosion and salinization can have enormous impacts on the productivity of agricultural soils. Depletion and contamination can damage groundwater resources. The pollutants in agricultural run-off can severely reduce the productivity of ecosystems and drastically shorten a reservoir's life". 19/ To the extent that no depreciation allowance is applied against current income for the loss of productivity, standard accounting practices provide an erroneous picture of the long-term economic and environmental sustainability of a given project.

## II. TRENDS CONCERNING THE MANAGEMENT OF WATER RESOURCES

### A. Africa

40. Although the Economic Commission for Africa has not recently conducted a survey of institutional responses to the recommendations of the Mar del Plata Action Plan and of Agenda 21, the view is expressed that in the light of serious political and economic problems, little if any significant success is evident in this regard, and that the fragmentation of institutional responsibilities hinders the formulation of holistic approaches for the integrated development of water resources.

41. In spite of this bleak assessment of the situation, there is evidence of an increasing recognition of the importance of implementing the recommendations contained in Chapter 18 of Agenda 21. The East African Water Resources Seminar held, with the support of the Government of Denmark, in Entebbe, Uganda, from 24 to 27 May 1993, agreed that the development and management of water resources in the East African region should be based on the general principles and guidelines emerging from the preparatory process of the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, in June 1992. Those principles are spelled out in the report of the International Conference on Water and the Environment, 20/ held in Dublin in January 1992, and confirmed in Agenda 21, adopted by the United Nations Conference on Environment and Development.

42. The Seminar recommended that national water resources policies should follow general decentralization principles, and guidelines regulate the various roles, functions and decision-making processes at different levels; and that participation at all levels, especially that of the private sector, should be promoted. In addition, the participants also agreed that mechanisms for

cross-sectoral coordination should be strengthened and developed and guidelines for cross-sectoral water resources impact assessments established.

43. The Seminar also recommended that practical guidelines for the estimation and application of direct, opportunity and environmental costs of water, and for charging, should be prepared, ensuring that charges reflected service levels and covered at least operation and maintenance costs, and were based on the full economic value of water, with allowance for cross-subsidization. A flexible legal framework for water resources management needs to be established and enacted at a national level, and enforced appropriately, and dynamic water action plans must be drawn up. The Seminar concluded that East African Governments needed to finance and maintain a well-coordinated information base in order to monitor and manage water resources at all levels, and that requirements for capacity-building needed to be assessed and appropriate plans formulated, with that involving institutions, local communities and users.

44. The Government of Uganda, with the cooperation of the Government of Denmark, is in the process of preparing a national water plan. Phase one of the project includes the carrying out of a rapid assessment of the water resources situation in the country, the preparation of a preliminary proposal for the establishment of an enabling environment for flexible water resources management, the formulation of a preliminary outline of a national water resources policy statement, and the formulation of detailed project proposals.

## B. Asia and the Pacific

45. The last survey conducted by the Economic and Social Commission for Asia and the Pacific (ESCAP) concerning the implementation of the Mar del Plata Action Plan was completed in May 1991 and provided information from Afghanistan, Australia, Bangladesh, China, Guam, Hong Kong, the Pacific Islands (Palau), the Philippines, the Republic of Korea, Samoa, Singapore, Sri Lanka and Vanuatu. The survey indicated that considerable progress had been made by countries in the region towards the formulation of national water policies and comprehensive master plans.

46. Twelve of the countries in the area reported the existence of legislation covering basic ownership of and right to use, as well as protection of, surface water. The ownership of and right to use groundwater were regulated in 11 countries in the region. The majority of the respondents felt that their existing regulations were not sufficient or were incompatible with existing development plans. Although floods were a major concern to the majority of the countries in the region, most of them had no adequate structural or non-structural measures.

47. In October 1993, China's State Planning Commission, together with the State Science and Technology Commission, produced the document known as China's Agenda 21. Freshwater resources are dealt with in chapter 14 of that document, which covers the protection and sustainable development of natural resources as programme E. The objectives are to formulate long-term plans of water supply and demand, and rationalize water resources based on assessment of water resources; to amplify necessary rules and regulations for the purpose of

rationally developing and protecting water resources; to improve water quality and supply capacity, and control water pollution; to reform the water resources management system and to improve efficiency of water utilization; to control domestic and industrial water consumption so as to alleviate water shortages and pollution; to protect the aquatic ecosystem based on the interrelation of water, forest and land use; to forecast climate change impacts on water resources; and to formulate and pursue related policies for adoption.

48. Moreover, the objectives of other chapters in fields such as agriculture (80 per cent of China's water is used for irrigation), health and sanitation, human settlements, transportation and industry, energy (hydropower and process water for petroleum, coal mining), biodiversity (lakes, rivers and wetlands), control of soil erosion, desertification and flood prevention are dependent on successful water resources management.

49. Water Resources Management in North China, the project of UNDP and the Department for Development Support and Management Services of the United Nations Secretariat, anticipated the Agenda 21 proposals for integrated management. The project has already demonstrated a computer-based decision support system, which uses a suite of interactive programmes that model hydrology, water system operations and economic inputs/outputs. The process is controlled by a multi-objective analysis programme that provides information on the achievement of a set of goals related to gross domestic product (GDP), food security, employment and environmental conditions. The programme allows varying weights to be attached to the goals and the corresponding allocation of the water resources. It also takes into account differing sequences and timing of water resource development projects.

50. Being based on macroeconomics, it provides a tool for decisions on the investment programme for water resources management. Although started from the viewpoint of water resources, it is capable of going much further. With a change of supporting models and an expansion of the database, the process can handle other multisectoral economic resource inputs such as land and energy. It is still in process, even for water, and the basic models will need adaptation for other parts of China, as well as for other countries. There remains much to be done in programme development and in capacity-building, including the training of decision makers.

## C. Latin America and the Caribbean

51. Water management in Latin America remains far from optimum despite the progress that has been made in the application of scientific management techniques. This is especially the case in regions where the use of the resource of water is most intensive and conflictive. In those regions the intensive use of water bodies has been difficult to accommodate within the existing management systems, as has the increasing urbanization of many river basins. A recent study by the Economic Commission for Latin America and the Caribbean (ECLAC) shows that many issues inherent in water system operation are being poorly handled and even ignored. This is the case almost without exception with respect to the maintenance of infrastructure, but other aspects of system operation and management are being woefully disregarded as well. It

is also observable that differences in management performance seem to be due not to organizational structure (although having an institutional structure in which water management issues can be publicly discussed helps), but to the degree of dynamism of management in any specific case. There is some evidence, however, that the establishment of a clear distinction between responsibility for the management of the resource and responsibility for the management of its use can be beneficial. Private sector or user participation in management can be a valuable tool in the effort towards achieving that distinction.

52. In the second half of the twentieth century, water management in Latin America has characteristically been highly centralized within the public sector and in the national Governments. The participation of other levels of government has been very limited, even in nominally federal States, and the idea of user participation has been honoured outside of the exceptions discussed above, only in the breach. The institutional structures prevalent in the countries of the region have varied markedly, but all have been centralist and with a very high degree of state control. One consequence has been the prevalence of national institutions with responsibility for a single water use. These institutions, which were founded mainly in the 1940s and 1950s, often replaced local water institutions that had been run municipally or regionally for centuries. The local institutions had, in many countries, a long history of user participation in their management. Such participation disappeared when management was centralized in national institutions.

53. The trend towards the management of water resources through centralized single-purpose institutions began to change in the 1970s. For example, in Argentina many responsibilities were transferred back to the provinces from the federal Government where constitutionally they had always rested. It came to a complete halt, however, with the crisis in Latin America that accompanied the debt crisis of the early 1980s. By then, the need to improve water management had become imperative, following Latin America's most serious economic recession since the 1930s; in most countries, the rate of expansion in the construction of control works slowed dramatically. There was growing concern that the gains anticipated from the investments that had been made in water control works had not been realized to the extent expected when the projects were originally undertaken. Moreover, there was criticism to the effect that in many water control projects heavy costs had been incurred in the loss of alternative environmental opportunities - costs not justified by the benefits actually obtained.

54. A result of the policies adopted to reduce the role of the state in Latin American societies has been the withdrawal of central Governments from water resource management responsibilities. The form of the withdrawal has varied considerably both among and within countries depending on their institutional structures and political traditions. One policy found in many countries has been that of the privatization of many water-related services, particularly hydroelectric power generation, as in Chile and Argentina, and water supply and sanitation, as in Mexico, Argentina and Venezuela. Privatization has even been extended to irrigation as management of schemes has been transferred to users. Such transfers of management responsibility, which began in Chile in the late 1970s, are now basic policy in many countries, including Argentina, Colombia, Mexico and Peru.

55. Among all the countries of the region, it is in Brazil, Chile and Mexico that the most interesting innovations in water management policies have occurred in recent years - innovations that in themselves are very different, but that point to the possible future creation of water management systems applying such concepts as integrated and coordinated water resource management with a clear distinction between responsibility for the management of the resource and that for the management of its use. In all three countries, the policy initiative has come from the top down as part of the efforts to generally redefine the role of government. In Brazil, the proposal for the reorganization of water management is still only a proposal, although a reduction and reorganization of the federal structure are already in place. In Chile, a system of water administration has been created that distinguishes between public responsibility for the resource and the users' responsibility to manage its use. In Mexico, the National Water Commission (Comisión Nacional del Agua (CNA)), which has replaced the Hydraulic Resources secretariat (Secretaría de Recursos Hidráulicos), is charged with the institutional responsibility for integrated water management within a more decentralized administrative system.

### 1. Brazil

56. Even before the adoption of the new constitution in 1988, a series of reforms had been introduced into water management in Brazil. The most significant innovation was the experiment with joint federal, state and municipal river-basin boards to control water quality in the State of São Paulo. The success of this experiment led the federal Government to create the Special Committee for Integrated Water Management in 1978. The terms of reference of the Committee included the carrying out of coordinated studies and the fostering of integrated action by federal, state, local and private agencies. The Committee is constituted of the Special Secretariat for the Environment (SEMA), the federal electricity utility (ELECTROBRAS), the National Department of Sanitation (DNOS), the superintendencies for regional development and state secretariats.

57. Recently, successive governments have introduced significant changes in the structure of water administration in the federal government. Many agencies have been abolished and others amalgamated. A new Ministry of Infrastructure has been created that has responsibility for navigation and power generation and to which the National Department for Water and Electrical Energy has been transferred. Responsibility for some uses still rest, however, with other ministries, although the number of agencies has been considerably reduced.

58. The 1988 Constitution stipulates the creation of a new National Water Management System for the water resources falling under federal jurisdiction. There has been considerable discussion of the form that this system should take, but no decision has yet been made.

### 2. Chile

59. In Chile, the reform of the Código de Aguas: (the water law), the creation of the Head Office for Water (Dirección General de Aguas (DGA)), the replacement of the Dirección de Obras Sanitarias (the Sanitation Works Administration) by

the Superintendencia de Servicios Sanitarios (the Superintendency for Sanitation Services), the creation of the Comisión Nacional de Riego (the National Irrigation Commission), and the promulgation of the Ley de Fomento de Riego (the Irrigation Improvement Law) have been among the most significant reforms. The result of these changes has been to change the thrust of the action of the state from one of almost complete responsibility for all aspects of water development and management to one of responsibility for the resource and of support and supervision of user actions. At the same time, most electricity utilities have been transferred to the private sector and the administration of water-supply and sewerage has been placed in the hands of regionalized autonomous companies; however, most shares in those companies are held by the Government.

60. The modifications made to the Código de Aguas have been the most commented innovations, and have included the creation of a market in water rights. The reformed water law, although maintaining water as a public good, establishes private ownership over the water right once it has been granted by the State. The right can be freely transferred on the open market. This, however, is only one among a number of interesting innovations. Among the most significant has been the establishment of one national body with comprehensive responsibilities for water resources data in the water directorate. From the water management viewpoint, equally significant are the reforms in the authority and responsibilities of the organizations of water users and in the role of public authorities in the management and construction of irrigation works.

61. The law assigns responsibility to the user organizations for the regulation and administration of water resources and related infrastructure under their respective jurisdictions. Most irrigation and drainage works, including dams and reservoirs, are now owned by user organizations.

62. River basins are not treated as water management units in Chile, but are commonly divided among two or more water committees. Any disputes among the committees must be resolved by the water directorate or by the courts.

### 3. Mexico

63. Mexico, although a federal State, has for a number of years enjoyed a highly centralized system of water administration. This system has recently undergone a profound revision which has changed the basis on which the administration operates.

64. The Comisión Nacional del Agua (CNA) was created in January 1989 to replace the Secretaría de Recursos Hidráulicos and to concentrate responsibility for water management in Mexico in one institution. CNA has responsibility to direct, coordinate and regulate all extractions from water bodies, all water use and all disposition of waste waters in Mexico. Despite the global responsibility of CNA, other government agencies have responsibilities in respect of various aspects of water management. For example, the Secretaría de Reforma Agraria (the Agrarian Reform secretariat) intervenes in the regulation of the water rights of ejidos (common public lands) and other rural communities and the Secretaría de Marina (the Sea Affairs secretariat) has responsibility for uses affecting navigation.

65. Allowing for these and other exceptions, CNA is responsible for managing the supply of water and assigning the right to use water. CNA must determine the natural supply, the water balance and the annual availability of water. Water rights are granted for a period of not more than 50 years, and can be revoked if the use of the water is changed. The management of water use lies with a variety of institutions at the public, federal and state levels, and with the private sector.

## D. Western Asia

66. In Yemen, with assistance from the Department for Development Support and Management Services of the United Nations Secretariat, reforms have been suggested that seek to integrate economic, technical, institutional and legal elements for the management of scarce water resources. The guiding principles for the reform have been the separation of regulatory functions from water use activities; comprehensive planning; integration with macroeconomic planning; and political feasibility. The proposed institutional structure comprises three components: a policy-making body; a regulatory independent agency; and a network of regional water engineers. The separation of the water management or regulatory function at the national level (policy development, supervision, and updating) and of the water development function at the sectoral and subsectoral levels (implementation of water projects aimed at the use of water for specific purposes) was warranted by the danger of neglecting the regulatory function due to preoccupation with lucrative development projects; conflict of interests arising from growing competition among water-using sectors; and the need for an independent entity to act on policy violations. Thus the responsibility for water management at the national level is not delegated to a water-using sector but to a central independent authority.

67. Similarly, Oman has established a Ministry of Water Resources in order to institute a comprehensive management of its water resources by a non-user institution.

## E. General observations

68. The available information suggests a trend towards decentralization of authority and towards a separation of functions between organizations responsible for policy formulation, and those in charge of implementing projects and managing utilities. There has also been an increasing awareness of the importance of the role of women in the management, development and utilization of water resources. Unfortunately, however, data on the extent and impact of women's participation are lacking. The lack of information for planning and decision-making and an inadequacy of monitoring capabilities are still a pervasive problem in developing countries. This refers not only to the assessment of surface waters and groundwaters, in terms of both quantity and quality, but also to water use and to the interrelationship involving land and water as well.

69. Early feedback from the follow-up to the International Conference on Water and the Environment and to the United Nations Conference on Environment and

Development indicates that there is greater acceptance of the importance of a suitable enabling environment and of the concept of integrated water resources planning. Similarly, the concept of water as a scarce resource and as an economic good also seems to be gaining acceptance. However, an assessment of the extent to which the concepts espoused by the United Nations Conference on Environment and Development are being applied world wide would be premature at this juncture.

70. The private sector is playing an increasingly important role as a source of investment capital and in the operation and management of water resources utilities. This is the case not only in industrialized countries, such as the United Kingdom of Great Britain and Northern Ireland and France, but in many developing countries as well. The potential benefits of intervention by the private sector in developing countries are evident, in terms not only of the flow of financial resources, but also of the bringing of technical and managerial know-how and of the providing of financial and managerial autonomy to utilities. At the same time, however, a measure of regulation is needed in order to ensure that services are provided to the poorer strata of the population, that the policies of private utilities are in line with national objectives and that adequate attention is given to environmental concerns. An evaluation of the performance of the private sector in developing counties is not known to be available at this time.

71. With regard to pollution, the concept of trading permits is gaining in acceptance both in the United States of America and in the United Kingdom, in the case of both air and water pollution. Under this concept, polluters are able to trade pollution allowances within an overall limit. This approach may motivate companies to invest in more efficient pollution abatement technologies, enabling them to reduce discharges below the permissible limits and to sell the balance to other companies for a profit. Other companies may in turn find it more economical to purchase pollution allowances as the lowest-cost alternative to compliance with pollution standards. The conditions under which this concept could be applied to developing countries would need to be determined.

## III. CONCLUSIONS

72. The information available as well as previous evaluations of progress in the implementation of the recommendations of the Mar del Plata Action Plan suggests that while there has been progress in several areas, very serious problems persist, and in some cases those problems are becoming alarming. While considerable progress has been made with regard to the eradication of some water-borne diseases, notably guinea worm, the outbreak of cholera in recent years illustrates the possible magnitude of an impending health crisis, particularly around urban concentrations. More and more rivers, recipient of untreated urban waste discharges, are becoming open sewers and pollution from the indiscriminate use of agrochemical products is often rampant. Water resources of suitable quality are becoming scarce and increasingly expensive.

73. Recent international forums dealing with water resources issues have all brought about an increasing awareness of the global magnitude of a water crisis. This possibility was already brought to the attention of the world community at

the time of the United Nations Water Conference in 1977, and renewed notes of alarm were sounded at the International Conference on Water and the Environment and at the United Nations Conference on Environment and Development. Although these expressions of concern may be deemed by many to be insufficient, there is a growing consensus among experts in the water resources field as to the seriousness of the situation. However, the spectre of a global water crisis has been overshadowed by concerns about other issues of manifest global proportions, such as the ozone layer, tropical forests and climate change. Internationally the seriousness of water problems has not as yet received the recognition warranted by the situation. Progress, however, is being made in this regard. On the other hand, at the national level, and particularly in developing countries, whatever measures have been taken, albeit in the right direction, have not been commensurate by and large, with the scope of the problems.

74. That this would be the situation in developing countries and economies in transition should not be surprising. For the last 15 years or so, most developing countries have had to cope with difficult economic conditions and been besieged by a slew of problems, all whether energy, food production, deforestation, urbanization, widespread unemployment and poverty or any one of many others - equally demanding top-priority consideration. Many of these developing countries are also in political turmoil, and their economies are in transition. Water resources cannot receive greater priority than other pressing problems unless a strong case is made to that effect.

75. Two elements are vitally important if a case is to be made to ensure that water resources receive a very high priority. First, an effective case cannot be made in the absence of solid information concerning the current situation and implications for the future. As has already been mentioned, information concerning the availability and quality of surface and water and groundwaters is often insufficient, and in many cases the capacity to collect data has been waning. The situation is even less satisfactory with regard to water resources uses, waste-water disposal, interrelationships between population, land and water, and impact of the application of economic and legal instruments to water resources use and pollution control. Second, owing to a lack of integration between water resources policy and planning and economic policy at the national and regional levels, whatever information might be available fails to find its due place in the national policy-making and planning process.

76. There is clearly a need for Governments to embark on a major effort to monitor key socio-economic, physical and environmental variables related to the assessment, development, utilization and management of water resources as an essential condition to progress. This needs to be done in a climate where, to date, insufficient attention and support have been given to this task. The collection of data for data’s sake needs to be avoided at all costs, particularly under conditions of extreme financial stringency. As a matter of urgency, Governments need to develop and implement monitoring strategies for the collection, analysis and dissemination of data of demonstrable value, including the formulation of methodologies for the evaluation of environmental variables.

77. The collection and analysis of information, as well as the formulation of policies and the implementation of holistic strategies, presuppose the existence of institutional structures that achieve a high degree of horizontal integration

within the various sectors of water resources, including management structures at the lowest appropriate levels, and vertical integration with the national socio-economic planning process.

78. In terms of the international community, the level of financial support has consistently fallen short of requirements. To a great extent this can be attributed to the economic difficulties experienced by industrialized countries in recent years. Beyond this, however, there has been increasing scepticism regarding the long-term usefulness of project-oriented programmes, accompanied by requirements for greater involvement by the recipient Governments in the planning, management and financing of development ventures.

79. All the recommendations contained in chapter 18 of Agenda 21 deserve urgent attention. However, if significant long-term progress is to be achieved, it is suggested that priority attention be given to the establishment of "a dynamic, interactive, iterative and multisectoral approach to water resources management, including the identification and protection of potential sources of fresh water supply" 21/ as an essential precondition of the implementation of all other recommendations. To this effect, it is suggested that Governments consider the need to carry out a diagnostic assessment of the current situation vis-à-vis their current institutional arrangements and human resources capacity, with a view to formulating a strategy and an action plan for the years to come.

## Notes

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