Water and Security in Southern Africa

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Foreword

Water is becoming an increasingly scarce resource, especially in dry climate regions such as Southern Africa. A finite amount of fresh water shall satisfy the needs of the growing population, the production of food, industrial and energy production, cities and conservation of nature. An increased competition between different users of water, both within countries and between countries, can be a source of conflicts but also instrumental in creating opportunities for strengthening cooperation.

As part of Sweden's commitment to Agenda 21, Sida will give higher priority to water resources in development cooperation. We are at present preparing a programme of support to sustainable use of water resources in the regional context of Southern Africa. This report has been prepared to give background information on potential conflicts related to water resources in that region. The views presented in the report are those of the author and are not necessarily shared by Sida.

We hope that the report will contribute to the discussion and improved understanding of water resources as an essential area for cooperation to prevent potential conflicts.

Stockholm in November, 1995

Johan Holmberg
Director, Department for Natural Resources and the Environment, Sida

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Summary of the Study

The need for integrated, basinwide, water resource management is considered a prime security objective for the prospects of SADC regional cooperation. Any measure that will strengthen such efforts therefore ought to be reviewed for development cooperation support.

In the short term, outdated or non-existent data merit support for basic hydrological data collection, necessary for creating or updating national water master plans, as part of assessing all river basin resources. Any programme directed at increasing awareness of water issues among decision-makers in the region deserves support. The possibility of utilizing existing competence from the new South Africa for regional capacity-building ought to be fully explored.

Water transfer schemes to ameliorate acute water shortage for cities and water-starved regions already are at the top of the regional agenda, and will continue to be so for the medium term, necessitating regional negotiations and underlining the need for basinwide management. The most important such regional water resource management programme, the ZACPLAN, has been scrutinized extensively by expertise from both within the region and by external reviewers. Judging by these reviews, the principal agency handling the programme, SADC ELMS, would benefit from institutional support.

Attention on security aspects of water issues so far has been concentrated on the risk of water transfer schemes creating conflicts – political or ultimately violent – between states in the region. The mere perception of such risks is a security threat in its own right, undermining confidence-creating measures between countries. On the merits of available evidence, however, the regional cooperative framework seems strong enough to handle present aspects of this threat, particularly since officials on all levels from the new South Africa seem very concerned about eliminating any ground for suspicion of regional great-power ambitions.

Furthermore, concentrating on security in this traditional inter-state sense may obscure the potentially much larger risks in the long run of environmentally induced scarcities creating misery and conflicts within countries, leading to consequences which are very difficult to foresee. Conflicts between states may turn out to be among these consequences. It is worth underlining, however, that the most likely scenario for such future conflicts to arise will be through a failure to meet the *internal* challenges facing governments and states already today.

These risks can be mitigated by cooperation, understanding, trust, identifying the expectations and concerns and by determining the potential of the resource base, so that negotiation can be based on facts.

Development cooperation efforts aimed at preparing countries in the region for a strategy of *learning to live with aridity* – i.e. using the available water, where it is available, to its greatest advantage – therefore seems imperative, as part of a larger strategy of preparing for the inevitable long-time and large-scale forces of societal change – with their inherent capacity of creating break-down tendencies for the state – being at work for the duration of the foreseeable future in the SADC countries.

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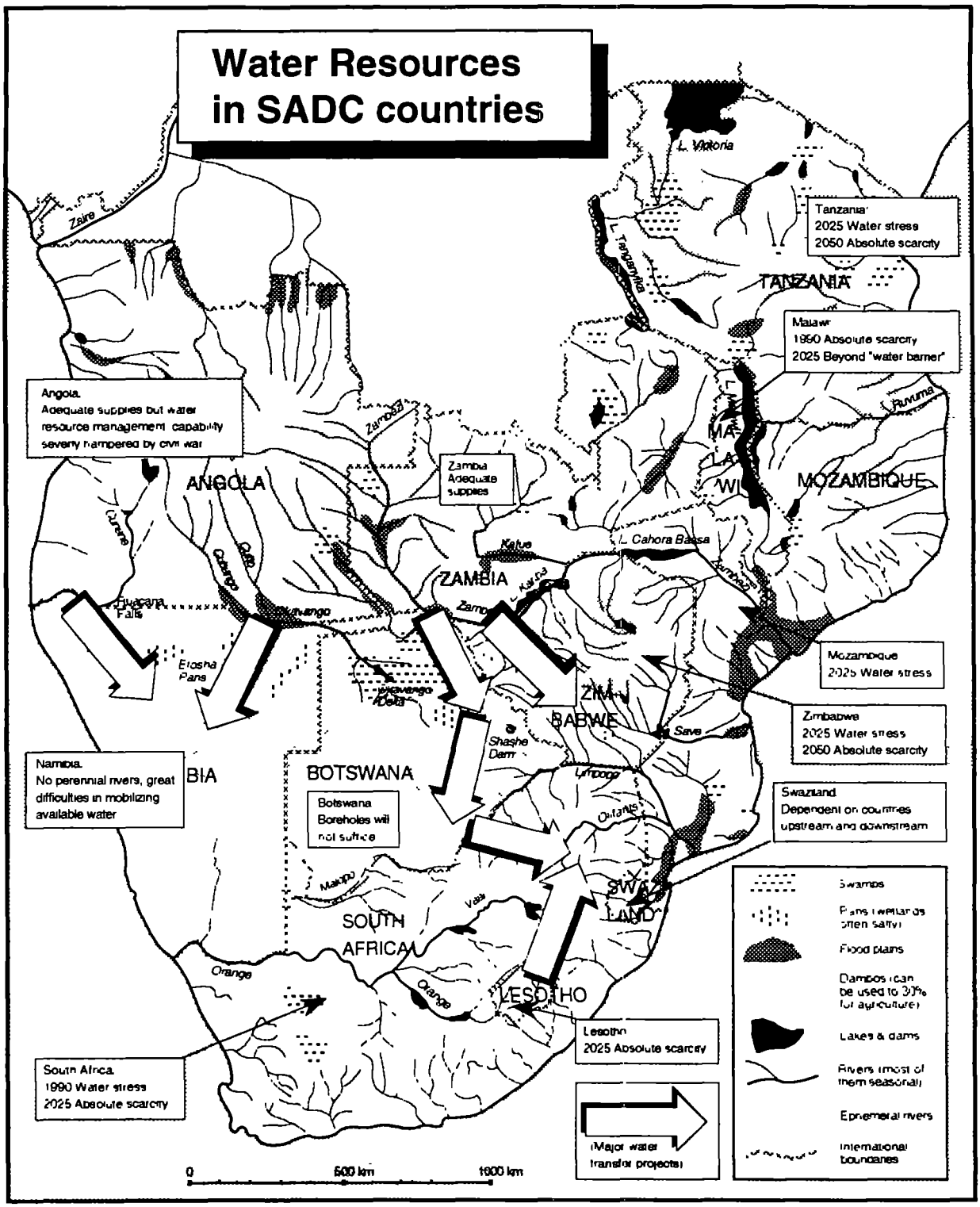

(Map drawn for this study, based on Chabwela, H., *Wetlands: A Conservation Programme for Southern Africa*, IUCN and SADC, Harare, Nov 1991)

Major water transfer schemes shown by arrows on the map, include the first international interbasin water transfer in southern Africa, from the Cunene to the Cuvela in Namibia; plans for diverting water from the Okavango to Namibia; plans to divert water from the Zambezi-Chobwe to Botswana, and possibly further to South Africa in several steps; and the largest water transfer scheme in the world, the Lesotho Highlands Water Project, which will bring water to South Africa's industrial heartland. Assessments of present and future water scarcity is based on deliberations in the study.

Main Study:

Water and Security in Southern Africa

Background

The triad peace, security and social development is identified by the Swedish government as the foundation for its foreign policy. Conflict prevention and resolution will be explicitly supported. A special Foreign Office deputy under-secreterary of state, responsible for security issues, has been appointed. The importance of creating regional structures with a capability of preventing conflicts and incorporating South Africa in the SADC (Southern African Development Community) regional cooperation is underlined. A special task force on security in Africa has been formed; the task to deliver a thorough analysis of security issues, compile information on the origins of conflict and available experiences on conflict resolution, and propose relevant Swedish development assistance programmes, directed primarily at southern and eastern Africa. The foreign minister for development assistance has stressed that competition for natural resources may lead to serious conflicts in the future. Water scarcity is identified as the potentially greatest future cause of conflict in the SADC region.[1]

At the first SADC Conference where the new South Africa took part, in January 1995, the Swedish diplomatic representation made a special address to member states, urging them to treat water issues as a priority area.[2] Ongoing attempts to create a mechanism for SADC regional management of shared water resources have been initiated and supported by Sida and other aid agencies.

The May 1995 high-level meeting of the OECD (Organization for Economic Cooperation and Development) Development Assistance Committe (DAC), confirmed the dedication of member states to conflict prevention and resolution, and the importance of development assistance in the preventive aspects of this work. The need to concentrate efforts on the areas of human rights and democracy was particularly stressed, as was measures to increase prospects of food security. The Swedish representative underlined the importance of developing networks of global and regional organizations for conflict management.[3]

1 Internal Memo, Sida Natural Resources Management Division, 950502

2 Internal Memo, Foreign Office, IU2, 950224

3 Internal Memo, Foreign Office, IU3, 950710.

Acting on these guidelines, Sida is preparing for a new programme on Regional Water Resources Management (RWRM) in the SADC-region. Building on existing knowledge in the region, the programme aims at increasing regional and national capacity. A sub-objective is to couple Swedish institutions with institutions in the region to mutual benefit. As part of the preparation, the present desk study on the relationship between different types of water scarcities and potential conflicts related to water resources in the SADC-region was commissioned; the study also to suggest a framework for a more thorough investigation, and identify research institutions in Sweden with relevant capacity.

This study

The study has three main points of departure: (1) Perceptions of security are changing from military matters to growing societal constraints, due to lack of natural resources; specifically resources vital to food production, and particularly in developing countries. Policy implications are yet to be determined and may potentially differ widely. (2) The limiting factor for increased food production is availability of water for irrigation, leading to competition between different societal sectors, possibly also between countries with common water resources. Particularly in dry developing countries, water scarcity therefore amounts to a general constraint for development, and cannot be treated separately from either population development, land use changes, or changes in development strategy. (3) A research programme relevant to development assistance efforts should preferably be compatible with the relevant policy documents, national planning efforts in the SADC countries, and the existing framework of regional institutions.

Built on a review of these three areas, prospects and stumbling blocks for SADC regional cooperation on water resources management are analyzed for their inherent, potentially both conflict-generating and confidence-building elements.

Background material used for the analysis, and references are collected in a number of appendicies, following the main report.

Changing Perceptions of Security

Parallell to, and even slightly preempting the outcome of the UNCED (United Nations Conference on the Environment and Development) process, a new discourse has emerged on environmental threats to security. Tying in to an older, and unfortunately somewhat neglected, discourse with spurious Swedish connotations,[4] the new discourse is markedly high-profile, policy-oriented and of distinctly US-American origin.[5]

The original content of this new discourse could be summarized as an attempt to place the UNCED issues – deforestation, biodiversity, climate change,

4. Cf. the work done by Arthur Westing while at SIPRI (Stockholm International Peace Research Institue), e.g. Westing 1986.

5. Its beginning is conveniently marked by a seminal 1989 article in *Foreign Affairs* by National Security Advisor Jessica Tuchman Mathews, "Redefining Security" (Mathews 1989)

population and development issues – legitimately within the sphere of high politics. Water issues figured high on this agenda as a potential source of international conflict, most often based on much-quoted threats of war from several of the national leaders in the Middle East. The analysis, basically, was of the traditional geopolitical and *realpolitik* variety.[6]

Within the semi-scientific, semi-policy sphere the discourse in later years has taken a turn with distinct apocalyptic overtones, conjuring up images of an anarchic, chaotic (lack of) world order;[7] as well as attempts at formulating adequate societal responses to these threats, most notably perhaps by US vice-president Al Gore,[8] and the administrator of USAID, Brian Atwood, who succintly summarizes the emerging new perspective on security:[9]

> Bosnia. Haiti. Rwanda. These troubling and unique crises in disparate regions of the globe share a common thread. They are the dark manifestation of a strategic threat that increasingly defines America's foreign policy challenge. Disintegrating societies and failed states with their civil conflicts and destabilizing refugee flows have emerged as the greatest menace to global stability [ ] The pyre of failed states is fueled by [...] endemic poverty, rapid population growth; food insecurity, environmental degradation, and unstable and undemocratic governments

The different strands of the discourse and, more importantly, their consequential policy implications, are conveniently analyzed in relation to the three cornerstones of Swedish foreign policy: peace, security and social development.

Environment and peace

For many researchers, the relation between environmental problems or scarcities, on the one hand, and open conflict (war) between countries, on the other, has always been the most spectacular and sought-after connection to establish. But it was not until the passing of the cold war era that amply funded and appropriately staffed programmes were initiated. Although some results have emerged from European soil, much of the present knowledge derives from a series of joint Canadian-US projects.[10]

The first project in this series amassed empirical evidence from a team of forty researchers from four continents, indicating that scarcities of renewable

6. This particular strand of reasoning was initiated by another seminal article, "Water Wars" by Joyce Starr, this time in *Foreign Policy* (Starr 1991), followed by several books on potential water wars, e.g Ohlsson (ed.) 1992 & 1995, Bulloch & Darwish 1993 A Swedish research proposal is outlined in Wallensteen & Swain 1994

7 This strand was started by Robert Kaplan and his – widely read in policy circles – "The Coming Anarchy: How scarcity, crime, overpopulation, tribalism, and disease are rapidly destroying the social fabric of our planet", in *The Atlantic Monthly* (Feb 1994). Some of these threads were also picked up by the influential historian Paul Kennedy in his 1993 book, *Preparing for the Twentyfirst Century*

8. In his 1992 book, *Earth in the Balance. Forging a New Common Purpose*

9 In a 1994 *Washington Post* article, poignantly entitled "Suddenly, Chaos" USAID is the US development cooperation agency.

10 The projects have been carried out in a surprisingly short span of years under the continuous leadership of Thomas Homer-Dixon, Peace and Conflict Studies, Toronto The main European project is the Swiss "Environment and Conflicts Project", hosted jointly by the Swiss Peace Foundation (Berne), and Center for Security Studies and Conflict Research (Zürich). A Swedish contribution is sketched in Wallensteen 1992.

resources – cropland, forests, water and fish – are already contributing to violent conflicts in many parts of the developing world, even though these conflicts often appear to be caused solely by political, ethnic or ideological factors. The project boldly concluded that these conflicts foreshadow a surge of similar violence in coming decades as environmental scarcities worsen in many developing countries. Conflicts over shared water resources was considered a high risk; although the outcome was more often deemed to be political conflicts between countries than war. The mere perception of water issues as a potential conflict source, however, remains a powerful factor *per se*.[11]

By the time of the second project, risks of international conflict was deemphasized. Instead, efforts were concentrated on reduced state capacity and risks for civil violence (as opposed to international conflict or war), as a consequence of environmental scarcities; stressing that environmental change is only one of three main sources of renewable resource scarcity. The second, population growth, reduces a resource's per capita availability by dividing it among more and more people. The third, unequal resource distribution, can concentrate a resource in the hands of a few people and subject the rest to extreme scarcity. The term "environmental scarcity" allows these three distinct sources of scarcity to be incorporated into one analysis.[12]

As will be seen, this concept is particularly useful when analyzing water scarcity, since, on the one hand, it points to the importance of finding more efficient ways of using the existing water, in order to stretch the resource base in the face of diminishing per capita allotments; and on the other hand the importance of diminishing inequalities in distribution.

In summary, the research so far does not allow for establishing a clear causal connection between environmental factors and threats to peace (not even in the seemingly clear-cut case of Rwanda).[13] It does, however, indicate that complex environmental scarcities of the type described above is an aggravating factor in undermining the capacity of weak states, leading to increased risk of civil violence and, ultimately, to possible break-down of the state. As a result, emphasis in the third project has changed again; now towards establishing links between the two factors population and environment, on the one hand, and the more general concept of security, on the other.[14]

11 The outcome of the project ("Environmental Change and Acute Conflict", sponsored by the American Academy of Arts and Sciences and the University of Toronto, 1990-93) is summarized in Homer-Dixon 1991, Homer-Dixon et al. 1993, and Homer-Dixon 1994 Water conflicts were treated in Gleick 1992, Lowi 1992.

12. I have tried to introduce the concept of environmental scarcity on the Swedish scene in a licentiate thesis, "Miljorelaterade resurskonflikter" (Ohlsson 1995) Points of departure for the project "Environmental Scarcities, State Capacity, and Civil Violence", running 1994-96, are summarized in Homer-Dixon 1994.

13 Rwanda, before its collapse, had one of the lowest per capita allotments of agricultural land in the world. The crucial factor unleashing the ethnic violence, however, seems to have been regime insecurity. Cf. Percival & Homer-Dixon 1995.

14 Some of the fast-track results of "The Project on Environment, Population and Security" (started in July 1994, sponsored by the American Association for the Advancement of Science and University of Toronto) are summarized in Homer-Dixon 1995, Percival & Homer-Dixon 1995, and Gizewski & Homer-Dixon 1995 – with more to come, i.a. "Environmental Scarcity and Violent Conflict: The Case of South Africa".

Environment and security

It has been argued that "security", in the contemporary usage of the term, is a concept that virtually had no meaning before the second World War, and that it is almost inextricably linked with the needs of the military in the post-war world order. Significantly, attempts to establish links between environmental scarcities and security did not receive official backing until the break-down of this security (or, as it were, insecurity) order.

Interestingly, almost immediately with the advent of the new discourse on environmental security in the US, a heated debate was started in that country on the feasability of using security as a viable concept for treating environmentally related problems. Proponents for using the concept seemed to have a clear-cut case: What could be more basic to a country's prospects than access to natural resources and a healthy environment? And environmental pollution does not respect borders. Contenders argued that environmental protection, access to natural resources, and potential constraints for food production, are indeed of primary concern, particularly for development policies, and clearly merit the highest degree of national and international concern. These goals, however, run a risk of being compromised by using a concept that by its inherent logic will advocate military-type solutions, or make for a continuation of the military national security agenda on problem areas hitherto largely uncompromized by this logic. [15]

At the root of this debate lies the inherent ambiguity of the concept behind the term "security", which allows for attempts of twisting it, from its prevalent contemporary meaning of "military and national security", into its more basic meaning "social and societal security".[16] The advantages of making such an attempt, in order to gain entrance to the scene of high politics, may seem overwhelming. The problems, however, will occur precisely when entering the area of policy making. Will the US shoulder a responsibility for sustainable development in e.g. southern Africa , if an analysis of the "new" or "alternative" security issues show that they pose very little threat to national security in the traditional sense? Will Sweden, in the long run?[17]

Environment and social development

Peace research has a strong tradition of stressing positive peace (prospects for social development) as opposed to negative peace (mere absence of war). The

15 Different views, and reviews of the US debate, are found in Lipschutz 1992, Claussen 1995, Dabelko & Dabelko 1995, Matthew 1995, de Sherbinin 1995

16 This is a feature particular to the English usage of the term The corresponding advantage does not exist in Swedish, where the meaning of "säkerhet" overwhelmingly is invested with military connotations, and virtually empty of "social och samhällelig trygghet" Proponents of including environmental issues in a new perception of "sakerhet" thus run much larger risks in the Swedish debate, than their English speaking contemporaries do when they argue for the relevancy of "environmental security".

17. These fears may seem premature. The present study, however, is only one of at least three official reports, related in one way or another to the subject of environmental security, that my own department lately has been asked to take part in, clearly pointing to the importance paid to the new discourse on security in Swedish officials circles. A word of warning, in the context of the ongoing international debate, would be that a similar struggle for definatory power may be going on between different actors close to the Swedish policy sphere

special task force on sustainable development assistance, appointed by the Swedish Foreign Office, ties in to this tradition (albeit not explicitly) when they, on the one hand, maintain the importance of including environmental and resource issues in a new security policy, but, significantly and on the other hand, take a very strong stand against military concerns or solutions having anything to do with this new agenda; heavily investing it instead with traditional Swedish concerns for social development.[18]

Sweden, it is argued, should continue its tradition of being one of the leading countries in the world on assistance for sustainable development, making it a high-profile issue of Swedish foreign policy. Water resource management explicitly is defined as the number one natural resources priority area, as part of preserving the basis for food production in recipient countries. The importance of including regional frameworks for conflict resolution processes as part of the development assistance is stressed.[19]

Implicitly, water scarcity thereby is defined as a threat, not first and foremost to international peace, but to the ability of developing countries to pursue a successful social development policy, as a result of challenges to the state, due in turn to a combination of population increase, and scarcity of land and water resources. The rest of this study will try to underpin this interpretation by complementing it with the analytic strength of the concept environmental scarcity as defined earlier.

Environmental Scarcity of Land and Water

At a 1994 meeting of African agricultural ministers, Zimbabwean minister Kumbirai Kangai condemned the lack of investment in agriculture by the continent's governments and said that without a change in direction "the majority of our states will continue to beg for food and aid from the international community".[20]

Africa is uniquely vulnerable to food insecurity.[21] With the lowest per capita incomes and the most rapid population growth, the continent has moved in the last three decades from food self-sufficiency to dependence on outsiders for one fifth of its food. At the same time, the continent suffers more than any other from drought and desertification. Only Asia has a larger area of degraded land. Although rainfall in some areas of the region is adequate for producing food also for others, the lack of transport infrastucture still poses great difficulties.

It is still an open question, whether the cyclical pattern of droughts in fact has changed its periodicity, so that droughts are occuring more often than they used to, which is an effect to be expected from global climate change. The recurring droughts in southern Africa meanwhile continue to be a serious challenge to the food security of the region.[22]

18 The task force very wisely abstained from trying to find a Swedish translation for the term "environmental security", thus temporarily circumventing some heavily mined territory. Cf. Utrikesdepartementet 1994, p 30 ff

19. Utrikesdepartementet 1994, p 12, 64, 68.

20 Engelman & LeRoy 1995, p. 26

21 Cf. Appendix I, "Population, Environment and Security· An Overview ..".

Despite these limitations, African farmers have proven themselves enormously resourceful and have expanded food production on average by two percent a year. Yet population is growing by three percent annually on average. In decades to come, these trends inexorably will induce environmental scarcities of land and water in several SADC countries.[23] Facin these challenges, the importance of programmes aimed at increasing the competence of farmers to manage property in the face of rainfall scarcity cannot be overstated.

It has been said that farmers do not produce in order to prove how much food it is possible to grow on a certain area, but for selling their produce on a market. Production figures thus tell us more about the economics of food production, than potential food production capability. Seen in this light, the food deficit in southern Africa could be interpreted more as a result of general economic failure, than as an inherent weakness of the agricultural base. Food not grown can be bought, if the economy is working.[24]

Others, however, maintain that changes in prospects for global food prices, as a result of increasing demands from growing populations who can afford to buy food, still will mean difficulties for economically weak areas like southern Africa.[25]

Population and land

The area of potentially arable land in southern Africa is limited, and the land itself is extremely vulnerable. As population growth continues well into the next century (as it will, in spite of changing reproductive patterns; the mothers of tomorrow are already born, and they are many), per capita allotments of agricultural land will shrink.

Calculations made for this study show that by 2025 Malawi and Tanzania will fall below the critical bench-mark of 0,07 ha of cropland per capita, to be joined in 2050 by Lesotho, Mozambique and Swaziland, and several other countries coming dangerously close.[26]

This bench-mark is not a fixed limit, but it is considered to be a threshold of concern, beyond which countries cannot support themselves without depending on massive input of fertilizers and – significantly – massive irrigation. The seriousness of the challenge can be mitigated by efforts directed at increasing water-use efficiency and conserving the inherent productive capacity of the land. This, in turn, will entail broad capacity-building programmes, since failing to raise the competence of farmers may also mean that efforts directed at enforcing an equitable land distribution could contribute to the unwanted effect of increasing the environmental scarcity of land through increased soil degradation.[27]

22. For an estimation of the food-security challenges from the present drought in southern Africa, only three years after the last one, see Appendix II "SADC Food Security An overview 1995", and Appendix III "SADC Food Security A country overview", built on the USAID Famine Early Warning System, FEWS.
23 Cf Appendix IV, "Population Growth and Land Scarcity"
24 The wellknown authority on the economics behind starvation, Amartya Sen, adopts this line of reasoning in a recent work on prospects for global food production (Sen 1994).
25 Brown & Kane 1994 I have reviewed the debate in Ohlsson 1995
26. Cf Appendix IV· "Population Growth and Land Scarcity"

On the other hand, failure to enforce an equitable land distribution will increase other problems. The very needs for increased output, modernization and intensification of agriculture in that case will lead to a surplus of labour, who will seek employment in cities, placing great demands on the modern sector. The growth of cities themselves, and the demands on land from industry, roads and other infrastructure will further encroach on agricultural land. Societal effects will include increased migration from the countryside to cities, possibly also between countries, entailing risks of conflicts between different groups of the population, and social discontent among the unemployed.

Population and Water

In Africa, more than perhaps in any other continent, the demand for increased food production capacity translates into a demand for more of the scarce resource water. As noted by the special task force on sustainable development: "It is unlikely that people in water-starved areas will die of thirst; they will die of starvation".[28]

Irrigation accounts for between 60 percent and three-quarters of all water used in southern Africa.[29] Of this, about 60 percent is wasted, not only throwing away a valuable resource, but causing serious environmental problems. In South Africa, the region's biggest irrigator, only one percent of the agricultural land is irrigated, but it produces 30 percent of the value of agricultural production. Botswana, whose currency is named after the most important resource in the region, *pula* or rain, in 1991 decided it could afford to irrigate only where there is no other possible use for the water. This has meant giving up the goal of food self-sufficiency in favour of food security; a poignant example of water, not agricultural land, being the limiting factor for food production in southern Africa.

At the base of the environmental scarcity of water in southern Africa lies climatic and environmental factors, difficult to overcome. The "thirst of the atmosphere" in many parts of the region makes most of the rain evaporate before it is absorbed by the ground; rainfall itself is scarce and unreliable on a year-to-year basis, producing little run-off except in a few areas in the south-east. A sizeable portion of the available water in most countries comes from rivers originating outside that country.

A measure of the precarious water balance in the region can be had from the fact that one man-made dam alone, Lake Kariba, contains an amount of water equal to 20 percent of the entire region's annual runoff. It is in turn more than three times the quantity of water consumed annually in the entire region (yet little of it can be used without jeopardizing power generation).

The enviromental scarcity of water is exacerbated in the first instance by simple population growth, and further by the needs for sustaining increasing populations through agriculture and industry. Water scarcity already ranks as the

27 As pointed out by P Heyns, Department of Water Affairs (DWA), Namibia.

28 Utrikesdepartementet 1994, p 29 (my translation).

29. SARDC (Southern African Research & Documentation Centre) 1994, p. 11 and 196. The different estimates seem to comply with estimates of irrigation's part of global water use, usually given as two-thirds (Sandra Postel in Gleick 1993, p. 56). Cf. also Appendix V: "Environment and Water· An Overview of the SADC countries".

number one constraint in several of the region's countries. South Africa and Malawi are classified as "water-stressed" by hydrologists. Namibia has great difficulties in mobilizing its available water.[30] Recurring droughts in Zimbabwe almost forced evacuation of the country's second city Bulawayo in 1992. Swaziland is totally dependent on rivers running out or in to the country, and thus vulnerable to the good-will of neighbouring countries.

Calculations made for this study, albeit marred by lack of up-to-date data, show that by any count the majority of the region's countries will suffer from acute water shortages within the next few decades as a result of the inexorable trends influencing environmentally induced water scarcity.[31]

In the short run, the water needs of the region has concentrated interest on efforts to supply more water; exploiting existing sources more heavily, and thus bringing the problems of shared water resources into focus. In a slightly longer perspectives competition between different societal sectors, already apparent – agriculture vs. industry, and country-side vs. cities – will bring new risks of conflicts of interest to the fore, within countries and between them.

Main attention in the region today is directed almost exclusively on the inherently conflict-generating attempts at increasing supply; in the long run, however, the need for a completely new water use regime will have to be contemplated, aimed at refining methods of water demand management, water awareness, conservation and recycling of existing water; and even restructuring industry and agriculture, in order to maximize the economic use of available water resources. Based on available reports, awareness of this necessity is still low in the region, implying in the short run a need for educational programmes, and in the long run a whole new agenda for research, development cooperation and capacity building.

The Challenge of Shared Water Resources

A complete overview of shared river systems and ongoing water projects in the region is provided in Appendix VIII: "Shared River Systems". As will be seen, almost all shared river basins have major projects that will have effects on downstream countries. Interest, however, is concentrated on the major perennial rivers; the Zambezi in particular, but also the Okavango, the Orange, the Pungue, the Cunene and the Save.

The Zambezi is the largest river in Africa running into the Indian Ocean, with 26 million people living within its catchment area, in eight of the eleven SADC countries.[32] Lack of water is regarded as the main constraint for agricultural production in all but 8 percent of the arable land in the Zambezi basin. The area embraces capitals and other larger towns, like Harare, Lusaka, Llongwe, Bulawayo, and Livingstone. The main proposed water projects are:

30 An account of the measures necessary to safe-guard water supply for cities and agriculture under these extreme dryland conditions is given in Appendix V. "Surface Water Management in Arid Regions".

31. Cf. calculations in Appendix VII "Population Growth and Water Scarcity"

32. Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe Cf. Arnestrand 1993

- Matabeleland Zambezi Water Project. to provide water to Bulawayo, Zimbabwe's second city, and accessible rural communities and agricultural developmental alternative sites on the Zambezi, both upstream and downstream of Victoria Falls.
- Botswana Water Project involving the supply of Zambezi/Chobe River water from Kazungula in Northern Botswana to a dam at Selibi-Phikwe and then on to Gaborone. As a first step the North-South carrier from the dam at Selibi-Phikwe to Gaborone will be constructed.
- Extention of the National Water Carrier in Namibia to bring water from Okavango to central Namibia.
- South African Water Project involving the transfer of water from Kazungula across Botswana to the Transvaal. This project is controversial among the Zambezi river riparian states.
- Other projects include the Batoka Gorge Hydroelectric scheme presently being studied by Zambia and Zimbabwe, and the Namibian hydropower scheme on Cunene, which involves Angolan water interests.

Other major water transfer schemes started or contemplated in the region are outlined in Appendix IX.[33] They include the presently largest water transfer scheme in the world, the Lesotho Highlands Water Project (LHWP), one of the few such projects that does not involve the Zambezi. Interestingly, the LHWP is the only water transfer scheme that according to some views has been instrumental in creating open conflicts in the region.

Facing critical water shortages, South Africa negotiated in vain with Lesotho for thirty years to divert water from Lesotho's mountains to the arid South African province of Transvaal. In 1986 South Africa gave decisive support to a successful military coup against Lesotho's tribal government. South Africa declared that it helped the coup because Lesotho had been providing sanctuary to guerrillas of the African National Congress. This was undoubtedly a key motivation, but within months the two governments reached agreement to construct the huge Highlands Water Project to meet South Africa's needs. It seems likely, therefore, that the desire for water was an ulterior motive behind South African support for the coup.[34]

According to other views, the LHWP in fact brought Lesotho, Namibia and South Africa together and showed the value of water commissions and oper discussion of fears and expectations.[35]

Lesotho is almost the only country in the region with abundant water resources. The compensation system in LHWP has been described as the most ge-

33 It is important to realize that most of these projects, with the important exceptions of the LHWP and Matabeleland projects, are as yet only contemplated. Ideas and projects, however, tend to be powerful agents of creating images of threats and conflictual interests. Feelings in Zambia, as an example, have been running very high over the recently signed Protocol on Protocol on Shared Watercourse Systems in the SADC Region (more of this below). Says Zambia's southern region's most influential chief, Chief Mukuni, whose kingdom spans the longest distance along the Zambezi in Zambia, according to news reports: "I am ready to die over the tapping of water from the river."

34. Homer-Dixon 1991.

35. As pointed out by P. Heyns, DWA Namibia.

nerous in Africa. But a prominent Basotho chief views it as the decline of a nation and the surrender of sovereignty because it takes away the only wealth Lesotho has.[36] As will be seen from calculations in Appendix VII: "Population Growth and Water Scarcity", Lesotho itself will be suffering from water scarcity within a few decades, and thus can be said to have sold out its own future.

The other side of the coin is that South Africa will also be dependent on Lesotho in the future, and that Lesotho will gain from the project by getting more water than it would have, if the water would have flown uniutilized into the sea.[37]

Namibia, who is contemplating water withdrawals from the Zambezi in the north to sugar plantations in the Caprivi strip, and from the Okavango to the central area of the country, is also affected in the south by the LHWP, through withdrawals from the shared Orange River, and has given a "no objection" only to phase I of the project.

The case of Lesotho, as well as the number of water withdrawals planned from the Zambezi, highlights the need for a functional and confidence-generating regional framework for water resource management negotiations.

The International IWRM Policy Framework

The existing international consensus on a framework for integrated water resource management (IWRM) has grown out of a series of policy meetings and documents, often spearheaded by Swedish and Nordic scientists and development policy-makers, fighting for the importance of placing water issues on the international agenda.

They include the four "Dublin Principles": (1) Water and land must be managed in an integrated way. (2) Management must be participatory and on the lowest possible level. (3) Positive policies must be formulated to address women's needs and empower women. (4) Water should be recognized and treated as an economic good.

To this should be added the OECD/DAC requirement that development programmes should contain a distinct element of conflict prevention and resolution. Further important contributions to the internationally accepted framework of water resource management has been made through work carried out within the International Convention to Combat Desertification.[38]

The SADC Regional WRM Framework

Within the region itself and in donor circles it is generally agreed that water resource management necessarily entails regional cooperation. A review of the background material provided for this study, however, shows that the type of institutions most suitable, and their scope of responsibility, are still contested issu-

36. SARDC 1992.
37. As pointed out by P. Heyns, DWA Namibia.
38. Cf Appendix X "The International IWRM Policy Framework" The overriding framework for managing internationally shared water resources, the Helsinki Rules, is reviewed separately in Appendix XI See also Lundqvist & Jønch-Clausen 1994

es. In what follows, the existing regional framework pertinent to water resource management will be reviewed for its capacity to comply with the need for basinwide management, participatory development, capacity-building, conflict-preventing and confidence-building.[39]

General environmental national legislation

Several countries, notably Botswana, Tanzania, Zambia and Zimbabwe, have prepared National Conservation Strategies (NCSs), modelled on IUCN's (International Union for the Conservation of Nature) World Conservation Strategy, to guide national environmental policies. Lesotho, Malawi and Mozambique use National Environmental Action Plans (NEAPs) for the same purpose, associated with World Bank-sponsored economic structural adjustment programmes (SAPs) as a precondition for aid. Namibia was the first country in the region to enshrine in its constitution a clause on protection of the natural environment and has an apporved environmental assessment policy.

Most countries in the region have established central environment agencies, such as Zimbabwe's Natural Resources Board or Tanzania's National Environment Management Council.

Environmental Impact Assessments on hydroelectric schemes have been done in Angola on the Kapanda hydroproject, in Botswana on the Bokaa dam, and jointly by Zambia and Zimbabwe in the Zambezi valley. Preparations are underway to incorporate EIAs into law in Botswana, Zambia and Zimbabwe, while South Africa has tabled a white paper for an all-embracing environmental ethics.[40]

National Water Master Plans

The Botswana National Water Master Plan Study from 1991 is one of Africa's most realistic plans for sustainable water resources. It clearly demonstrated that the water resources of Botswana do not allow for any large scale irrigation. As a result Botswana has given up its previous strategy of self-sufficiency in food and instead adopted a policy of "food-security", i.e. the economy has to be strong enough to purchase food from abroad.

Lesotho's Ministry of Agriculture has launched a project with funding from Sida called "Production Through Conservation" (PTC). It is an effort to decentralize the decision-making to district level in order to improve the provision of relevant, timely and effective services to people in the villages. PTC means planning at the lowest appropriate level in accordance with the Nordic Freshwater Initiative.

In some of the SADC countries (South Africa, Botswana, Namibia, Zimbabwe's Zambezi Valley, Tanzania and Malawi) studies toward water management master plans have been made. Namibia is developing her water resources according to the 1974 Water Master Plan. In other countries the planning of future development has not reached that far. This pertains in particular to Mozam-

39 Almost no material pertinent to the two remaining Dublin principles, gender issues and the correct pricing of water, has been found in the material, which further underlines the need for research and educational programmes, also in the region, on these areas.

40. SARDC 1994

bique and Swaziland. These countries will be prone to adverse effects from other countries' water use as a consequence of its downstream site. In Zimbabwe there is an urgent need for a National Water Resource Development Plan, since the existing Water Master Plan, prepared some years ago with NORAD (Norwegian Agency for International Development) funding, mainly concerns rural supply.[41]

Regional agreements

A wide plethora of water resource management programmes are going on in the region; some of the most important being coordinated by SADC,[42] but far from all.

In November 1981, the SADC Council of Ministers requested Lesotho to coordinate regional activities on soil, water conservation and land utilization. Eight sectoral coordination units have since been established, including the Environment and Land Management Sector (ELMS), entrusted with overall responsibility for environmental issues since 1990.

SADC ELMS is a three-tier programme developed to define priority areas of concern to the region. Seven areas of concern have so far been identified, including: sustainable water supply and quality; efficient use of energy resources; and demographic change and pressures.

One of the most important projects handled by SADC ELMS, the Zambezi River Action Plan (ZACPLAN), involves the eight countries of the Zambezi river basin, and focuses on ways to guarantee the quantity and quality of water crossing borders through sharing arrangements and compensation. ZACPLAN's principles come from the SADC Treaty itself, which provides for cooperation in the area of natural resources and the environment.[43]

ZACPLAN, however, is only one of many ongoing regional negotiations. Namibia has working joint river-basin management agreements with Angola on the Cunene since 1990; with Botswana on the Okavango since 1991; and with Angola and Botswana on the Okavango since 1994.[44] Botswana, Mozambique, South Africa and Zimbabwe have also set up a joint committee on the Limpopo river. Other water agreements have tended to be short-term, mostly in accord with the Helsinki rules.

There are approximately 22 major agrements between the eleven different SADC states concerning joint cooperation in various fields, including water. In some areas the institutions created does not function well, and in other cases no agreements for joint cooperation on shared watercourse systems have been established at all.[45]

The Protocol on Shared Watercourse Systems

ZACPLAN was initiated already in 1985 by UNDP (United Nations Development Programme), SADC ELMS, and the Zambezi basin states, except Nami-

41. Arnestrand 1993, and comments by P. Heyns, DWA Namibia
42 The SADC programmes are listed in Appendix XIII "SADC WRM Programmes"
43. SARDC 1994
44 P Heyns, DWA Namibia.
45 These agreements are listed in Appendix XII "Existing Agreements"

bia, which was not yet independent. Out of the work on the ZACPLAN has grown, in a sometimes tortuous process, the so called "Protocol on Shared Watercourse Systems in the SADC Region", originally planned for acceptance at the 1993 SADC summit, but not agreed upon until 1995.[46]

The 1992 Treaty establishing the Southern African Development Community defines "Protocol" as an instrument of implementation of the Treaty, having the same legal force as the Treaty. The Protocol is therefore an extremely important document, as a legal base to deal with the region's international rivers, though not interfering with already existing agreements.[47]

In 1994 the proposed Protocol was further strengthened by incorporating provisions for and the encouragement of the SADC states to establish appropriate institutions like Permanent River Basin Water Commission and Operating Authorities to manage the water resources of shared watercourse systems in a sustainable way.[48]

After many delays, the protocol was signed at the August 1995 SADC summit, with the exception of Mozambique, Tanzania, and Zambia.[49] The position of the Swedish government, conveyed to the SADC, is that the protocol is a mile-stone in SADC cooperation. Implementation of the protocol is now taken over by the Zambezi River Authority (ZRA), Lusaka, Zambia.

Evaluations of the existing framework for regional WRM cooperation

Real scientific backing can be found within the region for almost all conventions affecting the fate of southern Africa. But much of this expertise is scattered in universities, public research institutions and in the private sector, and is not fully utilized by governments in the region.[50]

A conclusion of the Sub-Saharan Africa Hydrological Assessment Project (SSAHAP, a study conducted on ELMS's behalf) was that institutions are more frequently constrained by organisational and administrative problems than by technical difficulties. While a strong base of highly qualified professionals already exists in the region, the lack of efficiency of water resources institutions is a common problem. Institution building and strengthening – at both the national and regional levels – is generally recognized as a key objective of all water resources development projects in the region. In the view of SADC ELMS itself, this is therefore an area where external support is urgently needed.[51]

Sever criticism against the present framework for regional cooperation on water resource management is delivered by the team appraising ZACPRO 6 (Project area no. 6 within ZACPLAN; development of an integrated water resources management plan for the Zambezi River Basin, funded by the Nordic

46 The Protocol does not replace ZACPLAN, which is for the Zambezi only

47 Editorial, *Splash*, Vol 10, No 1, 1994

48 Manuscript by P. Heyns, DWA Namibia

49. The technical reason given for not signing at the summit is the need for these countries to get parliamentary approval before signing. For some of the other countries the protocol is valid immediately upon signing, while others again need to go through a process of ratification.

50. SARDC 1994

51. Editorial, *Splash*, Vol 10, No 1, 1994

countries), stating that "ministers and water sector institutions of the region have limited knowledge" and are "unaware of specific objectives and constraints". Initiated persons number "just a few individuals" in each country. Planning efforts so far go little beyond the Helsinki rules and do not comply to the Copenhagen and Dublin principles of managment on the lowest appropriate level. According to the appraisal team, no appropriate provisions have been made for capacity-building training and education. One of the major reasons for the slow progress and few tangible results is deemed to be the inappropriate institutional framework.[52]

There seems to be a huge gap between the complexity of the project, and the capacity and competence of the national agencies concerned with water resources management in the riparian countries. Some countries, such as Botswana, are better off and some, such as Angola and Zambia, worse. The priority put on ZACPLAN is low; the participation so far very limited and the commitments made indicate no major change. Writes one reviewer: "Unless financial stability is achieved, there is little hope that ZACPRO 6 will be any different from other failed planning exercises in the region."[53]

The appraisal of the project, which also has been characterized as a "so far donor-driven activity", echoes other criticism directed at SADC ELMS. By all parties concerned, the organization is regarded as a valuable forum for discussion and a well-funtioning clearing-house for information; a common opinion, however, being that planning efforts are better handled by other types of organizations, such as a Water Commission set up by the riparian countries.[54]

P. Heyns, of the Namibian Department of Water Affairs, argues for establishing Permanent River Basin Water Commissions (PRWBCs) with adequate terms of reference and appropriate powers to meet its commitments. The PRBWCs should eventually propose at treaty for the equitable and beneficial utilization of the water resources of the particular basin.[55]

Such a commission, the Zambezi River Basin Water Commission (ZAMCOM), has been proposed by Namibia and Botswana, and is considered the most viable solution to solve the ZACPRO 6 problems. Similar Commissions have been set up jointly be several countries in the region for common rivers, such as the Commission for the Okavango River set up by Angola, Namibia and Botswana, the Commission for the Cunene River set up by Angola and Namibia, and the Commission for the Lesotho Highland Water Project set up by Lesotho and South Africa. However, setting up such a Commission and providing it with a competent secretariat is not an easy task; it will take time and require extensive support.[56]

52. Wangen et al 1995 P Heyns, DWA Namibia, regards this as a very sweeping statement, and points to the rural water supply competence at hand in Namibia and South Africa.

53 Nilsson 1995

54. Ibid.; Nilsson 1994, 1995, Arnestrand 1993, Internal Foreign Office IU2 memo on SADC meeting in Lilangwo, Malawi, January 1995 It is beyond my competence to evaluate opinions aired from the region, and determine whether they may be expressions of interest from particular countries or groups, or not

55 Manuscript by P Heyns made available to Sida.

56 Nilsson 1995. For examples mentioned, cf Appendix XII "Existing Agreements"

Others take a differing view on the need for a secreteriat. The Namibian perspective is that such Commissions must be cost effective, "lean and mean machines", utilizing steering committees set up from indigenous resources to study relevant topics with the assistance of consultants. The region must show commitment and achieve success on its own, as a prerequisite for using funding opportunities effectively.[57]

Security aspects

Putting not too fine a point on it, the situation thus seems to be that the best planning efforts, supported and initiated by Nordic donor agencies, concerning the most strategic river basin in the region, and carried out by the regional organization of highest stature, fall considerably short of expectations.

This may come as a disappointment to donor agencies, but from a regional cooperative and security point of view it does not necessarily entail failure. Regional cooperation has not broken down; the negotiating table has not been abandoned for power politics; criticism comes from inside the region, just as much as from project reviewers, and it is accompanied by constructive suggestions for how the process could be made more effecient.

True, there may be some loss of momentum and time (not unimportant, and a lesson for the future); and there may be some hurt feelings, both within regional offices and donor agencies, but in the absence of other information, the present state of affairs does not yet seem to imply serious political conflict.

Prospects for Regional IWRM Cooperation

No single factor has changed prospects for regional SADC cooperation on integrated water resource management more than the advent of the new South Africa. The main negative *raison d'être* for SADC's existence so far, has now become the organization's most powerful and competent member, bringing both hope and certain fears with it.

At the first SADC meeting where South Africa took part as a member, at Lilongwe, Malawi in January 1995, diplomatic observers were much impressed by the stature and maturity of the delegation's way of handling its inaugural session. Others have witnessed how South African officials were determined not to act as the "big bear" in the new regional context. Conversations in corridors proved that the South African delegation was just as much taken aback by the slightly anarchic way in which SADC proceedings took place, as other members may have feared a take-over by the new regional power. There was a feeling of newness on all hands.[58]

And newness there is, also in water affairs. South Africa provides a completely different picture from the rest of the region with regard to both capacity and competence; its water resources planning and management sector is extremely well developed, and hopes are high for utilizing the competence available

57. Comment by P. Heyns, DWA Namibia.

58 Internal Foreign Office IU2 memo on SADC meeting in Lilangwo, Malawi, January 1995. Nilsson 1994.

in South Africa for training in other part of the region. A start has already been made by training Namibians in the operation of weather services.[59]

But there is another side, not to be forgotten. Even with the best intentions from the ANC (African National Congress), the legacy of South Africa's apartheid past will define the direction of its development. The country has great water needs to satisfy, stemming both from a long marginalized majority in the homelands and elsewhere, and from the most advanced – and water-demanding – industrial sector in the region. Although an old engineering dream, the largest contemporary ongoing water transfer scheme in the world, the Lesotho Highlands Water Plan, was realized during the apartheid era by the means of power politics, arguably even overthrowing the government of another state, as a means to reach the end of satisfying the water needs of South Africa's industrial heartland, the Gauteng (Pretoria-Witwatersrand-Vereeniging) area.

Understandably, there may be fears from other countries in the region that the water needs generated by the existing and very powerful structure of South African agriculture, industry and economy will prove so overwhelmingly strong, that not even the best intentions of the new government could stand in the way of realizing its water needs at the expense of other countries'. These fears centre particularly on what will happen in a post-Mandela South Africa.

Putting too great a focus on risks of international conflict between countries in the region, however, may also blind observers, within and outside the region, to the potentially much larger risks in the long run of environmentally induced scarcities creating misery and conflicts *within* countries, leading to consequences which are very difficult to foresee at the present time. Precisely for this reason, however, they deserve to be held up at the front of the stage for review by development cooperation policy-makers. Much of what is reviewed in the following appendicies will be seen to underline the seriousness of these concerns.

Conclusion

The need for integrated, basinwide, water resource management is considered a prime security objective for the prospects of SADC regional cooperation. Any measure that will strengthen such efforts therefore ought to be reviewed for development cooperation support.

In the short term, outdated or non-existent data merit support for basic hydrological data collection, necessary for creating or updating national water master plans, as part of assessing all river basin resources. Any programme directed at increasing awareness of water issues among decision-makers in the region deserves support. The possibility of utilizing existing competence from the new South Africa for regional capacity-building ought to be fully explored.

Water transfer schemes to ameliorate acute water shortage for cities and water-starved regions already are at the top of the regional agenda, and will continue to be so for the medium term, necessitating regional negotiations and underlining the need for basinwide management. The most important such regional water resource management programme, the ZACPLAN, has been scrutini-

59 Nilsson 1995.

zed extensively by expertise from both within the region and by external reviewers. Judging by these reviews, the principal agency handling the programme, SADC ELMS, would benefit from institutional support.

Attention on security aspects of water issues so far has been concentrated on the risk of water transfer schemes creating conflicts – political or ultimately violent – between states in the region. The mere perception of such risks is a security threat in its own right, undermining confidence-creating measures between countries. On the merits of available evidence, however, the regional cooperative framework seems strong enough to handle present aspects of this threat, particularly since officials on all levels from the new South Africa seem very concerned about eliminating any ground for suspicion of regional great-power ambitions.

Furthermore, concentrating on security in this traditional inter-state sense may obscure the potentially much larger risks in the long run of environmentally induced scarcities creating misery and conflicts within countries, leading to consequences which are very difficult to foresee. Conflicts between states may turn out to be among these consequences, although is worth underlining that the most likely scenario for such future conflicts to arise will be through a failure to meet the *internal* challenges facing governments and states already today.

These risks can be mitigated by cooperation, understanding, trust, identifying the expectations and concerns and by determining the potential of the resource base, so that negotiation can be based on facts.

Development cooperation efforts aimed at preparing countries in the region for a strategy of *learning to live with aridity* – i.e. using the available water, where it is available, to its greatest value – therefore seems imperative, as part of a larger strategy of preparing for the inevitable long-time and large-scale forces of societal change – with their inherent capacity of creating break-down tendencies for the state – being at work for the duration of the foreseeable future in the SADC countries.

Appendix I:

Population, Environment and Security: An Overview of the SADC Countries

The population in the eleven SADC countries (Angola, Botswana, Lesotho, Namibia, Malawi, Mozambique, Swaziland, South Africa, Tanzania, Zambia and Zimbabwe) numbers about 136 million and is expected to double in the next 24 years.[1] Over five million babies were born in southern Africa in 1993. These babies need food and water, shelter and warmth. As they grow older they will need land for farming, or jobs for wages, and they will want to have children of their own. Governments will have obligations to these babies throughout their lives, providing health care, education, social services, roads and infrastructure, and the many other supports which citizens need. When all these needs are added together they can create a sizeable draw on natural and financial resources. Sooner or later, however, the resources cannot be stretched any further.

Population growth

In southern Africa, the population grows at three percent annually, on average, although the rowth rate for different countries ranges from 2.2-3.8 percent. At this rate, the region's population will double by the year 2018.[2]

Most people in southern Africa are of child-bearing age, or younger. In most countries, over 40 percent of the population is under 14 years of age. Although quite high, population growth-rates are stable or decreasing in six of the region's 11 countries. Southern Africa, which contains just over two percent of the world's population, is expected to contribute about six percent of global population growth between now and the year 2050. Infant mortality rates in southern Africa have dropped dramatically in the last 20 years, and now, on average, less than 1 in 10 babies born in the region die before the age of one year. Young children do not fare as well, with an average mortality of 2 in 10 for children under five years, although this rate has also improved.

Land use

Land is still relatively accessible in most countries in southern Africa, although population density and the number of people an area can support varies dramatically from place to place. While people need land for agriculture, the percentage moving to cities is higher than the birth rate in most of the region. Urban land requirements for housing are much less than in rural areas, and industrial demand for land is still relatively low.

The use of marginal or unsuitable land for farming is increasing, while intense pressure on some existing farmland often leaves it completely exhausted. The demand for land for cultivation is not only due to population pressure, but

1. Except where noted otherwise, material for this appendix is excerpted and condensed from SARDC (Southern African Research & Documentation Centre) 1994, different chapters
2 For country details, cf. the next appendix, "Population Growth and Land Scarcity"

also to land distribution, where large expanses are farmed commercially, reducing the amount available to small-scale, subsistence farmers.

Many areas have resources which are communally held and to which there is open access. Traditional management systems have been able to protect these "open-access" resources, but increased population, coupled with a free-market approach, has eroded traditional practices. This has often created disruptions with open-access resources such as grazing land, water, fish and trees. In some areas, the wealthier livestock-owners have fenced off areas of communal land and have begun digging private wells. When grass or water begin to run short, they move livestock to these fenced areas or water them at their wells, essentially "privatizing" communal resources.

Livestock populations now amount to about 45 million cattle and 71 million sheep and goats. However, over the last 10 years, cattle populations have dropped slightly in seven countries, while sheep and goat populations have increased substantially. This may be an indirect indicator of farmers' assessments of rangeland degradation. Sheep and goats are often brought in when land is too degraded to support cattle, because they are less selective feeders and are able to eat leaves as well as grass.

About 20 percent of southern African soils needs some degree of rehabilitation, and the degradation and loss of productivity is continuing. Most of the degradation is caused by overgrazing, although where the degradation is strong, cultivation is equally to blame. Poverty compounds the problem because farmers can't afford to fertilize, leading to less vigorous plant growth which leaves soil more exposed to eroding rainfall and runoff. Although fertilizer use is growing at a faster rate than new land being brought into production, a 1990 FAO study showed that soil in the region is being "mined" for its essential nutrients. Each hectare of cultivated land loses an average of 22 kg of nitrogen, 28 kg of potassium and 6 kg of phosphorous annually.

Successful tsetse-control programmes are allowing the opening up of some areas. Although the land appears to be under-utilized, there are some concerns. Tsetse zones tend to be in nutrient-poor areas which quickly become infertile under cultivation. In addition, they are often on fragile soils which have been protected by bush and grass cover. Clearing this for agriculture will almost certainly lead to heavy soil-loss.

Another complicating factor in the land equation is a possible sea-level rise due to global warming.

There are few available areas left for agricultural expansion outside of protected areas and forest reserves. As more land is brought under cultivation, land available for grazing decreases, forcing pastoralists onto smaller, less productive areas. Rapid urbanization also takes land out of agricultural production. In southern Africa, the amount of land cultivated (largely marginal land) has increased by only 0.2 percent each year in the last decade or so. If population growth is considered, the amount of cultivated land per person has actually dropped by 20 percent, from 0.4 hectares per person in 1980 to 0.34 hectares in 1989.

Water resources

The diminishing land area available for agricultural expansion means production growth will soon have to be achieved by increasing the amount of yield per hectare, rather than increasing the number of hectares available.

Irrigated farming is the method that surpasses all others in potential production per unit area, in the low rainfall parts of southern Africa. This requires huge amounts of water. About 60 percent of the total amount of water used in the region – almost 20 cubic km of water in 1993 – is used for irrigation.

By world standards, current water consumption per person in southern Africa is low. In many countries in this region, people get by on much less than the WHO target of 50 litres per person per day.

Trade in water has been discussed in a SADC document. For example, Mozambique has considered giving up rights to some Zambezi river water in return for access to more water in its drier southern part. Water transfers from one part of the region to another, such as the Lesotho Highlands Water Project, are likely to become more commonplace and countries with low economic growth may be tempted by the possibility of profits from sale of water.

As more land, especially marginal land, is brought into production, erosion and sedimentation will increase, unless management of land-use and control of erosion is improved. Not onlys does sedimentation cost the region vast amounts of money in lost water-storage capacity, but many areas are quite flat, with few good potential dam-sites left, so replacing silted dams may be difficult or impossible.

There is potential for domestic and industrial recycling of water, with some major cities, such as Harare and Windhoek, already recycling a significant part of their waste water.

The "dead storage" in dams amounts to huge quantities of water. Lake Kariba alone contains more than three times the quantity of water consumed annually in the entire region, yet little of it can be used without jeopardising power generation.

Food security

To meet the food requirements of a growing population in southern Africa, supplies will have to increase by four to five percent a year. This will be a challenge, since food production per person decreased in all countries in the region by anywhere from 0.7-3.7 percent each year between 1979 and 1991 – a total drop ranging from 8.4-44.4 percent. Measured as daily requirements for food consumption, people in eight countries receive less than they should, ranging from 70-99 percent of the minimum.

A number of countries are close to self-sufficiency in food production, measured by the food-import dependency ratio (the amount of food imported compared to the amount available). Such statistics are not available for all countries, but half the countries measured are more self-sufficient in food production than 15 years earlier.

Although many southern Africans are not eating minimum daily food requirements, the region could be self-sufficient in food production. Total net cereals prodution for the region (excluding Namibia) amounted to a surplus of about 1.6 million tonnes during the period 1987-89. This was accounted for by

large surpluses from South Africa and Zimbabwe, while all other countries were net importers. The overall level of cereal surplus declined by six percent from a surplus of about 1.7 million tonnes between 1977-79.

According to SADC's report to UNCED (United Nations Conference on the Environment and Development 1992), current data is insufficient to assess the land's capacity to support future growth in food production. A factor affecting domestic food production will be competition with cash crops, which are needed for foreign exchange earnings.

The only countries achieving adequate growth in food production have either brought new land into cultivation or intensified production through irrigation. Irrigation has been badly managed in some cases, leading to salinization and alkalinization. Only Angola, Mozambique and Zambia have significant areas of land they could bring into production, much of which is presently forested, inaccessible due to civil wars, or infested with tsetse-fly.

New varieties of sorghum and millet show vastly increased production over traditional varieties during droughts, and programmes are underway to encourage their use as a more nutritional and less risky food source than maize.

There are several pilot projects and many operating fish farms throughout the region, but the cost of farmed fish tends to be prohibitive. As more dams are constructed for water supply they can also be stocked for fisheries, as has occurred at Kariba, Zimbabwe.

Energy

Although energy consumption in southern Africa is quite low by global standards, per capita fuelwood consumption in the SADC region is among the highest in the world.

As fuelwood becomes scarcer, its value rises, a situation that may make it economical in future to plant fuelwood trees to sell. The value of food crops is increasing at least as quickly as fuelwood, however, which mitigates against the planting of fuelwood plantations. The need for fuelwood will hopefully decrease as ore power is made available in rural areas.

Mozambiqe's Cahora Bassa, the massive hydroelectric project on the Zambezi river downstream of Zimbabwe's Lake Kariba, is expected to come back on stream soon. It became operational in 1974 but was sidelined by armed conflict. While this dam already holds a tremendous amount of "dead storage" water, it will not take more water away from downstream sources to fill it, or more capital to build it, as new dams would.

The southern African region has very large coal reserves, which are mostly unused except in South Africa and, to a lesser extent, Zimbabwe. Already this is causing localised pollution in Zimbabwe and large-scale air pollution is evident in South Africa's eastern Transvaal.

Economic Growth

Economic growth in southern Africa as a whole is among the lowest in the world. Gross Domestic Product (GDP) is growing at a slower pace than population in virtually all southern African countries. In more than half the countries, economic growth declined during the 1980s, largely because of defence expenditures to counter South Africa's military action. Job creation has not kept pace

with the increasing labour force and per capita income declined by an average of 1.1 percent annually during the decade 1982-92.

Although statistics suggest that economies are in doldrums in much of southern Africa, these figures mask what really takes place. A significant proportion of the citizens of this region work in the informal sector – unrecorded, untaxed and regulated only by a common desire for at livelihood.

Structural Adjustment Programmes (SAPs) and poverty alleviation

A recent study of the environmental effect of SAPs in Ivory Coast, Thailand and Mexico revealed that environmental impacts had not been considered, and that unintended impacts (both positive and negative) had occurred. For example, the removal of subsidies, such as those on commercial energy, has usually resulted in more efficient use of resources; but export incentives have led to clearing of forests and other natural vegetation for cultivation, as well as farming of increasingly marginal land. There is also evidence that SAPs have perpetuated or increased existing patterns of overexploitation of natural resources.

Information on numbers of people in absolute poverty is difficult to get but statistics are available for Botswana, Lesotho, Malawi, Namibia and South Africa. For those five countries the figures ranged from 49-78 percent. A recent study in southern Africa also concluded that SAPs lead to wider gaps between rich and poor.

Less than half of the population in the region has access to clean water, health services and sanitation.

Debt burden

Foreign debt continues to climb, at least doubling in most SADC countries between 1980 and 1991. In some cases, the debt burden increased by three or even six times in that period, although economic research shows both positive and negative connections between debt levels and income growth depending on the countries studied. Two countries have foreign debt greater than GDP – Mozambique by four times and Tanzania by two. It is notable that the Mozambican government, in its official report to the UN Conference on Environment and Development (UNCED) said bluntly that it cannot achieve sustainable development in the short-term because it could not yet meet the human needs of its population.

The need to increase economic output will intensify pressure on southern Africa's resources, doubly so beause economic growth will not only have to meet the needs of people today, but also the expanding population over time. Much of the economic growth strategy is export-driven, with a sizable component dedicated to cash crops (from tobacco and coffee to bananas or roses), which can earn considerable foreign exchange.

Many volumes have been written about the debt burden and possible solutions to it, but it is unlikely that most southern African countries will be able to advance in the areas of envrionmental regulation and management until the debt burden is reduced.

The two most obvious resources which will be affected by the pressure to increase economic output are land and water. Land will be needed to grow food, support industry, graze livestock and, of course, as a place to build houses and

cities. Water will be needed for basic survival, and it is also essential to each of these land-based activities.

Risks for armed conflict

The seeds for further armed conflict or instability exist in this region as in other parts of the world – often related to dwindling supplies of various natural resources in relation to ever-increasing populations. Tensions over access to water and other shared resources already exist. Regional structures such as SADC are establishing mechanisms to deal with these concerns.

While statistics vary broadly from country to country, defence spending ranges from about 5-16 percent of annual budgets. SADC has expressed the hope that with the reduction of hostilities in the region, government resources can be redirected to environmental management, among other things. This so-called "peace-dividend" has yet to make its impact felt, and given the weight of debt in many countries, it may not be possible to increase envrionmental and social spending. Many countries continue to spend high proportions of national budgets on defence, although this will be reassessed in view of the changed situation of South Africa.

The new South Africa

Apartheid created one of the most environmentally degraded countries of the world. Soil erosion and desertification in the over-crowded homelands have been coupled with similar erosion on the mono-culture, profit-orented white farms. Industrial wealth was built on dirty, coal-fired electricity, while two-thirds of South Africans have been denied this basic amenity, or could not afford it, and thus had to cut down trees for cooking and heat.

Water distribution, perhaps South Africa's most precious resource, is similarly skewed. Millions of litres of water a day are squandered in white suburban gardens, while entire African communities may depend on one unreliable tap. The lack of proper sewage facilities in squatter areas makes the water situation even worse.

There will be enormous environmental benefits merely from the scrapping of the previous apartheid absurdities and the implementation of basic reconstruction plans (housing, sewage and sanitation, land redistribution, etc). These "brown" environmental issues are the core of ANC (African National Congress) environmental policy.

Appendix II:

SADC Food Security: An Overview 1995

(The following material is excerpted from the US development cooperation agency, USAID, Famine Early Warning System, FEWS, Special report 23 October 1995:)

The FEWS/Southern Africa office, with the assistance of the national and regional early warning units of the Southern Africa Development Community (SADC), recently assessed food security conditions in nine SADC countries: Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. The assessment looked at the impact of the drought on this year's (1995) harvest, El Niño events, economic conditions, food availability, stocks and commercial imports, and food aid and relief operations.

Regional overview

Across southern Africa, the food security situation varies considerably. While a worst-case scenario in which large numbers of people are threatened with starvation is not likely, the drought has led to severe socio-economic disruptions in some areas. Increased malnutrition and impoverishment and liquidation of household resources are becoming more common.

The drought-related problems which merit the closest attention appear in southern Zambia, northwestern Zimbabwe, and to a lesser extent in northern Namibia and central Mozambique. If the upcoming rainy season – which begins in late October or early November – is not adequate, food security conditions could deteriorate in the coming months in Zambia, Mozambique, and Zimbabwe.

Impact of drought on the 1994/95 harvest: The assessment found considerable variation in harvest outcomes across the region. Three countries – Botswana, Malawi, and Mozambique – actually produced more cereals in 1994/95 than their five-year production average. On the other hand, six countries – Lesotho, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe – fell far short of their average production levels. For these six countries, current cereal production levels expressed as a percentage of the long-term average ranged from 68 percent in Zambia, to 64 percent in Namibia and Swaziland, 56 percent in Lesotho, less than 50 percent in South Africa, and 45 percent in Zimbabwe.

El Niño events and crop failures: There was a north-south pattern to the harvest failure rate, consistent with El Niño events often associated with droughts in southern Africa. In northern Zambia, most of Malawi, and northern Mozambique, areas normally outside the zone of negative El Niño influence, crops were affected only lightly or not at all. Neighbouring areas normally affected by El Niño events, however, were greatly affected and experienced substantial crop failures. Southern Zambia experienced severe crop failure rates ranging from 50 to 97 percent. Crops were also severely affected in many areas in Zimbabwe, central Mozambique, South Africa, Lesotho, and Swaziland.

The most clearly identifiable drought-related problems are on both sides of Lake Kariba in southern Zambia and northwestern Zimbabwe. Last year's rain-

fall in these areas was among the lowest ever recorded and followed several years of diminished rainfall. In Zimbabwe, the highest levels of crop failure were found in a crescent running from the northwest to the west and then to the southwest.

In South Africa, the most drought-affected areas are located in the highly productive maize triangle around the Northern, Gauteng, and Free states, which saw substantial harvest losses. In Lesotho, lowland northern and western areas were also hit by drought, while central mountainous areas were hurt as much by early frost as by drought. In Swaziland, the most affected areas were lowland velds and valleys in the eastern half of the country.

Drought vs. poverty: In many cases, "emergency" food needs can be traced to chronic poverty rather than drought. The chronically high malnutrition rates in many of these countries are more the result of endemic food deficits than a symptom of acute drought. In many areas, people may not have adequate access to food even in good production years. For example, in Malawi large numbers of people are expected to receive emergency relief, despite an average harvest.

Other areas are perennially identified as drought-affected, when they are almost always dry. In such arid-generally non-agricultural-areas, the effects of crop failure will be felt less intensely than in more productive areas, as local agricultural production accounts for a relatively small amount of total consumption requirements and coping strategies are better adapted to the high risk of crop failure. Examples include southern Namibia, Botswana, southern Mozambique, southern Zimbabwe, southwestern Lesotho, and southeastern Swaziland.

These factors point to the need to take into account the underlying causes of poverty in deciding how to address "drought-related" problems. Interventions appropriate to helping a region deal with a temporary production deficit will generally not address long-term structural problems.

Food availability: In most countries covered in this assessment, food availability at the national level does not appear to be problematic. Assuming that planned or expected levels of commercial imports occur and emergency food aid requirements are met, the only gaps likely to lead to problems are those in Zambia (over 293,000 MT) and Mozambique (153,500 MT). For Zambia, the key issue is whether the commercial sector can successfully import enough food to meet national requirements. Nevertheless, in view of the magnitude of aggregate regional needs for commercial and food aid, limited regional and worldwide supplies, and relatively high prices in world markets, all the countries are likely to find meeting food needs somewhat harder than normal.

Different countries in the region plan to meet 1995/96 cereal requirements in different ways. The four countries in the Southern African Customs Union (Botswana, Lesotho, Namibia, and Swaziland) will cover a high percentage of total requirements through commercial imports, primarily from South Africa. A large uncovered gap is projected for Zambia, while smaller gaps are expected for Lesotho, Mozambique, Swaziland, and Zimbabwe. Botswana, Malawi, and Namibia will likely more than cover their requirements through normal levels of commercial imports and aid flows, as reflected in the negative value reported for the uncovered gap.

Stocks and commercial imports: The southern African countries examined will require substantial, but manageable, levels of commercial cereal imports. Zambia is a possible exception, as its ability to import has been constrained by the availability of foreign exchange, high interest rates, and mixed signals from the government, although recent actions may ease these constraints. Regional import needs may exceed what is available from South Africa, Kenya, and Tanzania, so that imports from other areas-primarily the Americas-will likely be required.

Food aid and relief operations: Relief operations have generally gotten off to a slow start. Some national relief organizations are struggling to define their objectives (intended beneficiaries and delivery mechanisms) and obtain the required resources. This pattern is particularly evident in Zambia and Zimbabwe, the two countries where drought has had the greatest impact. Even so, it appears that the most urgent needs are being addressed.

Planned or expected commercial cereal imports by the nine countries total 2.68 million MT. Over half of total imports are destined for South Africa and Zimbabwe which are usually surplus producers. Within the region, only about 30 percent of total imports planned have been imported to date. The majority of the imports have been in the form of yellow maize from South Africa. South Africa's role continues to be complex as it is both a major exporter of surplus yellow maize stocks to the region and a large importer of substantial quantities of yellow and white maize from other sources.

Difficulties in monitoring stocks following economic liberalization

Most countries in the region are engaged in structural adjustment and economic reform. Cereal markets are being liberalized, and the roles of parastatal marketing boards redefined and diminished. These changes are intended to encourage the emergence of a strong and sustainable private sector marketing system and provide increased production incentives to farmers. An unintended result, however, is that information on stocks and cereal markets is more difficult to obtain. In South Africa and Zimbabwe, normally the principal exporters in the region, stocks can now be held privately and so do not automatically end up in government hands. Both governments continue to control exports but do not have complete information about quantities available for export or other uses. In Zambia, following last year's liberalization of agricultural marketing, a large share of total food stocks is held by a few large traders-who can be reluctant to reveal stock information. In Malawi, there is uncertainty about the private sector's ability to expand its market role, in the wake of the reduced status of the government grain marketing board, ADMARC, in the marketplace. The volume of cross-border trade-always difficult to monitor- compounds the difficulty of monitoring stocks in the region.

Severe water situation

Southern Africa has not fully recovered from the severe drought of 1991-1992. Rainfall since then has been insufficient to fully replenish surface water reservoirs or recharge aquifers. After this year's drought, a number of water-related problems were reported in the region. Much of southern Zambia has experienced severe water shortages and a number of people in the Gwembe Valley

are relocating to areas with more reliable water sources. Water is being trucked into some rural communities in Lesotho and Swaziland. There is a critically short supply of water in the major commercial and industrial area of Manzini-Matsapa in Swaziland. In Zimbabwe, the worst-affected provinces are Matabeleland North and Masvingo; 45 percent of primary water sources have dried up in some areas. In Malawi, severe water supply problems in urban centers led the government to introduce rationing. Should drought conditions persist into the closing months of 1995, the water supply situation will deteriorate significantly within the region – affecting several major urban areas as well as much of the region's rural population.

Concurrently, several southern African countries are in the process of restructuring their water and sanitation sectors. Their objectives are to increase the autonomy and accountability of urban water and sanitation utilities and promote community involvement in the management of rural water supplies. This restructuring, called for by SADC in the aftermath of the 1991-92 drought, is critical to ensure longer-term water security in the region. In the short term, however, the process can slow the implementation of current drought relief strategies as institutional responsibilities are determined.

Appendix III:

SADC Food Security: Country Profiles 1995

(The following material is excerpted from the USAID Famine Early Warning System, FEWS, Special report 23 October 1995:)

Botswana

The 1994/95 cereal harvest, estimated at 47,400 MT, was above the long-term average, but will cover only 13 percent of the country's current domestic cereal requirements. As in most years, the commercial sector is expected to import sufficient cereals to cover this year's domestic cereal shortfall of 249,000 MT.

This is the fourth consecutive year that the Government of Botswana (GOB) has declared a drought. As in previous years, drought assistance will be delivered through labor-based rural development projects and supplementary feeding programs conducted in schools and clinics. The GOB has sufficient financial resources to ensure that these programs are implemented.

Lesotho

National-level food availability is rarely a problem in Lesotho. The close proximity of South Africa and relatively tight integration of Lesotho's economy and cereals market with South Africa's facilitate formal and informal imports. The recent official harvest estimate shows 88,789 MT of cereal production, a 68 percent increase from earlier estimates, but 44 percent below the 10 year average (158,264 MT). There was substantial crop damage from drought in Lesotho's lowland northern and western areas, where the bulk of the maize crop is grown. Lesotho's commercial cereal import requirement this year (177,000 MT) is within the normal range.

An early declaration of disaster, followed by the rapid production of a drought relief appeal, paid off in gaining donor commitments of food aid. Almost all the 51,225 MT emergency cereal requirement has already been funded or pledged by the government and donors. More than 529,000 people are registered to receive assistance (as well as 13,000 children who will receive supplemental feeding). Relief distributions were to begin in July, but a slower than expected registration process has held up implementation. In mid-September, the first distributions of several thousand tons of grain had just begun. There are no indications yet that the delay has had a serious impact on health or nutrition.

Malawi

The quality of the 1994/95 rainy season varied by region in Malawi. Northern areas received relatively good rains, while southern and central areas had more erratic and lighter rainfall. Overall, the drought's impact was less than in countries to the south. Cereal production in 1994/95 (1,662,200 MT) was above the five-year average. Aggregate food availability does not appear to be a problem. Approximately 252,000 MT of cereal will have to be imported by the commercial sector, not an extraordinary amount for Malawi.

The Government of Malawi estimates that nearly 2.2 million people require assistance, most of them in southern and central areas. Food-for-work, vulnerable household, and child supplementary feeding programs are being planned. WFP-estimated relief requirements of 45,000 MT are fully covered by WFP stocks and donor pledges.

Mozambique

In terms both of availability and access, food security appears more tenuous in Mozambique than in most countries in the region. A lack of data and data gaps caused by years of instability make it difficult to evaluate the situation. Nevertheless, existing food availability data are not encouraging.

Cereal production for the 1994/95 agricultural season is estimated at 1,089,000 MT. This is well above the 20-year average (645,620 MT), but will meet only 67 percent of domestic cereal requirements. As a result, there is a very large domestic cereal deficit (488,000 MT) and import gap (257,000 MT) this marketing year. The situation is further complicated by a lack of economic integration stemming from transport difficulties between the northern part of the country (with a 367,000 MT cereal surplus) and the southern part (with a 559,000 MT deficit).

WFP estimates that an average of 650,000 people will require emergency food assistance during the 1995/96 marketing year. This includes between 110,000 and 160,000 recent returnees (those arriving too late to plant field crops for the 1994/95 agricultural season) and about 455,000 drought-affected people (mostly earlier returned refugees, demobilized soldiers, and internally displaced populations). An additional 35,000 people are eligible for community development food-for-work programs based on other criteria. Approximately 105,000 MT of food are required for emergency programs. This will be more than covered by a projected 57,300 MT of food aid imports and 73,280 MT of locally purchased commodities. Donors have also pledged an additional 149,100 MT in program food aid to be distributed through commercial channels.

Namibia

Although this year's crop production was below average, most observers agree that the 140,000 MT national cereal deficit (for the 1995/96 marketing season) can be filled through imports by the private sector. There is also a significant quantity of government-held carryover grain stocks. Planned additional commercial imports of 72,600 MT should be sufficient to cover national needs until the next harvest in March/April 1996.

About 10 percent of the population (163,200 people) appear to have inadequate access to food. The highest concentration of drought relief recipients is in the six northern-most regions of the country. The Government of Namibia (GON) has formulated an emergency appeal requesting 10,000 MT of wheat, although no donors have yet responded with pledges of assistance. If no pledges are received, the GON will bear the cost of the relief efforts and will be forced to make difficult decisions with respect to its financial priorities.

South Africa

There were substantial harvest losses in the normally highly productive maize triangle around the Northern, Gauteng, and Free states. The 1994/95 maize harvest was only 4,227,000 MT, about half the long-term average. South Africa has more yellow maize than needed for domestic use and will export several hundreds of thousands of tons to its neighbours. At the same time, it may import as much as 750,000 MT of cereals, including white maize, from outside the region.

Swaziland

In Swaziland, drought had a widespread impact on crops, particularly in lowland and valley areas in the eastern half of the country. The Government of Swaziland is revising downward by 10 percent its estimate of area sown to maize which could lead to a corresponding reduction in its estimate of cereal production. Cereal production is currently estimated at 70,400 MT, about 32 percent below the long-term average of 102,641 MT. The commercial import requirement of 75,100 MT of cereals appears to be manageable.

Over 90,000 people were designated as food aid recipients through a rigorous screening process. To meet these needs, Swaziland requested approximately 11,900 MT of emergency food aid, almost all of which was covered by donor pledges. Relief operations recently began and are largely on schedule. Approximately 3,000 MT of grain were distributed in September, with the rest of the relief food to follow in regular monthly amounts. The program appears to be functioning as expected.

Zambia

Food availability and access issues give cause for concern this year in Zambia. Zambia's final crop estimate places 1994/95 cereal production at 922,500 MT, well below the 10-year average of 1,413,298 MT. This is the third out of the last four seasons that national cereal production was well below average. The southern half of the country was especially affected by poor and erratic rainfall, with crop failure rates ranging from 50 to 97 percent. Particularly hard hit were Southern Province (especially Gwembe Valley), Western Province, the rural areas of Lusaka Province (particularly the Luangwa and Luano valleys), and Central and Eastern provinces. In the southern half of the country, malnutrition rates are increasing and productive assets are being depleted as a result of the cumulative impact of successive years of poor and erratic rainfall.

Donors have pledged 75,665 MT of food aid toward estimated emergency food aid requirements of 88,000 MT. An additional 6,150 MT of aid, purchased by the GOZ in domestic markets, have already been distributed.

The poor harvest results led to a large national cereal deficit, estimated at about 531,000 MT. Approximately 40,000 MT of non-emergency commodity assistance are expected and the government recently purchased 30,000 MT of grain from Tanzania for its Strategic Grain Reserve. As a result of the liberalization of cereal markets in Zambia, the primary responsibility for filling the remaining deficit falls on the commercial sector. After subtracting planned commercial cereal imports of 80,000 MT (including 60,000 MT of wheat and rice), about 293,000 MT are yet to be imported.

While most analysts believe that the private sector is capable of importing this additional quantity of cereals, there is some question as to whether they will be willing to do so. Mixed policy signals from the GOZ appear to have dampened private sector interest in importing maize. Other constraints include limited foreign exchange, high nominal interest rates (between 45 and 50 percent), and low maize prices relative to those necessary to return a profit. The recent establishment of a US$25 million private sector credit import facility may help to facilitate commercial imports. The success of this and other initiatives will be monitored closely in coming months to determine whether the commercial sector will be able to import sufficient cereals to cover consumption needs until the next harvest.

Zimbabwe

Like its neighbor Zambia, Zimbabwe also suffered from severe drought-related agricultural production problems. In the northwestern part of the country, rainfall during the 1994/1995 season was near the lowest ever recorded and followed several years of reduced rainfall. Cereal production fell to 985,000 MT, 45 percent of the long-term average. Despite the production shortfall, food availability is not a great problem this year. Last year, Zimbabwe decided to maintain a very large reserve of almost a million tons of grain. Whatever the eventual costs and benefits of that strategy, these large stocks have lessened the country's need to import grain this year. Eventual commercial imports may total 200,000 MT of maize and 165,000 MT of wheat. So far, about 100,000 MT of South African yellow maize have been imported.

There is some objective evidence that rates of malnutrition are rising and some largely anecdotal evidence that childhood malnutrition-related mortality may also be increasing. Authorities and other qualified observers familiar with these problems have concluded that these issues are being adequately addressed. Although shortages of funds to cover transportation costs have been a limiting factor, relief programs moved substantial amounts to rural areas during August and September. As of late September, around 156,000 MT of grain (mainly as grain loans) had been delivered, about 65 percent of the planned total.

Appendix IV:

Population Growth and Land Scarcity

The Southern African Development Community's Environment and Land Management Sector (SADC ELMS) has stated that the increasing population is multiplying the effects of all environment problems in the region.

Table 1: Population growth in southern Africa

Country	1994 Population (millions)	1990-95 Average annual growht rate (percent)	2025 Population (millions)	1994 Density per sq km (persons)	Population in urban areas 1970	1990	1990-95 Urban growth rate (percent)
Angola	11 2	2 8**	24 7	9 0	-	28	5 4
Botswana	1 5	3.5**	3 4	2 6	8	28	8 3
Lesotho	2 0	2.9**	4 4	66 0	9	20	6 3
Malawi	10 1	3 6**	24.7	107.3	6	12	6 3
Mozambique	17.5	2 7*	35 4	22 3	6	27	7 6
Namibia	2 0	3 1*	4 7	2.4	19	28	5 2
South Africa	38 5	2 2**	65 4	32 5	48	59	3.2
Swaziland	0 9	3 6*	2 2	53 0	-	33	7 0
Tanzania	31 3	3 8*	84.9	33 3	7	33	7 0
Zambia	9 8	3 8*	26.3	13.0	30	50	5 6
Zimbabwe	11 0	3 1*	22 6	28 2	17	28	5 4
TOTAL	35 8		298 7				
Average		3 0***		17 7		42 7	6 5****

* growth-rate increasing, ** growth-rate decreasing or stable, *** regional population doubles in just under 24 years, **** urban growth-rate more than double average growth-rate
(Table from SARDC (Southern African Research & Documentation Centre) 1994, *State of the Environment in Southern Africa*, p 2, based on the UN population agency, UNFPA, *State of World Population* 1992)

Population growth diminshes each person's share of the world's finite arable land, increasing pressure for food production on each hectare suitable for the task. One way to illustrate this decline and consider its implications for agriculture is to explore a land-population benchmark noted by Vaclav Smil.[1]

Smil argues that countries with less than 0.07 hectares of arable land per person cannot feed their populations sustainably without intensive use of synthetic nitrogen, phosphorus and other fertilizers. He arrive at this threshold by examining history's most successful traditional cultivation systems, those of eastern Asia, the Nile River basin, and the Netherlands. Other experts argue that the minimum amount of land needed per capita is even greater. The benchmark would need to be much higher if an American-style meat-based diet were the global norm.

1 As referred to by Engelman & LeRoy 1995, p 23f.

The 0.07-hectare benchmark is not a fixed lower limit to the land's human "carrying capacity", a term some ecologists use to suggest the maximum population of any species that an ecosystem or area can support. Differences in land quality, farmer capabilities and the possibility of external sources of food complicate the relationship. Nonetheless, the 0 07-hectare benchmark is a crossing, a transition to the vulnerability of dependence on intensive modern inputs. The transition is permanent without later expansions of arable land or decreases in population size. In light of the 0.07-hectare benchmark of arable land scarcity, estimates of past, present and future per capita availability of arable land around the world suggest reason for concern. (In the table below, the points at which some SADC countries will pass this benchmark figure has been highlighted.)

Table 2: Population & Availability of Arable Land Per Person in SADC Countries, 1990, 2025 & 2050

Country	1990 Total arable land by country (thousands of hectares)	1990 Population (thousands)	1990 Per capita cropland (hectares)	2025 Population (thousands)	2025 Per capita cropland (hectares)	2050 Population (thousands)	2050 Per capita cropland (hectares)
Angola	3 400	9 194	0 37	26 619	0 13	41 182	0 08
Botswana	1 380	1 276	1 08	2 980	0 46	3 996	0.35
Lesotho	340	1 792	0 19	4 172	0 08	5 586	**0.06**
Malawi	1 670	9 367	0 18	22 348	**0.07**	33 658	**0.05**
Mozambique	3 130	14 187	0.22	35 139	0 09	52 145	**0.06**
Namibia	662	1 349	0 49	3 049	0 22	4 163	0.16
South Africa	13 174	37 066	0 36	70 951	0.19	90 129	0.15
Swaziland	158	744	0 21	1 647	0 10	2 176	**0.07**
Tanzania	3 367	25 600	0 13	62 894	**0.05**	91 132	**0.04**
Zambia	5 268	8 150	0.65	19 130	0 28	27 173	0.19
Zimbabwe	2 812	9 903	0 28	19 631	0 14	26 622	0 11

(Based on data from Engelman & LeRoy 1995, in turn based on UN 1994 medium projection for population. Arable land for Swaziland from Human Development Report 1994 All projections assume constant value for arable land at 1990 levels. Cf. text.)

Arable land values were held constant at 1990 levels when calculating projected population-land rations for 2025 and beyond. In actuality, of course, they will change over time – probably decreasing in most countries while expanding in a few. But there is no reliable way to predict how these fiures will change in each country, and the changes are not expected to be significant.

While certain countries in Africa have the potential to expand the area of land under cultivation, such gains are likely to be offset by losses due to land degradation and conversion of cropland to nonfarm uses. On balance, the best compromise lies in assuming constant values for arable land, especially considering the near consensus that most of the world's future food will be produced on today's farmland.[2]

2. Engelman & LeRoy 1995, p 42

Appendix V:

Water and the Environment: An overview of the SADC countries

(This appendix is excerpted and condensed from SARDC, Southern African Research & Documentation Centre, 1994; mainly pp. 181-206)

Three of the region's 11 countries face inadequae freshwater supplies within 30 years – Botswana, Namibia and South Africa. All have seen the dark shadow of extreme water scarcity within the last decade. Water demand is projected to rise at almost three percent annually until at least the year 2020. Governments in the region are responding by looking for ways to manage water fairly and cooperatively.

Freshwater ecosystems

Almost 13 percent of the SADC region, excluding South Africa, is made up of freshwater ecosystems, known as wetlands; and much of the rural settlement (which comprises about 60 percent of the population) is concentrated there. Freshwater wetlands can be divided into four main types: lakes, rivers (including floodplains), dams (which convert stretches of a river into artificial lakes); and palustrine areas (swamps, marshes, fens, bogs and *dambos*).

Freshwater fish are part of wetlands ecosystems and are an important source of protein throughout most of southern Africa. Fish catches are largest in major lakes and dams.

In a recent joint study, SADC and the World Conservation Union (IUCN) concluded that wetlands throughout the region are threatened by a variety of human activities. The study recommended a plan of action within a regional framework, based on national initiatives.

Lakes

There are few large, deep, natural lakes in the region. The largest are the Rift-valley lakes – Victoria, Tanganyika and Malawi. The last two are the world's second and third deepest. Most lakes in the region are shallow due to the landscape. The Rift-valley lakes have large numbers of unique species of fish and plants because they are isolated from other freshwater systems. The deepest, Lake Tanganyika is 20 million years old and has 1,300 species – of which more than 500 are found nowhere else. Lake Malawi has 250 species of fish, the highest number in the world, and 90 percent of these are endemic.

Shallow lakes also make a substantial contribution to fisheries, but can dry up, as happened to lakes Xau, Liambzi and Ngami in Botswana, which have been dry since 1982. There are also the "soda lakes" such as Lake Manyara in Tanzania, which have high salt levels and relatively alkaline water. Pans are very shallow, often seasonal, bodies of water found in arid zones such as the nama-karoo and southern dry savanna, and are usually slat. Soda lakes and pans furnish a unique habitat, and their unusual collections of species, such as huge flocks of flamingos, are often conserved for tourism. The Makgadikgadi pan in

Botswana and Etosha pan in Namibia are examples. They are sometimes mined for salt or soda ash, as in Botswana's Sowa pan.

Fisheries

The large lakes are quite productive in fish and provide almost all of the inland commercial and subsistence catches in the region, almost 500,000 tonnes per year. Some lakes are showing signs of overfishing, including Victoria and Malawi, two of the region's largest producers of fish. At present, southern Africa's lake-fish do not face many serious environmental problems. The main problem relates to transplanting of species from one lake to another. The "Lake Tanganyika sardine" (also known as *kapenta*) was brought into Lake Kariba and now provides the majority of the fish catch, about 21,000 t/yr, although some experts question whether this is sustainable. The introduction of sardines into Lake Malawi has been discouraged because scientists think that this could lead to the extinction of other fish species. This recommendation is based on the experiences with the Nile perch in Lake Victoria.

Sedimentation is having a negative effect on the fisheries of the Rift-valley lakes. In Lake Malawi, increased sedimentation at the mouths of inflowing rivers has reduced fisheries due to disturbance of spawning areas or high levels of sediment in the water. The invasion of some southern African lakes by water hyacinth has resulted in major changes in fish habiat. Malawi, South Africa, Tanzania, Zambia and Zimbabwe all have problems with the weed.

Rivers

The largest is the Zambezi river, fed by tributaries in eight countries, which drains about one-fifth of the region. Many of the rivers are shared, running thorugh several countries or acting as borders between them – including the Cunene, Limpopo, Orange, Ruvuma, Zaire and Zambezi. The flow of permanent rivers can vary dramatically beween wet and dry seasons. Zambia's Kafue river, for example, at low flow can be just two percent of the amount at high flow. There are no permanent rivers between the Cunene and Orange rivers, which mark the northern and southern borders of Namibia.

Floodplains

Floodplains are very productive fish environments. Several thousand tonnes of fish are harvested annually from Barotse (part of the Zambezi) and Kafue of Zambia, which yield about 11,000 t/yr. FAO estimates that 50,000 people in Angola are seasonally employed in the floodplain fisheries, especially in the Zambezi-river headwaters of the central plateau. The Okavango river and floodplains are the only significant areas for freshwater fish in Botswana and Namibia.

In recent years, the large dams, such as Kariba and Cahora Bassa on the Zambezi, and Kafue on the Kafue river, and a number of smaller dams, have had a dramatic impact on floodplain ecology. Low rainfall and incrasing water demand are causing the shrinking of some floodplains once useful for fish production.

Fisheries

Significant fishing takes place in the Shire river of Malawi and the Kafue of Zambia. The lower Shire produced 10,000 tonnes of fish in 1986, and has potential to produce more but has been hit hard by a water-hyacinth infestation. Fish are caught throughout the Zambezi system – on floodplains, in reservoirs and on the river and its tributaries. The Limpopo is a large river, but it contains few fish. Cunene and Orange rivers do not account for much of the annual catches either, although the Cunene has the potential to produce 5,000 tonnes annually.

Dams

Water tends to flow through dams more quickly than lakes, but slower than natural rivers. The Kariba dam reduced the flooding of the Zambezi river by 25 percent, affecting important floodplain areas such as Mana Pools in Zimbabwe and Marromeu plains in Mozambique, as did the Cahora Bassa dam.

In addition to benefits from electricity and/or irrigation, a dam normally increases fish-yields over those from the previously free-running river, though species diversity usually decreases.

In 1962, shortly after filling up, almost a quarter of Lake Kariba was covered by Kariba weed. This has declined as the initial flush of nutrients from drowned vegetations slowed.

If the gates of a dam are at the top, such as for hydroelectric generation, the water discharge will be warm, with low levels of silt and a tendency to cause downstream erosion ("silt-hungry"). Most of the reservoir's life is found in the upper layer, so water released from there provides excess nutrients downstream, in the form of vegetation, compared to the original river system. Water released from the bottom (as in dams used for irrigation or water supply) is cold, silt-laden, nutrient-rich and oxygen-poor. The heavy silt load from the lower layer can smother downstream life forms. As with lakes, poisonous gases can form at the bottom.

A large amount of dam-water evaporates. More than a quarter of the average inflow to Maputo's main reservoir, Pequenos Libombos, evaporates. Annual evaporation from Lake Kariba is about eight cubic kilometres per year.

Cahora Bassa and Kariba are the only major dams that are important to the fisheries of southern Africa, with Kariba providing about 90 percent of Zimbabwe's fish-yield. Most of the fish are of a few types, however, and dams tend to support a low diversity of fish species.

Other wetlands

There are a number of internationally known marshes in southern Africa, such as the Okavango delta and Kafue flats. One of the most common types of marshy area in the region is the *dambo* – a meadow grazing land, or more precisely, a seasonally waterlogged grass-covered depression, taking up as much as 10 percent of central southern Africa, including parts of Angola, Malawi, Mozambique, South Africa, Zambia and Zimbabwe. they are found in river headwaters and along streambanks, but can also occur independet of a drainage system. *Dambos* were once thought to be like sponges, absorbing water, then releasing it slowly, in the classic "swamp" form found in temperate countries. But studies show they are actually groundwater discharge zones. *Dambos* represent extensive wet-zones during the dry season. They are a good source of grazing

and allow the cultivation of maize, rice or vegetables. They can be degrade through draining, cultivation of too large an area (studies show about 30 percent is safe) and especially overbrazing.

There are no figures for southern Africa alone, but Africa as a whole is thought to have lost about 30 percent of its wetland area. Botswana's Okavango delta, a World Heritage Site, is the only large internal source of water in this arid country. While Botswana has committed itself not to develop the delta, as populations and water demands increase, it may be the only place to look. Other wetlands face similar dangers.

Sources of fresh water

Water management differs considerably, from highly managed in Botswana, Namibia and South Africa (each has a National Water Master Plan) to largely unmanaged in areas of armed conflict such as Angola. Some countries, such as Tanzania, have outdated National Water Master Plans.

Rainfall

Generally areas receiving less than 600 mm of rain annually cannot produce crops unless there is some supplementry water. About 500 mm is considered the minimum. In southern Africa, an average of 85 percent of the rain will evaporate again under the heat of the sun and/or dry winds. The water that remains amounts to about 600 cu km/yr (roughly four times the total volume of Lake kariba) of which 360 cu km/yr is feasible for use.

Evaporation

The high rates fo evaporation leaves only 3-15 percent of the rainfall to run off. Evaporation does not normally exceed rainfall in the savanna zone. In the Kgalagadi, when the weather is hot and dry, the first 5 mm of rain evaporates before it penetrates the surface of the sand.

A large amount of water is lost through evaporation from plants (evapotranspiration). The Okavango delta is a good example. About 150 cu km of water flows into the delta annually,[1] five times the amount consumed in the entire southern African region each year. Of this, 95 percent evaporates or evapotranspirates. Cutting trees can incrase the minimum flow of streams in the dry season (baseflow). One study concluded that removal of *miombo* woodlands in Zimbabwe's communal areas reduced evapotranspiration and may have contributed to reactivation of some *dambo* systems.

Burning of vegetation can increase the minimum flow of streams in mountain catchments by reducing evapotranspiration. Intensive grazing to keep grass short may incrase this baseflow for the same reason, while trampling and ground compaction from high cattle numbers can decrease the baseflow. Some years after the prohibition of grazing in the central area of Tanzania, water supplies became more reliable, streams began to flow during the dry season and wells which used to dry up began yielding water year-round.

Conversion of indigneous forests to plantations of fast-growing pine and eucalyptus increases evapotranspiration rates and reduces the dry-season flow

1. P. Heyns, DWA (Department of Water Affairs) Namibia states that the correct figure is 10 cu km of water. Pending a resolution of what these figures include, both are given.

of streams. In the temperate-forest zone of South Africa, tree plantations have significantly reduced available groundwater and streamflow. this has led to the indtroduction of a permit system for commercial afforestation based on runoff reduction. The maximum allowable reduction is 10 percent in some areas, down to zero in others. No more than three-quarters of a permitted area can be planted.

Human activity

A study into the discharges of the upper Save river in Zimbabwe, found that mean annual stream-flow had incrased by almost one-third between the mid-1950s and the late 1970s. The increase was attributed to more rapid runoff caused by a reduction in natural woodland and other vegetation cover.

An area that loses one-third of its rain to runoff may receive 600 mm/yr, but will retain only 400 mm/yr in the ground where it is available for plants. the less water that penetrates the soil, the lower the groundwater recharge. For people, plants and wild animals in an ecozone, more runoff means less water unless it can be stored by some means such as in a dam.

Surface waters

The surface waters are the same wetlands that provide habitat for aquatic plants and animals, and the potential for competition between these different roles is quite high.

Surface sources provide water directly, through reservoirs, and as part of the water-supply infrastructure. Rivers and lakes furnish direct water supply only locally – in spite of the vast quantities of water they hold.

River flow

The average annual flow of the Zambezi river at Katima Mulilo, Namibia, is 41 cu km/yr, but this figure hides the real situation – average November flow is about 300 cubic metres per second, increasing to 3,800 cu m/s in April. If each of these momentary flows continued for a year they would result in an annual flow of 9 cu km/yr and 114 cu km/yr respectively.

Almost all of the rivers in the region are actually seasonal, only flowing when sufficient rainfall occurs and ceasing to flow for part of the year. Many are ephemeral, and may flow only after an abnormally heavy rain, once in several years. The Zambezi river appears to have a long-term high- and low-flow cycle, and is currently in a low-flow period, which scientists say will likely continue for several more years.

Many of the rivers in southern Africa carry high loads of sediment, due mainly to poor land-management practices. About 120 million tonnes of silt go into South African rivers each year. In Malawi, incrasing silt loads have caused rivers to meander more than usual and to flood their banks more often, washing away river-bank crops.

As water supply becomes an issue, the management of international rivers will increase in importance. Virtually all of the major rivers in Mozambique, Namibia and Swaziland rise in other countries. Upstream actions on any river can have tremendous downstream impacts such as decreased water flows, increased siltation and pollution, or blocking of fish migration. This can be a potential source of conflict, and has stimulated the establishment of a number of inter-

national water commissions, such as those between Namibia and South Africa, Lesotho and South Africa, and Angola and Namibia.

Table 1: Major River basins and flows in southern Africa

River	Flow (cu km)*	Countries
Zaire	1 174	Angola, Zaire, Zambia
Zambezi	212	Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia, Zimbabwe
Lilongwe	29	Malawi
Cuanza	26	Angola
Rufiji	26	Tanzania
Kilombero	14	Tanzania
Orange	12	Lesotho, Namibia, South Africa
Shire	11	Malawi, Mozambique
Kafue	10	Zambia
Luangwa	8	Mozambique, Zambia
Okavango	8	Angola, Botswana, Namibia
Lurio	7	Mozambique
Cunene	7	Angola, Namibia
Limpopo	5	Botswana, Mozambique, South Africa, Zimbabwe
Save	5	Mozambique, Zimbabwe

(Source: FAO, *Source Book for the Inland Fishery Resources of Africa*, FAO, Rome, 1990)
* Other figures for the flow of these rivers are given by other sources, most notably the Zambezi, which is quoted by P Heyns, DWA Namibia, as having a flow of 100 cu km.

Importance of dams

There are a few, very large dams in southern Africa primarily intended for hydropower generation – Kariba, Cahora Bassa and Kafue Gorge. But there are more than 300 medium sized dams and thousands of small ones used for urban and rural water-supply, livestock watering and irrigation. South Africa has over 500,000 dams, while Zimbabwe has about 8,000. Botswana has about 300, largely for livestock, although additional storage has been added to allow for irrigation. Namibia has 13 major state-dams and another 500 small farm-dams.

In Swaziland, where there are no supply dams, water rationing is becoming common during the dry months.

Dams collect a huge amount of runoff. In South Africa, farm dams have reduced runoff by up to 40 percent in the Orange and Upper Breede rivers. Large hydroelectric dams, which release water only through the top, hold vast amounts of water (known as "dead storage") which cannot be used directly though it does serve as habitat to fish. Lake Kariba has 114 cu km of dead storage, equivalent to almost 20 percent of the entire region's annual runoff. This unusable water is worth US$130,000 million in terms of Botswana's water costs.

Conflict can occur over hydroelectric supply and other uses of water. In Tanzania, the national electricity authority, TANESCO, has accused upstream

irrigation schemes of depriving its hydro dams of water and has demanded closure of the irrigation schemes.

Silting of dams is a major concern in southern Africa and generally results from soil erosion, often caused by poor land-use practices. Siltation can cut the useful life of a dam by one quarter, with some major dams silting up in less than 20 years. Dams are a major investment and anything which shortens their life represents a large cost to the investors. High silt-loads also wear away power-generating equipment, further eroding investments. A survey of 120 dams in Zimbabwe's Masvingo province showed almost two-thirds were over half full of silt and others up to 100 percent silted.

Siltation in South Africa is better monitored than in most other countries in the region, and some idea of the regional extent of sedimentation can be interpreted from that country's figures. In high-erosion areas, dams lose capacity at the rate of 10 percent each decade. Following the construction of two large dams in the Orange river catchment, for example, the amount of sediment carried to sea dropped from 35 million tonnes in 1935 to less than 20 million tonnes due to sediment being trapped in the dams. The cost of constructing new dams to replace storage capacity lost to siltation in South Africa is estimated at between R100 million and R200 million per year (US$36 million and US$72 million).

Lakes and marshes

While rivers can be used to feed reservoirs, lakes are useful water sources only to those nearby. This is especially true of the Rift-valley lakes, which are at a much lower altitude than the surrounding area. Although Lake Malawi takes up 20.4 percent of the country, most Malawians rely on other sources of water. The large lakes and dams in southern Africa are largely a future resource, requiring vast funds to develop as water sources to meet long-term needs.

The marshy areas of southern Africa are not major water sources either. The provide an important water-purification function. Several schemes are in place or being developed to use marshy areas as natural sewage-treatment plants.

Groundwater

Groundwater is very important throughout southern Africa during the dry season and year-round in the arid zones. The depth at which water is found increases from 30 m in the east to over 100 m towards the Kgalagadi. Some boreholes are as deep as 600 m. Water quality varies greatly – especially the level of dissolved solids that make water salty. Groundwater is protected from evaporation, so much less water is lost than from dams, and it is more reliable – provided it is used sustainably, i.e. if abstraction is not more than what is replaced by rainfall over the long term.

Groundwater is the main source of water for many rural people throughout the region, catering for about 80 percent of the human and animal populations in Botswana and at least 50 percent in Namibia. Botswana has about 15,000 boreholes of which 45 percent are working. About 130,000 boreholes have been drilled in Namibia but only about 32,000 are presently used. Zimbabwe has drilled about 35,000 boreholes and Tanzania has more than 4,000. Malawi has

about 9,700 in addition to 4,000 hand-dug wells. South Africa has a huge number of boreholes; estimates suggest 30,000-80,000 are drilled each year.[2]

Natural recharge

Many seasonal rivers provide a good, reliable source of groundwater because they are replenished regularly. Dry riverbeds in Botswana often have aquifers under them which are recharged after heavy rains. These have limited amounts of water but a good chance of recharge.

Groundwater in arid regions can be salty. This is especially true of old groundwater which, over thousands of years, has slowly dissloved salts from the surrounding rolck or soil. Generally, a low concentration of dissolved solids indicates recent recharege of an aquifer, although this is not always the case. On the basis of poor water-quality in the deep aquifers under much of the Kgalagadi basin it was thought the groundwater there was all "fossil", from a much rainier period 10,000-15,000 ears ago. Evidence now suggests that most aquifers under the Kgalagadi are being recharged, with conclusive evidence or recharege as recently as 40 years ago.

An important factor slowing down recharge is the amount of silt carried in the water after a rain, which clogs the pores in the soil. By constructing a large dam to catch rainwater, allowing the silt to settle, and then releasing the water to huge infiltration areas, Namibians hope to increase the natural recharge rate of the huge Omdel aquifer.

Once a confined aquifer has been depleted the spaces where groundwater once was can easily collapse, permanently decreasing the capacity to store water again.

Irrigation accounts for over three-quarters of groundwater used in South Africa, and most farms currently using groundwater for irrigation are running short.

Pollution

Once groundwater is polluted by sewage, it can remain polluted a long time – depending on the type of soil, the rate of ground-water recharge and the amount of sewage being added. Groundwater pollution in Botswana is caused by sewage and bacteria, usually via leakage from pit-latrines and cattle concentrations near boreholes, or from poorly sited or badly built wells.

Borehole pumping can also contaminate groundwater by sucking salty water into the borehole. Scientists warn that moderate pumping of coastal aquifes in Tanzania could pull seawater into the freshwater aquifers.

The Zambian copper-mines pump groundwater out of the mines and discharge it into the Kafue river. The river discharge above the mines is 0.84 cu m/s and below the mines is 3.74 cu m/s, an increase of more than four times. Groundwater pumping of this enormity depletes supplies, while people downstream have come to depend on this increase in year-round flow and will have problems adjusting when the mines close.

2 The figure given here by the source excerpted (SARDC 1994) is hard to believe, as pointed out by P. Heyns, DWA Namibia, since it amounts to more than 100 holes put down per day If the figure refers to meters drilled, and if each borehole is 100 m deep, the figure is acceptable, even if it still means more than one borehole being put down per day.

Demand for groundwater in southern Africa is increasing and will continue to increase, as will demand for water from all sources. Yet despite the importance of groundwater for many people in the region there is a general feeling among water managers in all countries that data on groundwater is insufficient and record-keeping inadequate. Supplies and their quality are not really known except in specific cases, levels of usage are only estimates, recharege rates are partially known and processes are debated. Effects of various industries on water quality and quantity remains largely speculative. Even the number of boreholes and weills are largely estimates.

Demand for fresh water

Increasing water demand is a crucial concern in southern Africa because of the increasing human population and associated demand for resources, especially food. In water-scarce Namibia, for example, demand for state-supplied water increased from 37 million cubic metres per year in 1970 to 95 mcm/yr in 1993, an average of 4.2 percent per year and will above the population growth rate of three percent.

Environment

Environmental demand is the water needed for lakes, floodplains, estuaries, rivers, marshy ares, parks and vegetation growth, and it is by far the highest of any sector.

Water engineers often consider all water as available for human use, although an environmental consciousness is beginning to develop in which natural resources and their water quantity/quality needs are taken into account. Namibia's Oanob dam, for example, was specifically constructed to allow periodic release of water for ecological purposes in the ephemeral Oanob river to simulate flooding and maintain riverine woodland growth.

Irrigation

The main use of water by far is irrigated agriculture and changes in irrigation demand ill have the greatest effect on overall water demand.

In South Africa, the region's biggest irrigator, only one percent of the agricultural land is irrigated, but is produces 30 percent of the value of agricultural production.

Irrigation accounts for almost three-quarters of all water used. Of this about 60 percent of the water is wasted, not only throwing away a valuable resource, bu causing serious environmental problems. These include soil poisoning thorugh salinization and waterlogging of land. Bilharzia and malaria can become common problems.

One potential area for expansion of a traditional form of irrigation is *dambo* agriculture. While dambos (meadow graxing lands or seasonally waterlogged grass-covered depressions) can be overexploited, research has shown that up to 30 percent of one can be cultivated without any significant environmental impact. Dambo cultivation does not require specialized equipment, nor does it involve loss or wastage of water associated with mechanical irrigation. Currently, legislation prohibits dambo cultivation in countries such as Zimbabwe, but with careful monitoring to prevent degradation, these resources might provide

extensive irrigation potential while building on local knowledge – without requiringexpensive and often inappropriate technology.

Southern Africa has an estimated 9.1 million hectares of land where productivity could be improved through irrigation. About 1.8 million hectares are already under irrigation. Of the 11 countries, eight use more water for irrigation than all other uses combined.

South Africa estimates that irrigated agriculture should be able to achieve the same levels of production with 25 percent less water. Other studies show much greater levels of efficiency are possible.

Irrigation is often used to grow crops with low economic value. In South Africa, 80 percent of the irrigated crops, such as grain or pasture, are low value. This uneconomic use of water normally requires some form of agricultural subsidy.

National agricultural policies often promote irrigation to grow more food from the same amount of land, as in the case of South Africa, Tanzania and Zimbabwe. Water for irrigation is commonly supplied at lower than cost of supply to encourage agricultural development. This can lead to inefficient use and very high demand, which may not be economic. Demand from existing irrigation schemes in Zimbabwe is greater than supply.

Irrigation creates a huge drain on limited water supplies. This leads some water economists to question why irrigation, which creates a strain on water-supply infrastructures, is subsidized to grow low-value crops.

Botswana in 1991 decide it could afford to irrigate only where there is no other possible use for the water. This has meant giving up the goal of food self-sufficiency in favour of food security.

Table 2: Current and projected water demand (cu km/yr)

Country	1993 Demand	1993 Irrigation	2020 Demand	2020 Irrigation	Total Available
Angola	1 335	0 350	2 757	0 750	78 000
Botswana	0 129	0 020	**0.336**	0 047	**0.230**
Lesotho	0.118	0 070	0 268	0 160	2.490
Malawi	1.135	0.795	2.578	1 820	4 240
Mozambique	1 967	1.308	3 210	3.000	132 000
Namibia	0.265	0.108	0.538	0 248	0 740
South Africa	19 295	9 615	**30.168**	12 674	**28.470**
Swaziland	0.454	0.310	0 511	0 331	1 160
Tanzania	5 374	4 560	12 220	10.450	44.000
Zambia	0.994	0 690	2 192	1.580	60.000
Zimbabwe	2.524	2.175	5.737	4 980	7 860
TOTAL	33.590	19 981	60.515	36.120	359.190

Total Available has been calculated as 60 percent of the Absolute Total, the amount hydrologists assume as available for human use. Countries where demand in 2020 will surpass total available have been high-lighted.
(Source. Heyns, P. "Water Demand and Supply Management", in SARDC, 1994, p 197)

Population

One flow units equals 1 million cm/yr. Where the ration of population to flow units exceeds 600, stress begins to appear; above 1,000 there is invariably chronic water shortage; and above 2,000 there is extreme water scarcity.

Southern Africa, which has a population of 136 million, has about 360,000 flow units available. The overall ratio of population to flow units in southern Africa is about 360, not a problem, but, with the population doubling in just under 24 years, the ratio will be 720 by 2016 and over 1,000 by 2030. In other words, at current population gowth rates, this region will experience chronic water-shortage by 2030. And these calculations do not consider that some parts of the region have much lower access to wate than others.

Both current demand and projected demand are estimates. Many water-uses cannot be monitored cost effectively, especially in rural areas.

Conservation and water management

The demand for water is till largely related to irrigation, which makes up almost two-thirds of current demand and nearly half of demand projected for the year 2020.

Water conservation is not a systematic practice anywhere in the region, except for occasional campaigns during droughts. Botswana's Moupule power staton is dry-cooled to save water. Industres in South Africa have begun to implement water conservation, with notable success by the state electrical utility ESKOM, which has built two air-cooled generating plants, saving up to 30 mcm/yr.

There is one potential source of water that increases as water-use increases. That is waste water, or "return flow", as planners call it.

Some cities have already recognized the value of recycling return flow. In Namibia, Windhoek recycles about 13 percent of its waste water for domestic consumption. Harare, Zimbabwe, recycles about 10 percent (18 mcm/yr) and has plans to increase this to 20 percent, at least partly due to government policy on funding major water-supply projects. The policy requires that 20 percent of a city's waste water be recycled before funding for new projects is made available. South Africa recycles return flow for industrial and irrigation use, but not for domestic consumption.

Consultants estimate that 90 percent of water used in Gaborone, Botswana, is returned to the sewers. If this approximate figures holds for other major centres then there is a substantial value of water literally going down the drain throughout the region. Gaborone plans to re-use 38 mcm/yr of treated sewage by 2020, equivalent to 60 percent of return flow. Using a figure of 7,201 mcm/yr of domestic and industrial water-use throughout the region, a recycling rate of 20 percent would save 1,440 mcm/yr. Long-term studies in Namibia indicate no increase in water-borne diseases resulting from incorporation of recycled water in water-supplies.

The term "catchment management" is being used more frequently, denoting the need to consider all activities in each river or stream basin, all water sources and wetlands, and the ways all these things interact. The lack of such management has, for example, led to dams being sited in areas of high erosion

with no direct programme to promote or require proper upstream land husbandry, leading to high siltation rates.

Water harvesting

Water-harvesting has been studied in Botswana in an experiment that diverted water from a tiny stream basin to a field, using earth-ridges up to half-a-metre high. In this system, the area used for harvesting water was up to 50 times the size of the growing area. The downstream environmental impacts of removing the water from the stream have not been studied.

Rooftops have been used in arid urban areas. It is currently practised in Botswana's smaller urban centres, and was effective in Bulaway, Zimbabwe, in helping to stretch limited water-supplies during the disastrous 1991-92 drought.

The World Resources Institute says water-harvesting could increase agricultural production in sem-arid and sub-humid Africa on 10 million hectares of land in the short-term and 50 million hectares over the long-term.

Appendix VI:

Surface Water Management in Arid Regions

(Excerpted and condensed from a manuscript made available to SIDA by Pieter Heyns, Department of Water Affairs, Namibia)

In Namibia there is a distinct rainy season between October and April and a dry period druing the rest of the year. The rainfall in the summer is scarce and erratic. In Namibia the mean annual rainfall is usually between 4 and 25 times less than the potential mean annual evaporation. Within the borders of Namibia there are no perennial rivers, only ephemeral rivers. These rivers flow during the rainy season if, and only when it rains enough. The mean annual rainfall over a period of time is usually made up of a large number of years with low rainfall and only one or two years with very high rainfall. Only 2 percent of the rainfall in Namibia is available as runoff because almost 83 percent of the rainfall evaporates shortly after precipitation and the balance infiltrates the dried out ground.

The so called antecendent factors means that even a year of good rains may not produce any appreciable runoff, if it was preceded by a year of good rain, because the increased amount of vegetation will reduce runoff.

Dams can be operated for high efficiency (with reduced production during dry years) or high reliability (with low yield in rspect to water). This is because the high evaporation. High reliability, means being able to collect enough water to bridge several dry years. This means high evaporation losses. High efficiency in water use, means using the water when it is there, but cutting back on production (e.g. mining) during periods when there is little water.

If several dams, in different catchment areas, are used in conjunction to minimize evaporation losses, efficiency will be increased.

If dams are combined with groundwater, it means that groundwater can be overpumped during dry years, and left to recuperate during wet years, when there will be enough water in the dams.

The system becomes even more efficient if integrated with water from perennial sources, such as the Okavango.

In Namibia three dams have been built and interconnected to suply water to the industrialized Windhoek-Okahandja complex.

The water from the Okavango River will be very expensive water, but ininitially it will not be necessary to suppply water at all times. The additional water will serves as an insurance policy which makes it possible to use the less expensive water of the dams at higher risks of failure and therefore getting more water out of them.

Recycling is encouraged but has only been implemented with great success in cases where the industry has to pay to full economic cost of the water supplied. The Rossing Uranium Mine in the Namib Desert is an excellent example where an initial daily consumption of 30,000 cum of fresh water has been reduced to 10,000 cum/day as a result of the reuse of industrial effluent.

Appendix VII:

Population Growth and Water Scarcity

A basic understanding of water requirements in southern Africa for the coming decades will be gained from calculating per capita availability of water as a result of population increases:

Table 1: Annual Renewable Fresh Water Availability, per capita water availability and population pressure on water availability in SADC Countries, 1990, 2025 & 2050

Total annual renewable fresh water available (cubic km)		Population (thousands)			Per capita water availability (cubic m)			Population pressure on water availability (people/mcum, year)			Water scarcity index*		
Country		1990	2025	2050	1990	2025	2050	1990	2025	2050	1990	2025	2050
Angola	158	9 194	26 619	41 182	17 185	5 936	3 837	58	168	261	1	2	2
Botswana	18	1 276	2 980	3 996	14 107	6 040	4 505	71	166	222	1	2	2
Lesotho	4	1 792	4 172	5 586	2 232	959	683	448	1 043	1 397	2	**4**	**4**
Malawi	9	9 367	22 348	33 658	961	403	267	1 041	2 483	3 740	**4**	**5**	**5**
Mozambique	58	14 187	35 139	52 145	4 088	1 651	1 112	245	606	899	2	**3**	**3**
Namibia	9	1 349	3 049	4 163	6 672	2 952	2 162	150	339	463	2	2	2
South Africa	50	37 066	70 951	90 129	1 349	705	555	741	1 419	1 803	**3**	**4**	**4**
Swaziland	7	744	1 647	2 176	9 355	4 226	3 199	106	235	311	2	2	2
Tanzania	76	25 600	62 894	91 132	2 969	1 208	834	337	828	1 199	2	**3**	**4**
Zambia	96	8 150	19 130	27 173	11 779	5 018	3 533	85	199	283	1	2	2
Zimbabwe	23	9 903	19 631	26 622	2 323	1 172	864	431	854	1 157	2	**3**	**4**

*Index 1 = Adequate; 2 = Quality and dry season problems, 3 = Water stress; 4 = Absolute scarcity; 5 = Water barrier. Values 3-5 highlighted
(Calculated from Engelman & LeRoy 1993, revised 1995 Population figures from UN 1994 medium projection. Water scarcity index from Falkenmark 1993: <100 = 1, 100-600 = 2, 600-1,000 = 3, 1,000-2,000 =4, >2,000 = 5)

This table forms the basis for comments made on countries' water prospects made in the map on the cover of this study.

A note on the reliability of data in this, and all the following, tables

Almost all figures in the literature for total annual renewablefresh water available seem to come from investigations made in the seventies by Belyaev, Institute of Geography, USSR. He compiled data on water resource from models using other data, such as area under irrigated agriculture, livestock populatons, and precipitation, where necessary Data from small countries and countres in arid and semi-arid zones are less reliable than are those for larger and wetter countries. The annual average figures hide large seasonal, interannual, and long-term variations. When no data are provided for annual river flows to or from other countries, the annual internal renewable water resources figure may include these flows.

The very unsatisfactory state of basic data for water availability in the southern African region would seem to merit development assistance support to basic hydrological investigations, particularly if programmes are designed as part of an indigenous capacity-building process.

Further understanding will be gained from plotting the degree of withdrawal of available resources, and the societal use of these withdrawals:

Table 2: Fresh water withdrawal by country and sector, SADC countries

Country	Total annual renewable fresh water available (cubic km)	Year of data	Total annual fresh water withdrawal (cubic km)	Fraction withdrawn (percent)	Per capita withdrawal (cum per person and year)	Domestic use (percent)	Industrial use (percent)	Agricultural use (percent)
Angola	158	1987	0.48	0	43	14	10	76
Botswana	18	1980	0 09	1	98	5	10	85
Lesotho	4	1987	0.05	1	34	22	22	56
Malawi	9	1987	0 16	2	22	34	17	49
Mozambique	58	1987	0 76	1	53	24	10	66
Namibia	9	1987	[n d]	2	77	6	12	82
South Africa	50	1970	9 20	18	404	16	17	67
Swaziland	7	1987	0 29	4	414	5	2	93
Tanzania	76	1970	0 48	1	36	21	5	74
Zambia	96	1970	0 36	0	86	63	11	26
Zimbabwe	23	1987	1 22	5	129	14	7	79

(Gleick 1993, p 374-375)

All data, except for Botswana and South Africa, come from the work by Belyaev commented above.

Note the low degree of mobilization in all countries except South Africa, and the high degree of actually mobilized water going to agriculture.

Note also the misleading character of data, since the amount of water coming from rivers going in or out of the country (thus in practice being counted several times as an asset) is not noted. The only country for which such data are given is Botswana, where 17 of the18 cu km of available water in fact comes from rivers flowing from other countries.

In the table on the next page, the importance of this feature will be seen more clearly. There, I have tried to make projections of the degree of mobilization of available water resources necessary in order to sustain requirements of food production for growing populations. In countries where the necessary degrees of mobilization turn out to be very high, it will indicate a need to utilize shared water resources, particularly rivers flowing into the country from another country.

The following table tries to capture future water requirements as a result of the demands of agriculture, combined with population increases. At the base of these calculations lie so called H-values, a concept excerpted from Falkenmark 1993.

(One unit of H corresponds to the amount of water required for sustaining basic drinking water and sanitation needs, and equals 100 l/cap,d. It is thus another way of expressing per capita water use. Actual withdrawals today are typically below 3H, at the highest 7H in South Africa.)

For purposes of comparison, the first column of H-values represent the total annual renewable fresh water available, expressed as H-units. The generally higher H-values in the projections are adopted from Falkenmark's (1993) approximation that self-sustaining agriculture would demand a level of water mobilization corresponding to 20H in Lesotho and Namibia, and 10H in Botswana, Mozambique, Malawi and Zimbabwe. To this must be added the requirements of big cities and industry which demand a lot of water locally.

Table 3: Projections for degree of mobilization of water resources, necessary for self-sustaining agriculture 2025 & 2050

Country	Latest available data			Projection for 2025				Projections for 2050			
	Total annual renewable fresh water available (cubic km)	Expressed as H-value	Present mobilization (percent)	Population (thou's)	H-value	Total annual withdrawal (cu km)	Necessary mobilization (percent)	Population (thou's)	H-value	Total annual withdrawal (cu km	Necessary mobilization (percent)
Angola	158	1 2	0	26 619	10	10	6	41 182	10	15	10
Botswana	18	2.7	1	2 980	10	1	6	3 996	10	1	8
Lesotho	4	0 9	1	4 172	20	3	**76**	5 586	20	4	**101**
Malawi	9	0.6	2	22 348	10	8	**91**	33 658	10	12	**137**
Mozambique	58	1.5	1	35 139	10	13	**22**	52 145	10	19	**33**
Namibia	9	2.1	2	3 049	20	2	**25**	4 163	20	3	**34**
South Africa	50	11 1	18	70 951	10	26	**52**	90 129	10	33	**66**
Swaziland	7	11 3	4	1 647	10	1	9	2 176	10	1	11
Tanzania	76	1 0	1	62 894	10	23	**30**	91 132	10	33	**44**
Zambia	96	2 4	0	19 130	10	7	7	27 173	10	10	10
Zimbabwe	23	3 5	5	19 631	10	7	**31**	26 622	10	10	**42**

Values where the necessary degree of mobilization turns out to be greater than 20 percent highlighted.
(Last available data from Gleick 1993, pp 374-375, expressed as H-value calculated from same Population values in projections from UN 1994 medium projection H-values in projections from Falkenmark 1993)

Falkenmark notes that at degree of mobilization realistic for SADC countries would be 20 percent. More than 50-60 percent is probably physically impossible due to the thirst of the atmosphere (dams and reservoirs will evaporate). The theoretically derived values above 20 percent of mobilization therefore have been highlighted. They would imply massive water transfers[1] from abroad, or – more realistically – increasing needs to import food, and/or a radicallywater use regime, i.e. *learning to live with aridity.*

Rather than as projections, the value of theoretical exercises such as this thus serve the purpose of indicating that water and food security problems may become acute in several countries (highlighted) not captured by earlier, more simplistic, projections of shrinking per capita availability as a result of just population increases.

1. For South Africa 2050, as an example, the amount necessary to import theoretically would amount to 10 percent of the Zambezi's flow at the outlet, or an amount as large as the combined flow of both the Orange and Limpopo rivers This is clearly unrealistic

Appendix VIII:

Shared Rivers

Table 1: International river basins shared between SADC states

River basin	Basin states	Special features
Buzi	Mozambique Zimbabwe	Two smaller hydropower installations in Mozambique. One of the dams also used for irrigation.
Cunene	Angola Namibia	Potential hydroelectric power capacity of 2,400 MW Four dams in Angola (some of them diverting water to Ruacana power station, 240 MW, in Namibia). Feasability study of Epupa Dam (415 MW, Namibia) initiated
Cuvelai	Angola Namibia	Low and erratic runoff 40 dams built to provide water for agriculture and livestock to just under half of Namibia's population. Groundwater in the basin to saline for human or animal consumption. Water diverted from the Cunene to the Cuvelai No agreement between Angola and Namibia on the Cuvelai.
Incomati	Mozambique South Africa Swaziland	At least six dams in South Africa Transfer of water to the Olifants in the Limpopo basin for cooling of powerstations in the Eatern Transvaal. Diversions in Swaziland for irrigation. Tripartite commission has not been functioning well, but the bilateral commission between South Africa and Swaziland, as well as the Komati Basin Water Authority (KOBWA) established by the commission are functioning
Limpopo	Botswana Mozambique South Africa Zimbabwe	Four dams in Botswana, one in Mozambique, 26 in South Africa, and nine in Zimbabwe
Maputo	Mozambique South Africa Swaziland	Five dams in South Africa, four in Swaziland, and one in Mozambique
Nata	Botswana Zimbabwe	Partly ephemeral, unimportant as international river system No agreements
Okavango	Angola Botswana Namibia	Very little known about development of Cubango and Cuito in Angola since civil war. One dam in ephemeral Omatako river in Namibia to supply Windhoek. Major diversions from Okavango to Namibia will be necessary by 2005 One dam in Botswana to supply Orapa diamond mine. Proposed development plans in Botswana shelved after critical IUCN report 1992 Permanent tripartite commission established 1994
Orange	Botswana Lesotho Namibia South Africa	Most developed river in SADC region. More than 24 large dams in South Africa, five in Namibia and two in Lesotho. Largest project the Lesotho Highands Water Project (LHWD) diverting water to South Africa; royalties to be paid to Lesotho for fifty years. Downstream country Namibia has only said OK to phase I of the project Border line conflict between South Africa/Namibia solved recently. Irrigation scheme on Namibian/ South African territory regulated in special treaty Internal diversions in South Africa via the 85 km (longest in the world) Orange-Fish Tunnel to Eastern Cape Province and other transfers in and out of the basin may become sources of conflict
Pungué	Mozambique Zimbabwe	No significant development made or planned.
Rovuma	Malawi Mozambique Tanzania	No significant development made or planned

(Source: Manuscript draft to SIDA by P Heyns, Department of Water Affairs, Namibia)

Table 1: International river basins shared between SADC states

River basin	Basin states	Special features
Save	Mozambique Zimbabwe	One of the most important rivers in eastern Zimbabwe and Mozambique. More than seven major dams for household use, irrigation and mining in Zimbabwe High silt loads from erosion due to changing land-use patterns. Development plans in Zimbabwe will mean less water for Mozambique. International Water Commission proposed.
Umbeluzi	Mozambique Zimbabwe	Two dams in Swaziland, one in Mozambique No immediate future development plans.
Zambezi	Angola Botswana Malawi Mozambique Namibia Tanzania Zambia Zimbabwe	Largest African river flowing into the Indian Ocean Supports more than 26 million people. Water availability exceeds demand at present, but may change due to increased population, need for irrigated food production (main reason), higher standard of living and environmental needs. Two dams in Malawi, five in Zambia and twelve in Zimbabwe. Hydropower potential 20,000 MW; about 4,500 MW installed. Largest hydropower works at Victoria Falls, Kafue Gorge, Kariba, Cahora Bassa and the Kamuzu Barrage. Future plans include Katombore (upstream of the Victoria Falls), Batoka Gorge and Devil's Gorge (between Victoria Falls and Lake Kariba), Mupata Gorge (between Kariba and Cahora Bassa) Other development projects. 10,000 ha sugar care project in the Eastern Caprivi in Namibia, Bulawayo Water Diversion Project in Zimbabwe, and diversion at Kazungula to South Africa by 2020. (Last projects of questionable economic viability)

(Source Manuscript draft to SIDA by P Heyns, Department of Water Affairs, Namibia)

*

This information could also be viewed in another way, i.e. to see how many international river basins, common to SADC countries, fall within each country:

Table 2: International river basins shared between SADC states

Basin state	Number of basins	Name of river basin covered
Angola	5	Cunene, Cuvelai, Okavango, Zaire, Zambezi
Botswana	5	Limpopo, Nata, Okavango, Orange, Zambezi
Lesotho	1	Orange
Malawi	2	Rovuma, Zambezi
Mozambique	9	Buzi, Incomati, Limpopo, Rovuma, Save, Maputo, Pungué, Umbeluzi, Zambezi
Namibia	5	Cunene, Cuvelai, Okavango, Orange
South Africa	4	Incomati, Limpopo, Maputo, Orange
Swaziland	3	Incomati, Maputo, Umbeluzi
Tanzania	2	Rovuma, Zambezi
Zambia	1	Zambezi
Zimbabwe	6	Buzi, Limpopo, Nata, Pungué, Save, Zambezi

(Source: Manuscript draft to SIDA by P. Heyns, Department of Water Affairs, Namibia)

Tables such as these are often used for pointing out an inherently conflict-generating situation. It could also mean further incentives for conflict-resolving cooperation, given a functional regional framework and a confidence-building context. See main text for further comments.

Appendix IX:

Major Water Transfer Schemes

(Excerpted and condensed from SARDC special reports SR21 921209; Arnestrand 1993; interview with Nils Kellgren, BITS. This overview is provisional and in need of substantial amendment.)

Angola:

Average rainfall over 1,500 mm a year and adequate supplies of water on a nation-wide basis. Under no pressure to embark on water development projects. Angola is the source of both the Zambezi River and the Okavango River shared with Botswana, and the Cunene River shared with Namibia. It has a very strategic position and plays a crucial role in the region, but virtually nothing is known about water management insida Angola, due to the civil war.

Botswana:

Two-thirds of the country, covered by the Kalahari Desert, has no surface water supplies. By 2020 demand will double. Botswana is ultimately planning to supply its major cities with water from the Chobe River, which is a tributary to the Zambezi River.

Lesotho:

Has abundant water resources. Its mean annual rainfall is over 1800 mm. The compensation system in LHWP has been described as the most generous in Africa. But a prominent Basotho chief views it as the decline of a nation and the surrender of sovereignty because it takes away the only wealth Lesotho has.

The water transferred from Lesotho to South Africa via the LHWP will go through tunnels under the mountains on its way to South Africa.

Malawi:

The country's water position seems secure. But it will not be easy to harness water from Lake Malawi for industrial and domestic use because it is very low lying and nextto it is a very high plateau. Malawi has plans for a Shire Highlands Water Project which could start after an environmental impact ssessment. It will primarily be used for watering som 29,000 hectares of land. A canal will carry water from the Kamuchira Falls. The project will be constructed over a period of 20 years.

Namibia:

Diamond and uranium mining and irrigation are the major water users, but even basic requirements exceed the naturally available water in most areas. Under South African rule construction of the Eastern National Water Carrier (ENWC) was started. This is a more than 750 km long water carrier comprising pipelines and canals, which will eventually connect the Okavango river to the central arid region. The completed portion has a 200 km canal which has been a death trap

for wild animals. The situation is managed by patroling the canal and assisting animals to get out.

Namibia wants to divert water from the Okavango and a 302 km long canal from Omatako to Grootfontein is already complete. The final phase involves connecting the canal to Okavango river which feeds the internationally acclaimed Okavango delta. The volume of water which will be abstracted is claimed to be relatively small (4 cum/s).

On the border-river between Angola and Namibia, the Cunene, a new hydropower installation is planned. A pre-feasability study has been carried out by NORAD. There are several views about the proposed project: It is perceived that one of the last of Africa's indigenous populations, the Himbas, will be affected. Several rare species of fish risk extinction. The Cunene will be dried out during part of the year downstream of the dam. This happens also under normal conditions due to the variability in seasonal runoff. With the dam generating hydropower and regulating the river flow, it is claimed that conditions in fact will be improved.

Both countries have water rights to the river, and the installation will be built as a joint project.

South Africa:

Expected to outgrow its water supply by 2020. Current dam capacity in the country is 50,000 mcum/yr. An additional 2,200 mcum/yr will be diverted from Lesothos's Sengu-Orange river to the Vaal in South Africa.

Thre project, LHWP, will cost R8.1 billion, and involves the construction of four major dams, a tunnel and hydroelectric power stations. The water will be used in the mines and factories of the Gauteng area, South Africa's industrial heartland.

Even with the LHWP shortages will occur in South Africa within the first quarter of the next century. To make up the difference South Africa has proposed another ambitious water plan, the Zambezi Aqueduct, which is intended to draw water over 1,200 km from the Zambezi River at Kazungula through Botswana to Pretoria.

Swaziland:

Depends on the goodwill of neighbours as its rivers originate in South Africa, who has already dammed the major rivers. The future will depend on whether or not the rivers that run through it are not excessively dammed in its neighbouring countries.

Tanzania:

Enough water to meet its present needs. Working on a river sources protection project. The Rufiji River Basin Development Project is another Tanzanian project designed to swell the supply of energy and water for irrigation. When complete it should generate some 4,000 megawatts and provide water to over three million people living in the area for agriculture.

Zambia:

Plans in the New Economic Recovery Programma (1989-1993) provides for 161 dams and 650 km of canals in the Bagweulu, Lukanga and Zambezi basins. Some 205 km have already been built for irrigation and domestic use.

Zimbabwe:

Water consumption is expected to double in the next 20 years. Two dams are being proposed on the Save River in the eastern part of the country to supply water for irrigation in Zimbabwe's fertile low veld. Zimbabwe is planning to use the Zambezi River for "all" major cities.

Industrial development in Zimbabwe's second largest city, Bulawayo, has been handicapped by water scarcity. The Matabeleland Zambezi Water Project has been proposed. It will carry water from the Zambezi River to Bulawayo. The estimated cost stands at Z$1,650m but so far only Z$7m has been received by the project trustees.

Zimbabwe and Zambia are planning to construct a hydroelectric scheme at Batoka Gorge upstream of Lake Kariba.

Appendix X:

The International IWRM Policy Framework

The conclusions of the main meetings leading up to the present consensus on integrated water resources management and development programmes on water are excerpted in order to ensure that all relevant aspects will be covered by the research process suggested in the "Research Proposal".

The overriding framework for managing internationally shared water resources, the Helsinki Rules, is reviewed in the following appendix.

Copenhagen 1991

The groundwork for the present framework was laid at this "Informal Consultation on Integrated Water Resources Development and Management prepared and supported by the Nordic Countries". Two important principles were singled out: (1) Water and land resources should be managed at the lowest appropriate levels. (2) Water should be considered as an economic good, with a value reflecting its most valuable potential use. In addition, the role of international agencies and donors to support developing countries in creating an "enabling environment" was stressed. This should include mechanisms to channel donor support to local levels in developing countries.

Dublin 1992

The number of guiding principles was increased to four – the so called Dublin Principles – at this pre-UNCED "International Conference on Water and the Environment":

(1) Effective management should link land and water uses across the whole of a catchment area or groundwater aquifer. (2) Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels; decisions to be taken at the lowest appropriate level. (3) The need to adress the crucial fact that women play a central part in the provision, management and safeguarding water, but that this role seldom has been reflected in institutional arrangements, requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them. (4) Water has an economic value in all its competing uses and should be recognized as an economic good.

The conference pointed to the need for similar water management institutional arrangements in all countries sharing a river basin or groundwater resources. The threat of global climate change, and the challenges posed by managing it, was stressed as important also from a water management point of view. Capacity building will require an enabling environment in terms of institutional and legal arrangements.

UNCED 1992

Water issues are treated in a special chapter of Agenda 21 (the all-encompassing international action plan governing the planning efforts of individual nations on

environmentally related issues) adopted at the 1992 Rio Conference. It is treated here by relating the outcome of later meetings addressing issues raised by Agenda 21.

Noordwijk 1994

At this "Ministerial Conference on Drinking Water and Environmental Sanitation", dedicated to implementing the UNCED Agenda 21, it was concluded that The International Drinking Water Supply and Sanitation Decade (1981-1990) resulted in a proportional increase in coverage, but made only a marginal impact in reducing the total number of unserved people. The main reasons were identified as population growth, lack of political support, limited mobilization of resources for infrastructure projects particularly in urban areas, poor operation and maintenance of installed systems, and, in a number of cases, inadequate attention to small-scale, low-cost approaches where these would have been more appropriate than large infrastructure projects.

OECD/DAC 1994

At this "Development Assistance Committee Meeting on Water Resources Management"[1] the consensus reached in Dublin 1992, Rio de Janeiro 1992 and Noordwijk 1994 was confirmed; Water Resource Management (WRM) to be the operative concept.

Donors were asked to prepare themselves for long-term committments, systematically check their development assistance programmes for the application of the Dublin Principles, and to create a "learning culture" in which successes and failures in WRM are shared within and between donor agencies and with recipient countries. The need for environmental economists and gender studies was reconfirmed.

OECD/DAC 1995

The meeting added a new element to the requirements for water resources management, viz. the need for member states to dedicate themselves to conflict prevention and resolution, adding the importance of development assistance in the preventive aspects of this work. The need to concentrate efforts on the areas of human rights and democracy was particularly stressed, as was measures to increase prospects of food security.

The International Convention to Combat Desertification, INCD

Adopted in June 1994, the International Convention to Combat Desertification, INCD, is now in the process of being ratified. Of particular importance from a SADC regional water resource management perspective, are the Regional Implemenation Annex for Africa, and an additional resolution for Urgent Action for Africa, included in the convention. Ensuring that OECD and African countries will work together to implement the resolution for urgent action, is listed as a particularly critical step in the further process.

1. Members of the Development Assistance Committee are the 21 largest industrial countries plus the Commission of the EC, with the IMF, UNDP and the World Bank as permanent observers

Appendix XI:

The Helsinki Rules

The Helsinki rules, derived from a 1966 International Law Association study, at its simplest say that each basin-state has the right to a reasonable and equitable share of the water in the basin, and that maximum benefit should be achieved with minimum disadvatage to other states. The rules further stipulate that one state cannot be prevented from using water just so another can have it available in the future; and that existing reasonable uses can continue unless it is shown that the use must be modified to accomodate a competing, incompatible use.

(The following comments on interpretations and problems of the rules are excerpted and condensed from a manuscript made available to Sida by Peter Heyns, Department of Water Affairs, Namibia:)

An important principle of the Helsinki Rules is that each basin state is entitled, within its own territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.

It should be noted that the Helsinki Rules are exactly what it says: they are rules and not fixed principles which are a law unto all. It only forms guidelines as a basis for discussion.

The principle of equitable sharing does not mean that each state must necessarily receive an equal share in the use of the water, but the economic and social needs of each basin state must be taken into consideration and the maximum benefit, with minimum disadvantage, should be provided to each basin state.

A beneficial use need not be the most productive use to which the water may be put, nor need it to utilize the most efficient methods known in order to avoid waste and ensure maximum utilization. However, in its application the present rules are not designed to foster waste, but to hold each state to a duty of efficiency that is commensurate with its financial resources.

> Different, and potentially conflict-creating, principles compete for the interpretation of the Helsinki rules:
>
> The principle of equitable apportionment or equitable utilization may not ensure the most beneficial development of the basins, while its parallel, independent development by each of the basin state may, in addition to causing conflicts among them, prove economically wasteful. Hence the so called "theory of community of interests" in the shared waters considers that the water system as a hydrological unit ought to be managed as an integrated whole
>
> Equitable utilization (or apportionment) means that each basin state has a right, under international law, to utilize the waters of the basin It is entitled to a reasonable and equitable share in the beneficial uses of the waters. Equitable utilization means that consideration be given to the legitimate rights of all interested states.
>
> Equitable utilization is a general principle of international water law which states that while each state enjoys sovereign control within its own boundaries where international drainage basins are concerned, it may not exercise such control over the proportions of such basins, located within its territory without taking into account of effects upon other basin states This is an appropriate principle for all cases which call for the balancing of needs and benefits of one state against harm done to the other.

Appendix XII:

Existing Agreements

There are approximately 22 major agrements between the eleven different SADC states concerning joint cooperation in various fields, including water. These agreements can be divided into four major groups: General agreements where water may come in as a part; water matters of common interest but not specific river basings; river basins; and specific projects or schemes on an international river. In some areas the institutions created does not function well, and in other cases no agreements for joint cooperation on shared watercourse systems has been established at all.

Table 1: SADC Agreements in existence pertaining to shared water resources

Name	Year	Countries	Content	Assessment
ANJCC Angolan-Namibian Joint Commission of Cooperation	1990	Angola Namibia	Umbrella institution, large number of issues, including water	Functional
PJTC Permanent Joint Technical Commission	1990	Angola Namibia	Cunene river Basin. Major priority is the Epupa Dam hydroelectric power scheme	
JCA Joint Operating Authority	1990	Angola Namibia	Operation of the regulating dam at Gove and the Ruacana hydropower infrastructure	Functional
OKACOM Permanent Okavango River Basin Water Commission	1994	Angola Botswana Namibia		(New)
LBPTC Limpopo Basin Permanent Technical Committee	1986	Botswana Mozambique South Africa Zimbabwe		Not functioning well, needs revival
JPTC Joint Permanent Techical Committee	1989	Botswana South Africa	Limpopo River and its tributaries in Botswana and South Africa, up to the confluence of the Shashe River and the Limpopo	
JPWC Joint Permanent Water Commission	1990	Botswana Namibia	Development and utilization of water resources of common interest, particularly Okavango River and the Kwando-Linyanti-Chobe river system	Functional
JPTC Joint Permanent Technical Commission	1986	Lesotho South Africa	Advisory and monitoring capacity in construction of Lesotho Highlands Water Project (LHWP)	
LHDA Lesotho Highlands Development Authority	1986	Lesotho	Parastatal subordinated to JPTC, responsible for LHWP in Lesotho	Functioning well

(Source: Manuscript draft to SIDA by P. Heyns, Department of Water Affairs, Namibia)

Table 1: SADC Agreements in existence pertaining to shared water resources

Name	Year	Countries	Content	Assessment
TCTA Trans-Caledon Tunnel Authority	1986	South Africa	Parastatal subordinated to JPTC; responsible for LHWP in South Africa	Functioning well
JCC Joint Commission of Cooperation	1992	Malawi Tanzania	Umbrella institution, does not mention water specifically	Not functioning well
PCC Permanent Commission of Cooperation	1982	Malawi Zambia	Umbrella institution; does not mention water specifically.	Not functioning well
PJCC Permanent Joint Commission of Cooperation	1984	Malawi Mozambique	Umbrella institution, does not mention water specifically	Not functioning well
JPTWC Joint Permanent Technical Water Commission	1991	Mozambique Swaziland	Technical adviser on water matters of common interest	Not functioning well
JPTC Tripartite Permanent Technical Committee	1983	Mozambique South Africa Swaziland	Joint water schemes on Limpopo, Incomati and Maputo.	Has not funtioned well in the past
Permanent Water Commission*	1992	Namibia South Africa	Orange river basin	Functions satisfactorily
JIA Joint Irrigation Authority	1992	Namibia South Africa	Established by the Treaty on the Vioolsdrift and Noordoewer Joint Irrigation Scheme (VNJIS) on both sides of the Orange River	Functions well
KOBWA Komati basin water authority	1991	South Africa Swaziland	Construction of the Komati River Basin Development Project	
ZRA* Zambezi River Authority Council	1987	Zambia Zimbabwe	Hydroelectric installations at Lake Kariba Planning of the hydropower facilities at Batoka Gorge	
SARCCUS Southern African Regional Commission for the Conservation and Utilization of the Soil	1948	Angola Botswana Lesotho Malawi Mozambique Namibia South Africa Swaziland	Ten standing committees, one of which is for Water Resources Management; deals with a wide spectrum of water related matters	Water committee very active
SADC Southern African Development Community	1992		Water matters falls under the Food, Agriculture and Natural Resources Sector, based in Harare, Zimbabwe	

* Two other draft proposals concerning the Zambezi River Basin and the Orange River Basin are under discussion between the respective basin states.

(Source: Manuscript draft to SIDA by P Heyns, Department of Water Affairs, Namibia)

Appendix XIII:

SADC RWRM Programmes

(Excerpted and condensed from an article by Egil Skofteland, Water Resources Advisor, SADC ELMS Coordination Unit, in *Splash*, Vol. 10, No. 1, 1994)

One of the major issues identified is the need to coordinate efforts within a rapidly increasing number of regional water resource management (RWRM) programmes. The following list outlines the most important of those programmes.

Zambezi River System Action Plan – ZACPLAN

(SADC Project AAA.7.3). Adopted by SADC in 1987, it consisted of 19 projects (ZACPROs), with 8 projects grouped as "category 1" and 11 project ideas as "category 2".

The SADC Environment and Land Management Sector (ELMS) was entrusted with the responsibility for executing and coordinating the programme, assisted by a committee of focal points from all SADC member States (later to become the ELMS Water Resources Sub-Committee, responsible for advising ELMS on all regional water resources issues). To date, funding has been secured for the following projects:

ZACPRO 1: inventory of existin and potential development, evaluation of the envrionmental impact of major projects, and initiation of a basin-widde exchange of information.

ZACPRO 2: development of regional legislation necessary for the management of the Zambezi and minimum national legislation required by riparian States for enforcement.

ZACPRO 5: development of a basin-wide unified monitoring system related to water quality and quantity.

ZACPRO 6 (phase 1): development of an integrated water resources management plan for the Zambezi River Basin.

In general, progress admittedly has been slow. ZACPROs 1 and 5 (inventory, information exchange, monitoring) have only partly achieved their objectives. However, ZACPRO 2 (regional and national legislation) has made great strides,with its proposed "Protocol on Shared Watercourse Systems in the SADC region", expected to be officially adopted in August 1995. Covering all international river basins in the region, the Protocol constitutes a very important step towards committing member States to regional cooperation in water resources management.

With the launching of ZACPRO 6 (integrated WRM) in 1993 (which strengthens ELMS with two water resources specialists and advanced computer equipment), ZACPLAN is regaining momentum. Completion of Phase 1 is scheduled for April, 1995.

Regional Hydrological Assessment Project – SSAHAP

(SADC Project AAA.7.2). A regional report, published in December 1990. A main conclusion is that the performance of hydrological data collection agen-

cies is more often constrained by organisational and administrativeproblems than by technical difficulties. Security problems, restricted budgets, shortage of skilled manpower, and old, decrepit equipment are common problems in the region. As a consequence, the hydrological network and hydrological data collection have deteriorated considerably, and in some countreis are nearly non-existent.

The SSAHAP report concluded that there is little the countries can do to mitigate such problems, beyond continuing to seek external assistance.

Hydrological Cycle Observing System for SADC – HYCOS-SADC

(SADC Project AAA.7.9). The most promising follow-up of the SSAHAP.

Regional Hydroelectric Programme

(SADC Project AAA.3.4). Phase 1 completed in 1991. The final report agrees in principle that a future reginal hydrological centre would most likely be under the jurisdiction of ELMS. Phase 2 will develop forecasting/operation models for major hydropower developments in the Zambezi Basin upstream of Cahora Bassa (one alternative being Batoka Gorge).

Water Resources Planning for SADC

(SADC Project AAA.7.10). Funding has yet to be secured. Regional envrionmentally sound strategies. Promote awareness of issues relating to water development and amangement among decision-makers in the region.

SARP Region Water Sector Assessment

Funded and recently initiated by USAID, covers the SADC countries, South Africa and Zaire. Objectives: to determine what organisational strucutre exists within the Southern African region and how water resources can be effectively coordinated on a regional basis as opposed to a country basis, and to prioritize specific projects worthy of financial support.

Southern Africa FRIEND Project

Southern Africa's Flow Regimes from International Experimental and Network Data (FRIEND) project. Organized within the framework of UNESCO's International Hydrological Programme. Launched in 1993, coordinated by the University of Dar es Salaam, Tanzania. Includes all SADC countries (except Angola) and South Africa. Resources from UNESCO, Ireland, ODA (UK), and South Africa.

Rationale for Water Sector Capacity Assistance

A project idea presented to ELMS in 1993 by the Water Resources Branch of UNDESD. Objective: to facilitate the development and execution of an agreed strategy for capacity building in the water sector at the national and regional levels.

Appendix XIV:

Abbreviations

AIWP	African Inland Waters Programme (subprogramme of EMINWA)
CITEC	Centre for International Technical and Educational Cooperation
CNRET	Centre for Natural Resources, Energy and Transport (defunct UN body)
CSD	Commission for Sustainable Development (follow-up of UNCED)
DANIDA	Danish International Development Agency
DWA	Department of Water Affairs
EC	European Community
EIA	Environmental Impact Assessment
ELMS	Environment and Land Management Sector (of SADC, Maseru, Lesotho)
EMINWA	Environmentally Sound Management of Inland Waters (UN)
FANR	Food, Agriculture and Natural Resources
FINNIDA	Finnish International Development Agency
GDP	Gross Domestic Product
HYCOS-SADC	Hydrological Cycle Observing System for SADC
IMF	International Monetary Fund
IUCN	World Conservation Union (International Union for the Conservation of Nature)
IUCN-ROSA	IUCN Regional Office for Southern Africa (Harare, Zimbabwe)
IWRM	Integrated Water Resource Management
JPTC	Joint Permanent Technical Commission
LHWP	Lesotho Highlands Water Project
MZWP	Matabeleland Zambezi Water Project
NCS	National Conservations Strategy
NEAP	National Environmental Action Plan
NGO	Non-governmental Organization
NORAD	Norwegian Agency for International Development
OECD	Organization for Economic Cooperation and Development
OECD/DAC	The OECD Development Assistance Committee
PJTC	Permanent Joint Technical Commission
PRWBC	Permanent River Basin Water Commission
PTC	Production Through Conservation
PWV	Pretoria-Witwatersrand-Vereeniging (industrial centre in Transvaal, South Africa)
RWRM	Regional Water Resource Management
SADC	Southern African Development Community (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe)
SADCC	Southern African Development Coordination Conference (now SADC)
SADC ELMS	SADC Environment and Land Management Sector (Maseru, Lesotho)
SAP	Structural Adjustment Programme (of the IMF)
SARDC	Southern African Research & Documentation Centre (Harare, Zimbabwe)
SEI	Stockholm Environment Institute
SSAHAP	Sub-Saharan Africa Hydrological Assessment Project
SIDA	Swedish International Develoment Cooperation Agency
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WRM	Water Resource Management
WWF	World Wildlife Fund
ZACPLAN	Zambezi River System Action Plan
ZACPRO	Project within ZACPLAN
ZAMCOM	Zambezi River Basin Water Commission
ZRA	Zambezi River Authority (Lusaka, Zambia)

Appendix XV:

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