



**German Advisory Council on Global Change
(WBGU)**

**World in Transition:
Ways Towards Sustainable Management
of Freshwater Resources**

1997 Annual Report

Executive Summary

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*Never have I held back the waters of the Nile,
never have I barred the water its way,
never have I dirtied the Nile.*

PHARAONIC INSCRIPTION
IN THE VALLEY OF KINGS (RAMESES III)

Introduction

Water resource management – the harvesting, distribution, utilization, purification and control of water – has shaped the history of human civilizations to a major and permanent degree. Management of water resources is also one of the greatest challenges facing the present generation. Today, around 2 billion people have no access to clean drinking water and sanitation. Only 5% of the world's wastewater is treated or purified. As a result, one person in two in the developing countries suffers from a water-related disease, and 5 million people die each year after drinking contaminated or infested water. Freshwater is the most important factor limiting food production, with agriculture already accounting for 70% of global water use. Worldwide, as many as 40,000 dams are in operation to secure and increase the supply of water, with a new dam being added daily. The total volume stored in reservoirs is five times that found in all the world's rivers. International conflicts are expected to arise from the growing scarcity of this crucial resource in many parts of the world. Referring to Ethiopia's plans for dam projects on the Blue Nile, President Sadat, the former Egyptian president, once threatened that "Anyone who plays with the waters of the Nile is declaring war on us!"

The dimensions and implications of today's freshwater problems, the source of a potential major crisis of global society and the environment, have prompted the Council to focus this year's Annual Report on this burning issue. The Council analyzes and evaluates the total complex on the basis of facts and interrelationships, describing in detail the available instruments for freshwater management and outlining ways to prevent a global crisis from unfolding. The solutions put forward by the Council are based on two elements, namely a model and a strategy for the future management of water resources. The first key element is generated from the Council's "crash barrier" model, which is an attempt to resolve the dilemma between social, environmental and economic goals by setting clear priorities. A robust paradigm for the "sound management of freshwater resources" is generated in the process.

The guiding principle developed by the Council can be summarized as follows: achieve the greatest possible efficiency while taking into consideration the imperatives of equity and sustainability. This principle takes account of the fact that water, like no other environmental asset within the global commons, is both a scarce and a crucially important resource. Water is not only a commodity, but also a foodstuff. Its essential properties define the sociocultural and ecological framework and the non-sustainable limits (the "crash barriers") within which water must be used effi-

ciently in order to optimize the general welfare of humans everywhere. The very scarcity of water resources requires, on the other hand, that within the crash barrier there are as few obstacles as possible to an efficient search for beneficial freshwater use. However, efficiency can only be achieved if appropriate institutional, technical and educational conditions are met.

From this paradigm, the Council develops ways to solve the water crisis and addresses these to specific policy and research fields. The second key element therefore involves a global strategy for putting this paradigm into practice. The strategy is sub-divided into three components: creating an international consensus, instituting a World Water Charter and drawing up an international Plan of Action against the freshwater crisis.

Essential foundations for analyzing the global water crisis

BIOLOGICAL AND PHYSICAL FOUNDATIONS

A description of the natural state serves as the basis for further analyses. The first step is to describe the various freshwater habitats and the threats to limnetic biodiversity. This is followed by a description of the abiotic factors of key importance for the hydrological cycle. Such a description must take account of the interactions which occur between the atmosphere and vegetation. In what ways can key elements of the water balance and the hydrological cycle be altered by climate change? To answer this question, the Council presents an analysis in which characteristics of the hydrological cycle under present climatic conditions are compared to those in a simulated climate with CO₂ doubling (concentrations equivalent to twice present-day levels). Here, the WBGU draws on calculations made with the ECHAM/OPYC coupled atmosphere-ocean model developed by the German Climate Computing Centre (DKRZ) and the Max Planck Institute for Meteorology (MPI). Simulations with the model show that more precipitation falls on land masses in a warmer climate, especially at high latitudes and in parts of the tropics and subtropics, while other regions have less rain. The latter include large areas of Brazil, Southwest Africa and West and North Australia. Human-induced climate changes will enhance the hydrological cycle as a whole, although this will be bound up with substantial regional variances. In effect, this means that there will be losers and winners.

WATER NEEDS AND WATER DEMAND

The Council has predicted future trends in global water withdrawals by agriculture, industry and private households in a scenario, the basic elements of which were developed at the Potsdam Institute for Climate Impact Research and the Environmental Research Center at the University of Kassel. These computations are based on the future development of core trends relating to water, such as variations in water supply as a result of climate change, consumption levels in relation to demographic and economic trends, and the efficiency of water use. Water prices, cultural influences and institutional conditions for water withdrawals were not taken into consideration. The predicted figures show that total water withdrawals by agriculture will increase by 18% in the thirty-year period between 1995 and 2025. Despite

this increase, the proportion of agricultural withdrawals in relation to the total global figure falls to 56%, almost one fifth less than 1995. This decline is attributed to water withdrawals by industry, which will treble by the year 2025, i.e. at a rate much faster than population growth. Household water consumption will increase substantially, especially in Africa and Asia, but falls are expected in Europe and Latin America.

WATER QUALITY

Before environmental and social crash barriers can be defined for water quality, monitoring must be carried out as comprehensively as possible. However, current data on water quality are distributed very unevenly in geographical terms. Human impacts on water quality are impairing the natural and cultural functions of water, primarily through direct interference by agriculture and pollutant loads emanating from point and non-point sources in settlements, the small business sector, agriculture and industry. Too little is known about the behavior of substances that enter water through human activities, about their decomposition and conversion, and about the impacts they have on ecosystems and humans. The most important factors influencing global water quality include acidification, eutrophication, salinization, and pollution caused by organic and inorganic trace compounds (pesticides and heavy metals, for example). Quality standards such as those governing agricultural and industrial uses have yet to be defined for many other types of use. Those standards already in operation tend to vary considerably from one country to the next, one example being drinking water, for which the highest quality criteria must, of course, apply. Setting limits can provide only relative safeguards against damage to health. If water stress levels are to be kept below the critical threshold, quality targets must be defined on the basis of expert knowledge, and appropriate efforts made to meet such targets.

FLOODS

The greater part of the Annual Report addresses problems that arise from shortages or the poor quality of water resources. However, too much water can also lead to major problems and even disasters. Floods are the natural disasters which cause the greatest economic damage worldwide, often with great loss of human lives. The Council examines above all the mechanisms by which floods originate, how global change influences the incidence and severity of floods, and how the risk of floods can best be mitigated. The next Annual Report produced by the Council will focus in detail on risks and risk management.

Impacts of global change syndromes on the water crisis

In its various Reports to date, the Council developed a concept for the holistic analysis of global environmental change (WBGU, 1993–1996). This approach enables the most important global environmental problems to be described in the form of 16 “clinical profiles” or syndromes afflicting the Earth System. The Council now applies this systems approach to the crisis of freshwater resources. Of these 16 syn-

dromes, the Council has selected three that are particularly relevant to water and which therefore require detailed study: the Green Revolution, Aral Sea and Favela Syndromes.

Analysis centers, firstly, on the role played by water within the “Global Network of Interrelationships”, a method developed by the Council for organizing the complex interactions within global change into a form suitable for further analysis. By applying this method to global water problems, it is possible to examine how typical trends in the hydrosphere (such as freshwater scarcity, groundwater depletion or changes in the local water balance) are linked to other trends of global change. The interactions are described and graphically portrayed as a water-centred global network of interrelationships.

SIGNIFICANCE OF THE REGIONAL FRESHWATER CRISIS

The regional importance of the freshwater crisis is emphasized further by the criticality index developed by the Council. This approach involves assessing the water crisis using a composite indicator that combines natural water stocks and the drain on water resources caused by humans, while also taking society’s problem-solving capacity into consideration. On the basis of detailed scenarios for water supply and water withdrawals, which were developed and computed at the level of subnational catchments by the Center for Environmental Systems Research at the University of Kassel, and linked to national problem-solving capacities by the Potsdam Institute for Climate Impact Research, the Council derives world maps that show the present “hot spots” of the freshwater crisis and other relevant aspects. With the help of additional scenarios for population trends, a climate scenario developed by the MPI in Hamburg and assumptions about future water withdrawals, the regions which will face severe problems in the future are identified and presented.

THE GREEN REVOLUTION SYNDROME

The Green Revolution Syndrome circumscribes the extensive, centrally planned and rapid modernization of agriculture with imported, non-adapted agricultural technology, whereby negative side-effects on geographical conditions of production and the social structure can occur, and indeed are put up with. The successes of the Green Revolution are primarily achieved in irrigated agriculture; within the space of a few years, however, typical water-related problems can arise. The “evolution” of the Green Revolution Syndrome is characterized by a particular combination of geopolitical, biological, population and economic trends (the interplay of national interests, the “seed revolution” in agriculture, population growth and impoverishment respectively). The Green Revolution was forced through “from above” within the framework of large-scale plans, and on a global level through the transfer of technology and know-how “from the rich to the poor”.

The syndrome analysis approach illustrates that the food security problem cannot be reduced to food shortage alone. Poverty is often accompanied by chronic malnutrition and famine. Close links must therefore be forged between rural development and increased production. The Council recommends in the debate over a “New Green Revolution”, i.e. enhancing food production while at the same time ensuring the growth of the small business sector, the craft trades and rural markets

BOX: Overview of global change syndromes

UTILIZATION SYNDROMES

1. Overcultivation of marginal land: Sahel Syndrome
2. Overexploitation of natural ecosystems: Overexploitation Syndrome
3. Environmental degradation through abandonment of traditional agricultural practices: Rural Exodus Syndrome
4. Non-sustainable agro-industrial use of soils and water: Dust Bowl Syndrome
5. Environmental degradation through depletion of non-renewable resources: Katanga Syndrome
6. Development and destruction of nature for recreational ends: Mass Tourism Syndrome
7. Environmental destruction through war and military action: Scorched Earth Syndrome

DEVELOPMENT SYNDROMES

8. Environmental damage of natural landscapes as a result of large-scale projects: Aral Sea Syndrome
9. Environmental degradation and development problems through the adoption of inappropriate farming methods: Green Revolution Syndrome
10. Disregard for environmental standards in the context of rapid economic growth: Asian Tigers Syndrome
11. Environmental degradation through uncontrolled urban growth: Favela Syndrome
12. Destruction of landscapes through planned expansion of urban infrastructures: Urban Sprawl Syndrome
13. Singular anthropogenic environmental disasters with long-term impacts: Disaster Syndrome

SINK SYNDROMES

14. Environmental degradation through large-scale dispersion of emissions: High Smokestack Syndrome
15. Environmental degradation through controlled and uncontrolled waste disposal: Waste Dumping Syndrome
16. Local contamination of environmental assets at industrial locations: Contaminated Site Syndrome

should be taken into consideration. Secure land tenure rights are essential if farmers are to have the capacity to plan the utilization of their resources on a long-term basis. Enhancing legal security for small farmers is thus a contribution to resource protection and a better means of realizing the right to food and water laid down in the International Covenant on Economic, Social and Cultural Rights. Water rights should therefore be specified in greater detail, and special institutions should be established with responsibility for enforcing such rights. Environmentally-sound management methods that protect resources, such as agroforestry (combined agri-

culture and forestry practices) and multiple cropping, are very difficult to implement on a large scale without start-up assistance. States must therefore become involved in the field of rural development and assist in the improvement of agricultural practices. The “debt for food security swaps” recommended by the World Food Summit are supported by the Council as an important instrument in this respect.

The analysis of the Green Revolution Syndrome with special reference to water problems reveals that current irrigation systems are urgently in need of improvement, as almost two thirds of all land irrigated worldwide is in need of rehabilitation. Subsidies should be dismantled, but without endangering the subsistence of small farmers. One way to achieve this would be to introduce a special form of “water benefit” for specific target groups, whereby those most vulnerable to crisis would have to be identified. Water resource development projects and water management systems must form an integral part of regional development programs, with preference given to local, small-scale solutions.

THE ARAL SEA SYNDROME

The Aral Sea Syndrome refers to the problems associated with centrally planned, large-scale projects involving water resource development. Such projects are ambivalent – on the one hand, they provide the additional resources that are required (water for food security, renewable energy), or they protect existing structures and people (flood control); on the other, they can have severe impacts on the environment and society. The effects of these large-scale installations are rarely confined to the local or regional area, but can assume far-reaching and even international proportions.

The various manifestations of the Aral Sea Syndrome are illustrated in two case studies. Attention is directed first and foremost to the greatest environmental catastrophe ever caused to regional water resources by mankind – the desiccation of the Aral Sea that lends the syndrome its name. The second study concerns the Three Gorges Dam that China is currently constructing on the Yangtse River, and describes the benefits derived in the form of electrical power and flood control, as well as the serious problems engendered in the form of compulsory resettlement of more than a million people and major environmental impacts.

How can the “susceptibility” or “vulnerability” to the Aral Sea Syndrome on the part of the various regions be measured? To do this, a complex global indicator is being developed for assessing the anthropogenic changes in surface runoff caused by large-scale projects. A second indicator mirrors the vulnerability of the various regions to the occurrence of the syndrome as a function of various geographical and societal factors. Combining these two data sets produces a global indicator for the intensity of the syndrome.

Applying the syndrome approach gives rise to the general imperative to preserve the integrity and function of catchment areas and to prevent the degradation of ecosystems and soils. The Council attaches considerable weight to the reduction or avoidance of the disposition to large-scale water resource development projects with severe environmental or social consequences. If large-scale installations are nevertheless essential, they must be subjected to a cautious assessment in which all

environmental and social costs are first internalized. The Council specifies crash barriers that may not be crossed and puts forward recommendations regarding the assessment procedure.

THE FAVELA SYNDROME

The Favela Syndrome refers to the progressive impoverishment and environmental degradation brought about by uncontrolled growth of human settlements. Due to the sheer speed of such informal urbanization and the failures evident in many policy fields, states become incapable of controlling further settlement (e.g. by planning land use and building, or by constructing water supply and wastewater treatment facilities). Uncontrolled urban agglomerations have a very high level of water demand and in most cases an inadequate system for sewage disposal. Most people living there have no access to clean drinking water or adequate sanitation. This explains the diseases typical for this syndrome (e.g. cholera), which can spread to other regions of the world as a result of global mobility.

How can the Favela Syndrome be mitigated? Firstly, it is essential to combat the basic underlying causes, such as rural exodus, which give rise to the Favela Syndrome in the first place and which ultimately produce the water-related problems. To eradicate the latter, the Council recommends establishing the prerequisites for integrated treatment of water-related problems in the urban agglomerations, for example by capacity-building in the local government sphere and through closer cooperation between public administration and the informal sector. In most cases water prices are too low and lead to wastage (frequent when water supply companies are state-owned); conversely, however, water prices are often much too high (where private-sector water traders operate) and impose a particularly heavy burden on the poor. The system for pricing water in urban agglomerations should therefore be changed in such a way that prices minimize wastage without, however, depriving the poor of access to water. Here, too, it may be necessary to consider paying "water benefit" to the needy. The Council also recommends a series of technical measures for mitigating water crises. A very practical method could be the institution of inter-city partnerships focusing on solutions to the water crisis in the favelas and in the surrounding areas from which people migrate to the favelas.

Key issues in the freshwater crisis

Certain problems are common to all syndromes and are dealt with by the Council as cross-cutting "key issues" of the freshwater crisis.

CONFLICTS

One such issue concerns the potential for political conflict ensuing from water resource problems. Are international "water wars" conceivable? Under what conditions are water wars especially likely? What options are available for the peaceful settlement of international conflicts over water resources? These questions are examined for four conflicts with very different trajectories. Disputes over the Great Lakes in North America have generally been resolved through cooperation, and in

the case of the conflict between Hungary and the Slovakia, both parties accepted the jurisdiction of the International Court of Justice. There are no signs of an agreed solution to the conflict between Turkey, Syria and Iraq over the waters of the Tigris-Euphrates basin. Some observers see the possibility of a renewed escalation of political conflict between Israel, Jordan, Syria and the Palestinian administration of the West Bank over the allocation of water resources.

HEALTH

Medical aspects form an important dimension of the freshwater crisis. In the first half of this century, many vector-borne diseases appeared to be in decline. However, these diseases are increasingly commonplace again in many developing countries. Such infections have acquired greater significance in industrialized countries as well, especially through highly-resistant strains of pathogens. There are manifold reasons for this trend: human settlements with high population density even in the vicinity of forests and swamps, growth in world trade with greater mobility of people and goods, excessive use of pesticides and antibiotics, the adaptation of pathogens to environmental conditions, social and political collapse, rapid population growth and regional climate disturbances. Waterborne infections are one of the main causes of disease and death worldwide: at present, diseases transmitted through water or water-related vectors afflict about half the world population. Regulating the supply of water and the treatment of wastewater according to the quality criteria drawn up by the WHO is therefore the most effective precaution against disease. Investments in this area promise one of the greatest possible "health gains". The Council therefore recommends, inter alia, that drinking water and wastewater treatment projects be given greater levels of support within the framework of development cooperation, and that food security programs be linked to infrastructural improvements in drinking water supply. The construction of reservoirs and open irrigation installations should no longer be supported as long as their health impacts have not been examined and counter-measures implemented. Vaccination against waterborne diseases should be improved and distributed more widely; this also requires greater investment in the development of vaccines.

FOOD

In irrigated regions, the issues of food and water supply are intimately linked. In the large river basins such as the Nile, the Euphrates or the Tigris, the use of water in agricultural irrigation systems enabled the rise of the oldest civilizations over 5,000 years ago. Although there have been quantitative and qualitative improvements in the supply of food to humans over the last thirty years, the situation in regions with water scarcity and large fluctuations in rainfall continues to be highly problematic. In many developing countries, economic stagnation, climatic and pedological disadvantages, distributional problems and population growth are causing a dramatic deterioration in the food situation. Whereas undernutrition is no longer a serious problem in the growth economies of Southeast Asia, states in sub-Saharan Africa as well as South Asia give cause for concern. One person in three in sub-Saharan Africa is chronically undernourished.

At the same time, the area of cropland available for growing staple foods is in

decline. Today, there are 16 million hectares less land in use for cereal production compared to the 1981 figure. Even though the area of irrigated land is increasing by 1% per annum, this corresponds to a per capita decrease of 12% in real terms by the year 2010. The trends for cropland are even worse on the whole, as the available land per capita will fall by a total of 50 million hectares (21%) by the year 2010, despite increases in the area of land used by agriculture. The response recommended by the Council is to increase irrigation efficiency, reduce the amount of water wasted through pumping, diversion or delivery to plants, and make greater use of salt-tolerant plants. Rainfed cropping should also be improved, as should the cultivation of locally adapted crops and varieties. Another option would be to optimize aquacultures and develop strategies for multiple use of water resources.

DEGRADATION OF FRESHWATER HABITATS AND NEIGHBORING BIOTOPES

The Council examines in close detail the degradation of freshwater habitats, i.e. the damage to waterbodies by physical, chemical or biotic factors exceeding the former's stress-bearing capacity. Degradation reduces the quality of the natural areas affected and impairs their usefulness for humankind. Any reduction in water quality alters the composition of the biota; in most cases, the number of species declines. In cases of severe damage, species diversity is reduced to a small number of common species with high resilience. Increasing salinity produces similar impacts. Sulfur and nitrogen compounds released through the burning of fossil fuels are transported by air currents across large distances and later deposited as "acid rain", the most important factor causing acidification of waterbodies. Eutrophication – enhanced nutrient loads to waterbodies – is accelerating the production of primary organic material and biological decomposition processes in particular. In numerous industrialized countries, the ecosystems of the major rivers have been largely destroyed through the construction of dams for hydroelectric power generation. The Council recommends that no untreated wastewater be fed into non-flowing waterbodies, that the shores of lakes be placed under special protection and that action be taken to prevent the erosion of slopes near the shores of lakes. The importation of unlisted exotic species should also be stopped. Wetlands perform a special ecological function and should no longer be drained; renaturalization measures are needed here instead.

WATER TECHNOLOGY

Technological solutions for supplying households, agriculture and industry with water, for efficient water use and for purifying wastewater play a key role in the sustainable management of this precious resource. Due to the mounting contamination of surface water and groundwater, increasingly costly treatment processes must be deployed in order to supply people with drinking water. Pollution from industrial sources should therefore be reduced as far as possible by integrating environmental protection into production. Leaching of chemicals and other problematic substances from agriculture should be avoided. Because of the high cost of treating sewage, the wastewater of one third of humankind is discharged without treatment, even in OECD countries. In developing countries, where the majority of people have neither access to clean drinking water nor sewage systems, there is an urgent need to

develop and implement culturally and locally adapted technologies for water supply and sewage treatment. In many cases, existing technological potential for efficient water use is not exploited to the extent possible, despite the fact that substantial reductions in water consumption by irrigation schemes, industry and private households could often be achieved with suitable technical equipment.

Ways out of the global water crisis

On the basis of the new paradigm and the guiding principles for “sound management of water resources”, the Council describes the sociocultural and individual foundations for water resource management. The ways in which people use water depend not only on environmental and economic conditions, but also on manifold cultural factors, in other words the specific “water culture” of a society. Water resource management was often the starting point for human civilizations: ancient civilizations such as those in Egypt, the Indus Valley or along the Huang He in China arose from regional water cultures. The water culture in a specific type of society is multidimensional, featuring scientific, technical, economic, legal-administrative, religious, symbolic and aesthetic dimensions, for example. Another important aspect is how people perceive water: for instance, water is barely acknowledged as a resource in many industrialized countries, where it flows “straight from the tap” at a relatively low price.

A central pathway out of the water crisis is therefore to enhance environmental education and public discourse. The Council has developed a series of concrete solutions in this respect. Possible responses include media campaigns to save water, information on specific options, or pilot projects in selected urban districts. Communication between those involved, thus triggering learning processes that can subsequently lead to changes in behavior patterns, is of the essence here. In the industrialized countries, discursive forms of planning and conflict resolution are gaining in popularity – examples are Round Table discussions, citizen involvement, alternative procedures for settling conflicts, or Local Agenda 21 initiatives. In general, water-related problems should be made easier for people to perceive. The extent to which individual behavior affects water resources must be made clear to all, as must the successes that can be achieved by modifying behavior. An effective step would be, for example, to publish the water consumption figures of a particular community on a noticeboard so that a local “water-saving culture” can be promoted.

The instruments with which policymakers could shape society’s management of water resources in a viable way are described in detail. This requires a highly differentiated analysis, since there is hardly a single resource that is used in as many different ways as water. To arrive at an optimal distribution of water resources, attention is focused primarily on institutional solutions. However, precisely because of the different uses to which humans put water, no institutional solution can provide a convincing response by itself. The Council therefore recommends that consideration be given in any case to a combination of different instruments, whereby the criteria of efficiency, equity and sustainability must be complied with as optimally as possible in each specific case. Market-based solutions generally hold out the prom-

ise of more efficient water use. However, the state must support them by establishing an appropriate framework and by implementing measures in order to conform to the criterion of equity and the secure coverage of basic needs for water as a basis for life (e.g. through anti-trust law, water benefit for the needy and similar).

The main focus of the section dealing with the role of law in the sound management of water resources is on multilateral aspects of water use. A distinction is made between two areas in which international cooperation is essential: firstly, riparian states bordering on inland waterbodies, i.e. which share a river basin or an inland lake, must engage in cooperation. In such cases, international freshwater law requires that riparian states share the utilization of water resources in an “equitable” and “reasonable” manner. This aspect is regulated in detail by the Convention on the Non-Navigational Uses of International Watercourses recently adopted by the Sixth Committee of the United Nations General Assembly. Secondly, the Council’s view is that the global water crisis also demands international partnership over and beyond the riparian states of an inland waterbody. The entire international community is called upon to support all those states that are affected or directly threatened by a water crisis. The Secretary-General of the United Nations has called for a global consensus on international freshwater policy, which the Council expressly supports. From the viewpoint of the WBGU, this consensus could form the basis for a variety of institutional solutions – states could agree on a new Plan of Action, or they could go a step further and adopt a World Water Charter establishing behavioral standards for states, multilateral organizations and non-governmental bodies that would be non-binding in international law, but nevertheless representing a political commitment on the part of signatories. A third step would be to use the Desertification Convention as a model for negotiating an international convention on the protection of freshwater resources, in the form of a legally binding Framework Convention on Freshwater Resources, for example. The Council believes, however, that the time is not yet ripe for this latter step. Nevertheless, Germany should make a concerted effort to initiate negotiations for a World Water Charter, for which the Council has drafted a basic outline in its Report.

Potential instruments within an international and national strategy for sustainable management of water resources could take a variety of forms. Optimal “instrument mixes” for responding to various problems of freshwater policy are presented, for example in the fields of water supply, wastewater treatment, protection of health, irrigation, human nutrition, disaster prevention and control, and for the settlement of disputes at national and international level.

Recommendations to the Federal Government

A number of specific recommendations to policymakers and on further research needs can be derived from the “ways out of the water crisis” developed by the Council. The basic guiding principle for efficient, equitable and sustainable management of freshwater resources as applied by the Council must be operationalized in specific contexts and given shape and form through practical action. Germany can help resolve global water problems primarily by asserting its influence in various fields of international policymaking. These include international development cooperation,

foreign trade, the transfer of knowledge and technology, and support of existing and forthcoming international regimes in the environmental and development field. Furthermore, by implementing a national water policy complying with the guiding principles outlined by the Council, Germany can strive for an enhanced role as a “model” of sound water resource management for other regions to follow.

THE CRASH BARRIERS

Sound management of water resources requires a definition of sociocultural and ecological “crash barriers”. It is crucially important in this context to take an integrated view of environmental and development standards and to elucidate in sufficient depth the repercussions of water-related projects. Specifically, the Council recommends that:

1. minimum standards be defined for the supply of drinking water and water-related sanitation facilities to individuals,
2. the resultant country-specific and culture-specific demand for freshwater be ascertained in respect of quantity and quality, giving special consideration to health aspects,
3. general safety standards be defined in respect of natural water-related disasters,
4. the geographical and sociopolitical pattern of vulnerability and the resultant need for precautionary action be determined in light of 3. above,
5. international principles of equity governing access to national and transboundary freshwater resources be agreed upon,
6. global groundwater reserves in fossil aquifers and the renewal and self-purification rates of recent groundwater reservoirs be determined,
7. the global stock of ecosystems dominated or influenced by freshwater and in need of protection be identified and classified,
8. the respective stress-bearing limits of the semi-natural systems identified under 7. above be determined in respect of water stocks, water quality and water variability, and that
9. the methods for integrated analysis and assessment of water-relevant projects in the private or public sector be developed further.

A fundamental consensus between competing users, societal groups or states on the specific crash barrier criteria for sound management of freshwater resources does not automatically mean that these limits will be respected, however. This would require agreement on institutional regulations that can be enhanced by technical, educational and economic programs.

INTERNATIONAL REGIMES AND INTERNATIONAL LAW

In connection with the further development of international law and international regime formation, the Council recommends that the Federal Government supports negotiations for a World Water Charter and for a comprehensive Global Plan of Action for “Sustainable Water Management”. Additionally, water-relevant standards should form a more integral part of international trade and credit agreements (WTO, World Bank programs, Hermes credit guarantees, etc.), and sound management of water resources should be taken into consideration more as a cross-cutting task in sectoral regimes for sustainable development (examples being the Climate Convention, negotiations on the protection of forests, the Biodiversity Convention

and the Desertification Convention). International cooperation should also be stepped up with regard to water-relevant aspects of the International Covenant on Economic, Social and Cultural Rights and the relevant responsibilities of the United Nations High Commissioner for Human Rights.

Finally, it is important to improve the coordination of international organizations and programs in the field of “sustainable development”; here, the Federal Government should exert political pressure to ensure integration of the latter within a single “Organization for Sustainable Development”. In particular, it would be possible to integrate the UNEP, the CSD and the UNDP in one body, while closer links could be forged between it and the World Bank, the International Monetary Fund, the World Trade Organisation and UNCTAD.

Regarding the amendment of the United Nations Charter, which Germany supports (German membership of the Security Council), the Federal Government should also lend support to the inclusion of articles on sustainable development, for example by including environmental protection in Article 55, and the goal of sustainable development in the Preamble and in Article 1 or 2. Negotiations on the Convention on the Non-Navigational Uses of International Watercourses have made substantial progress following the recent resolution of the Sixth Committee of the United Nations General Assembly. The Council recommends that these negotiations be brought forwards as rapidly as possible, that the ban on major environmental damage to waterbodies and neighboring ecosystems be given priority in international law over riparian states’ utilization rights, and that extra regulations be agreed upon to include all groundwater stocks, wetlands and coastal waters.

FOREIGN POLICY, FOREIGN TRADE POLICY AND DEVELOPMENT COOPERATION

As far as foreign trade policy and development cooperation are concerned, the Council recommends that securing a basic supply of water for nutrition and sanitation purposes be given greater consideration, in addition to environmental aspects, in multilateral agreements on development cooperation, whereby agreement must be reached with the partner countries in question. Preference should be given to recycling water as opposed to primary withdrawals, whereby withdrawals from fossil aquifers should be seen as a last resort. Local cultural traditions of protecting waterbodies and the environment, as well as indigenous knowledge must be respected as a matter of principle. It is essential to ensure public participation on the part of those affected, as this is the only way to guarantee the social acceptability and effectiveness of development policy measures and to determine the real needs of users. These aspects should be taken into consideration above all in the debate over a “New Green Revolution”; it is precisely here that efforts should be made to bring about a greater diversity of seeds and breeds in agriculture, and to promote rainfed cropping in particular more intensively. A second main focus of water-specific development cooperation should be the improvement of water supply to poor sections of the urban population. In general, integrated water resource management in cities should be carried out to a greater extent by examining quantity and quality in combination only, by linking supply issues to wastewater treatment issues and by choosing catchment areas as planning units rather than local authority and national borders.

The Council recommends, in particular, that better support be given to states affected or threatened by water crises, above all in the modernization of existing agricultural irrigation systems, in the repair and expansion of water supply networks, and in establishing or improving systems for drinking water extraction, treating wastewater and recycling water. These activities should be carried out within the framework of bilateral development cooperation as well as through close collaboration with international organizations such as the FAO, the WHO, the UNDP or the World Bank.

In addition, environmental and development projects advancing the cause of peace should be vigorously promoted in areas suffering from water crisis (the Middle East, for example). Another important activity concerns the transfer of technology and expertise to maintain sociocultural and ecological water standards, especially in areas affected by water crisis, and to protect the world's natural heritage, whereby special weight must be attached to water-saving and environmentally, culturally and locally compatible methods. Macroeconomic externalities (such as long-term impairment of waterbody quality as a result of industrial activities) should be taken into consideration by means of appropriate operationalization of the liability principle, whereby the ecological crash barriers can be complied with in an effective way by granting tradable emission certificates, for example. Improvements should be made to the conditional framework for efficient management of scarce freshwater resources; to this end, rights of tenure and disposal should be secured as far as possible, available water resources should be subjected to economic valuation, and limits imposed on subsidies that reduce competition. Where effective competition and anti-trust laws are in place, international water markets should be furthered in various regions of the world. A basic supply of freshwater in water-scarce countries must be secured by appropriate forms of direct assistance ("water benefit" rather than large-scale water resources projects).

Environmental education must similarly be advanced, also in relation to Local Agenda 21 initiatives. Special efforts should be made here to increase awareness of the interactions between individual behavior and damage to the environment, to provide the population with feedback on successful modification of behavior (such as information on consumption, and implications for water charges) and to enable learning from models.

FINANCING ASPECTS

As far as financing activities are concerned, the Council believes that greater efforts need to be made in order to increase Germany's financial contribution in support of water management policies in countries with insufficient resources, particularly in light of the UN Secretary-General's estimate of US\$ 50 billion per year to meet global drinking water needs over the 1990–2000 period. All opportunities for reducing the debt servicing burden on developing countries threatened by water crisis should be exploited to this end, whereby links to water policy programs should be examined (debt for water security swaps). The Council also recommends exploring the possibility of assistance to financially overburdened countries from a global Water Fund replenished via robust international financing mechanisms (for example, a "World Water Penny" levied on water consumption).

INTERNATIONAL RESEARCH COLLABORATION

With regard to international research collaboration, the Council recommends: enhancing the international transfer of knowledge about physiological, epidemiological and environmental factors of relevance to water resources, and on all aspects of sound management of freshwater resources, whereby special emphasis should be placed on communicating scientific and technological interrelationships (in the fields of hydrology, hydraulic engineering, water treatment or hygiene, *inter alia*), tried-and-tested regulations of the institutional organizations, and methods for efficient management of scarce environmental resources; developing integrated and participatory mechanisms for maintaining water-specific standards in private- and public sector projects (water audits, water impact assessments, etc.), and disseminating information on same.

Five years after Rio – an initial assessment

In addition to the key focus on water resources, the Council assesses the follow-up process to the 1992 UN Conference for Environment and Development in a further section of the Report. In the Rio Declaration of 1992, almost all states agreed on “the goal of establishing a new and equitable global partnership through the creation of new levels of cooperation”. Growing institutionalization of international environmental and development policy can indeed be identified, following the entry into force of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1989, the Biodiversity Convention in 1993, the Framework Convention on Climate Change and the Convention on the Law of the Sea in 1994, and the Desertification Convention in 1996. The first follow-up documents have meanwhile been signed, for example the Draft Agreement for the Implementation of the UN Convention on the Law of the Sea (focusing on straddling and highly migratory fish stocks); the next steps could be a Protocol to the Framework Convention on Climate Change, a Biosafety Protocol to the Biodiversity Convention and a Forests Convention.

The intervening period since 1992 has seen a whole series of UN Summits closely related to the goals of Agenda 21, such as the United Nations Conference on Human Settlements (Habitat II) in Istanbul, the World Summit on Social Development in Copenhagen and the World Food Summit in Rome. Even though these major UN conferences ended in non-legally binding “Declarations” and “Plans of Action”, they perform a key function at the symbolic level of politics, where the agenda for international policymaking is determined and where general expectations are formulated for policymaking at national level. This is the case, for example, with the so-called “20/20 compact”, according to which developed and developing country partners agreed to allocate 20% of the ODA provided by the donor countries and the development banks and 20% of the national budget, respectively, to basic social programs.

Despite the various “Earth negotiations” that have been conducted recently, one

must not lose sight of the fact that Agenda 21 can only really be implemented through participation and initiative on the part of every individual. The Rio Conference set in train a process of implementing Agenda 21 at local level, which is an important addition to the processes operating at international level. The "Local Agenda 21" initiatives form an indispensable part of the overall effort to preserve global environmental assets. Both trends are equally important constituents of effective political action to protect the global environment.

The Council's overall conclusion is that the Rio Conference in itself was a major step forward. For the first time in history, the overwhelming majority of nations adopted the guiding principle of sustainable development. The countries represented at UNCED acknowledged their responsibility for the global environmental and development system and accepted the need for action at the global level. However, the negative trends that led to the Rio Conference in the first place continue unabated and in some cases have worsened still further. The strategies adopted in Rio must therefore be pursued with added vigor and determination. Moreover, every effort must now be made to ensure that the pressures exerted by national problems and the greater financial constraints now operating do not lead to declining involvement in global issues. The fact that difficulties at national level are often linked through globalization to global environmental problems and development concerns and experience feedback from the latter means that national and global tasks can only be tackled through joint action. Germany has a special obligation and responsibility to bear in this context. As one of the major causal agents of global environmental problems and as one of the most powerful economic nations in the world, Germany should display a special level of commitment in the field of global environmental and development policy.

Key recommendations for action

The Council's analysis shows that the emergent global crisis of freshwater resources could become even worse in the future. The political domain should therefore take action without delay; national and international action programs must be designed and implemented as rapidly as possible in order to minimize risks and reverse current trends. The sheer complexity of the freshwater crisis calls for detailed and case-specific recommendations on activities and research. In line with the Council's criteria for "sound water resources management", these recommendations can be summarized in the form of four central and three syndrome-specific demands:

INCREASING EFFICIENCY AND EFFECTIVENESS

Water is a scarce resource that is becoming more and more scarce for humankind and nature as a result of population growth and rising individual demands. It is therefore all the more important that any assessment of water resources be oriented to water scarcity around the world.

- The Federal Government should therefore exert political pressure to ensure that reliable and efficient water supply and wastewater treatment systems are established in all countries; these systems should involve water prices that reflect the scarcity of water resources, on the one hand, while, on the other, ensuring that the right to have access to sufficient drinking water to meet basic needs is safeguarded and that environmental standards are met. The Council's view is that this demand can best be met by establishing water markets based on competition as well as proprietary rights to water supply and wastewater treatment systems. Another option at local or regional level would be the creation of cooperatives.
- The regulation of water supply and water demand should be governed by the principle of subsidiarity. Decentrally organized systems and regulations for water supply are usually more efficient than inflexible, centrally planned solutions; they are also easier for those concerned to understand and utilize, and tend to be better adapted to the specific characteristics of the region in question.

COMPLIANCE WITH THE SOCIAL "CRASH BARRIERS"

Efficient management of scarce water resources provides benefits for all humankind. However, the distribution of water must also conform to the principles governing the individual's right to a livelihood as well as – especially in international conflicts – the principle of distributive justice. There should also be adequate protection against severe droughts and floods. The Council puts forward the following key recommendations in this respect:

- The Federal Government should play an active role in enforcing the right to water worldwide. Efforts must be primarily geared at ensuring not only that all countries have the technical means to provide free access to water, but also that a (regionally defined) minimum supply of water for individuals is provided to low-income strata of the population throughout the world. This should be achieved by allocating "water benefit" (akin to housing benefit in Germany), or by appropriate water charges, i.e. inexpensive rates for the quantity of water defined

as the minimum consumption level for individuals.

- Combating the freshwater crisis by means of national and international action programs requires the provision of financial support to those regions facing severe water scarcity, even when major increases in water efficiency are achieved. The UN Secretary-General estimates that annual investments of US\$ 50 billion until the year 2000 are necessary to meet the global requirement for drinking water, an amount far beyond the financial resources of many developing countries affected by severe water crises. The Council therefore recommends that the Federal Government do everything it can to increase Germany's contribution towards supporting water policy efforts in countries with insufficient financial resources of their own. Consideration should be given here to providing assistance from a global Water Fund, replenished through robust financing mechanisms (such as a "World Water Penny" levied on water consumption).
- Educational programs centering on the interrelationships between water, health and the environment are as essential as full public participation at local level if the subsidiarity principle is to be complied with and the supply of water to be adapted to regional lifestyles and cultures. What are also needed are equitable decision-making processes for determining the amount of water use and the minimum level of environmental protection to be provided for waterbodies and surrounding areas of land. This is another area where the traditions, lifestyles and role patterns (gender roles, for example) of those affected have to be respected and taken into account. The Council therefore recommends that the Federal Government lend its support to culture-specific educational work and to appropriate means of public participation (like the "water parliaments" in France).
- Another basic problem concerns the inequitable utilization of water resources by upstream and downstream riparians of river basins, or by joint users of waterbodies. This problem is the source of many international conflicts, and these are likely to escalate in the future. The Council therefore recommends that the Federal Government promote pilot projects for the equitable use of transboundary rivers, provide international mediators for settling such conflicts and insist on compliance with equity principles as a criterion in development cooperation.

COMPLIANCE WITH THE ECOLOGICAL "CRASH BARRIERS"

Utilization of water resources by humans is placed under natural constraints wherever essential ecological functions are disturbed or where valuable biotopes are threatened. The basic principles that should operate include protection of species diversity in freshwater ecosystems, ensuring that water quality does not deteriorate beyond an environmentally acceptable level, and conservation of all major wetland areas. The impacts of water withdrawals and waterbody utilization on surrounding areas of land (land consumption in particular) must be taken into consideration here, as must the indirect human-induced effects operating through the media of soils and air on water-based habitats.

- The Federal Government should therefore carry out activities for preserving and re-establishing the structural and functional integrity of water-based ecosystems (including neighboring habitats) and exert political pressure to ensure that such measures are promoted in other countries as well. Such activities are of para-

mount importance for preserving and re-establishing the vital habitat functions that freshwater resources perform. The Federal Government can contribute towards this goal through the transfer of knowledge and technologies and by supporting specific rehabilitation projects.

- The core principle of sustainable use of water resources by human societies defines a crucial environmental crash barrier, or boundary zone, for preserving the natural resource base on which present and future generations depend. This implies that the annual withdrawals of (ground)water in a catchment basin must not exceed the renewal rate. The Council recommends that states restrict the delivery of water and/or water rights whenever a critical level is exceeded. To safeguard the quality of water, substance and organism loads may not over-tax the capacity of the medium to purify itself. The Council therefore recommends the definition of quality targets in accordance with the precautionary principle.
- The Federal Government should continue to provide financial and research support for protection of the biotopes included in the UNESCO World Heritage List. It should also promote the inclusion of additional globally important and significant freshwater habitats.

BUILDING THE CAPACITY OF INTERNATIONAL INSTITUTIONS

In addition to national activities aimed at a leading role and geared to bilateral economic, development and finance policy, it is absolutely imperative to codify the goals of sustainable water use in the form of international conventions and treaties.

- The Council therefore recommends that the Federal Government launch a “World Water Charter” to which all governments, local authorities, international organizations and non-governmental bodies can be signatories. The Charter would operate as a global code of behavior committing all concerned to take the requisite political action to combat the freshwater crisis.
- Cooperation among the international community is made overly difficult by the hypertrophy endemic to the international system of institutions and organizations. This is the background to the Council’s recommendation to improve the coordination of international organizations and programs in the field of “sustainable development” and to integrate the separate bodies in an “Organization for Sustainable Development” endowed with extensive monitoring powers. This organization could unite existing institutions and programs such as the United Nations Environmental Programme (UNEP), the Commission for Sustainable Development (CSD) and the United Nations Development Programme (UNDP) within a single body. It should engage in close collaboration with institutions such as the World Bank, the International Monetary Fund, the World Trade Organisation (WTO), the World Health Organisation (WHO), the United Nations Food and Agriculture Organisation (FAO) and the United Nations Conference on Trade and Development (UNCTAD).

MITIGATION OF WATER-RELEVANT SYNDROMES

Alongside the key recommendations directly derived from the guiding principle of sound management of water resources, the Council has identified three syndromes in which increasingly negative trends in the water-centred network of inter-

relations are concentrated. They therefore play a crucial role in exacerbating the global water crisis and hence require rapid and effective strategy responses. Key recommendations giving special consideration to the systemic nature of the fresh-water crisis can be derived in this area as well.

- The analysis of the Green Revolution Syndrome shows that the food security problem cannot be attributed solely to food shortages in specific regions. More specifically, poverty and the severe lack of resources and capacities are primary determinants of chronic malnutrition and famine. The Council's recommendation to the Federal Government is that it take steps within its development projects to ensure that farmers have clearly defined water rights and fair competitive conditions with water traders so that they can plan ahead with confidence and thus achieve a modicum of local sovereignty. Adequate training and education programs must be implemented to improve awareness of the interrelationships between agricultural activities and the environment and to build the capacities of local communities to solve their water problems.
- The analysis of the Favela Syndrome shows that health and hygiene problems in the slums of major cities have reached extremely alarming proportions. The Council recommends that the damage to health caused by contaminated water be seen as the priority issue in the field of development policy and that action be taken to combat the root causes. Additional steps should involve the development of affordable wastewater treatment systems and the provision of support for essential health care (e.g. simple forms of disinfection and hygiene education).
- To cure the Aral Sea Syndrome, the Council recommends that environmental and development strategies be designed in such a way that large-scale water development projects with sometimes unforeseen impacts on the environment and society be granted financial or non-material assistance only on condition that an assessment of all the benefits and possible repercussions of such projects shows they make good overall sense. Such assessment must take fullest possible consideration of the social and environmental costs. Construction of large-scale facilities should be dispensed with entirely if the environmental and social crash barriers are overstepped.

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