world water vision

GREEN CROSS

Water for Peace
in the Middle East and Southern Africa

GREEN CROSS INTERNATIONAL
March 2000

Green Cross International, 2000.

This Collection was compiled and distributed in conjunction with two high-level Panel Debates on Water for Peace in the Middle East and Water for Peace in Southern Africa organised by Green Cross International at the 2nd World Water Forum, The Hague, 20 March 2000.

Cover and layout design by Estelle Piguet, Lausanne (Switzerland)
Printed by Ruckstuhl SA, Renens (Switzerland)

Green Cross International would like to thank all contributors to this Collection for responding at very short notice to our call for papers.

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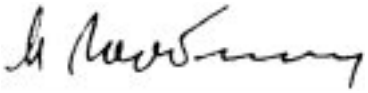
Forword

Water is truly the lifeblood of all human and natural systems. Although certain parts of the world have abundant water resources, supplies of drinking water are inadequate in many regions. By one measure, some 20 countries were experiencing severe water shortages in 1990. Based on population projections alone, some 33 countries are expected to have chronic water shortages by 2025. Moreover, such projections do not take into account the possibility that climate change could further exacerbate water shortages in many parts of the world. Current and projected water shortages are nowhere so acute as in the arid countries of the Middle East and Southern Africa, where water is both scarce and unevenly distributed.

Over a century ago, the American author and humorist Mark Twain observed that "whiskey is for drinking, water is for fighting over" as he reflected on both the scarcity of water and the importance given to water and water rights in the semi-arid American West. Indeed, battles have been fought over water allocation in many other countries. The potential for a conflict over water is perhaps at its most serious in the Middle East where water supplies are extremely limited, political tensions traditionally run high, and water is just one of the issues that may divide countries and make cooperation difficult. By contrast the nations of Southern Africa, many of whom are just emerging from decades of turmoil and still suffer from crippling poverty, have committed themselves to seizing the opportunities created by their many shared watercourses to cooperate as a region.

The word 'conflict' need not automatic need not automatically be associated with water, not even in the Middle East. Cooperation to solve water problems is possible - indeed, joint action on water has the potential to lead to even greater cooperation in the wider political arena. Peaceful resolution of their water problems may help key Middle Eastern actors slowly build the trust needed to settle other issues that divide them, and cooperation among the Southern African states regarding water can help strengthen regional ties and economies to play a major role in fostering security and development. All would agree that mutually beneficial, 'win-win' solutions are preferable to conflict or stalemate. Conversely, arrangements that are not perceived to fairly allocate one of life's most important necessities can only perpetuate conflict.

Water, like religion and ideology, has the power to move thousands of people.



Mikhail Gorbachev
President
Green Cross International
and Honorary Member of the World Commission on Water for the 21st Century

Introduction

All of life depends on water. It is essential to every living being on earth. Because it is essential, animals can smell water from miles away; the roots of plants will seek water wherever it might be found; while our human societies have been recurrently inventive in gathering, distributing and using water to keep us alive.

Because water is as old as life itself, and because recent human history has seen great technological achievements, we would like to believe that we will be able to meet the challenges of water by identifying clear problems with clear technological solutions. This approach has been enormously successful for much of the past century. For the next century, however, it will not be enough because never before have so many people needed so much from the natural world in such a short period of time. With every day that passes, we are stepping further and further into the unknown.

When European societies invented the industrial revolution, they were escaping an earlier ecological trap as the agricultural systems of the day could no longer support the growth of their populations. Now we are caught in a new ecological trap. We would like to escape this one as well, but this time we need to find a way to live resiliently and symbiotically with each other and with the natural world that has supported us for so long. This will certainly require new technologies, some of which are already invented. However, as was true when the industrial revolution took place, we will also need to invent new institutions, new agreements and new skills that can be widely and quickly shared. In short, we are not faced with a clear problem that has a clear technical solution. We are instead faced with the transformation of our societies and our relationships in all directions – with each other, with the cultures around us, and with every living thing in the world.

Green Cross International works to prevent conflicts in environmentally-stressed regions, and to promote harmonious relations between humankind and the natural environment. Tensions caused by inadequate freshwater supplies can arise at many different levels, and involve an intricate web of relationships between water, people, and nature. The mission of Green Cross is to bring people together from across the water spectrum and representing different needs and priorities, in order that they might shape solutions together. Although armed interstate conflicts over water are thankfully extremely rare, it must be remembered that these are not the principal types of conflicts facing societies in regions of increasing water stress. Internal conflicts between different ethnic groups, regions, users and even small communities can and do arise over water. Both types of dispute are relevant to the emotive question of national sovereignty, which has both inter-state and domestic manifestations. If we continue with our current behaviour, at least 60 countries will face severe water stress within the next 25 years; unless a comprehensive set of principles on how to share this precious resource is developed now, certain states may be forced to resort to desperate measures to secure enough water for their survival. Green Cross' contribution to the World Water Vision for the 21st Century is therefore an innovative report on National Sovereignty and International Watercourses, inspired to a large degree by discussions with the four former world leaders who make up the "Sovereignty Panel": Mikhail Gorbachev, Sir. Ketumile Masire, Fidel Ramos and Ingvar Carlsson.

We are not talking about "water wars", but about lingering conflicts between peoples which not only run the risk of resulting in small-scale violent confrontations, but also represent an additional burden on societies in some of the world's poorest nations. There can be

no development, whether social, economic or technical, without adequate water supplies; there can be no lasting stability in regions where large quantities of water are shared between states if this fundamental element in the life and growth of the nation is not sustainably and fairly managed. Regional cooperation is imperative. Unfortunately, it is also something that many of us are not very good at. We have to learn how to become good water neighbours. In the case of transboundary watercourses, the basin represents the logical wider unit of operation, and institutions need to be strengthened and created to reflect this. Water management should become a key component in the process towards more representative and just societies, and in such a way replace divisions imposed by national boundaries with dialogue between and among people all across a basin.

An excellent start would be the adoption of good water laws and priorities at the national level, but states who face a water-troubled future need also to look to their neighbours and develop agreements on protecting, fairly apportioning and jointly developing common watercourses. A spirit of solidarity is required between all states in a basin that goes beyond calculations of water allocation quotas and recognises that every action involving water has consequences for the entire basin and can contribute to problems of scarcity, flooding and pollution. This should be seen as creating a system of *effective interdependence*, based on cooperation, sharing and a pooling rather than a restriction of each nations' sovereignty. Integrated basin-wide cooperation entails opportunities for all and provides the best chance for the protection of international watercourses for the benefit of future generations. To achieve effective cooperation, all activities which involve and effect water must be considered, including land-use, and all concerned parties must be represented in the process. This is therefore clearly a matter which involves considerations of social security, human rights, political and public will, minorities, gender, culture and the environment, and calls for a change in the way we value and treat water.

Mankind has never done anything like this before on this scale. It is exciting and frightening in equal measure. Fortunately, as a species our capacity to learn is tremendous. We also have an enormous bank of social experience which has created a great variety of ways of working together in nearly every ecosystem in the world. We have a history of meeting great challenges using imagination and our irrepressible capacity to adapt. It is inevitable that in the process of transformation we will face crises and conflicts. It is also true that human resourcefulness has repeatedly learned to meet challenges that were previously unknown.

Green Cross has long been involved and active on the question of alleviating water problems in the Middle East. We have held a number of workshops on this subject, in Paris, in Geneva and in Amman, and recently received the support of the leaders of Jordan, Israel and the Palestine Authority for the creation of a committee of influential individuals, private sector leaders and country representatives to investigate practical possibilities for water sharing and regional water management. In a region where water is so intimately linked to other highly sensitive and potentially divisive issues, the mediation and information-sharing capabilities of such a group could greatly facilitate the arduous process of resolving critical water issues by clearing the way to viable, practical solutions. Decision-makers in the Middle East are perfectly aware that there will be no lasting peace in the region unless the water question can be solved.

Southern Africa is a water-scarce region, 70% of whose surface water is shared by two or more states. It has been widely recognised that these states must develop ways to share their water before they find the need to fight over it, and this has prompted the region to become a leader in regional water management. The Southern African Development Com-

munity has encouraged its 14 member states to benefit from the opportunity offered by the natural partnerships created by shared watercourses to foster greater regional cooperation, and with its 1995 Protocol on Shared Watercourse Systems has provided a framework to encourage and direct the joint management of the region's precious water resources. Many river basin commissions have already been established to manage water between states but more still needs to be done, particularly in terms of concrete action and ensuring respect for the needs and rights of downstream riparians. The SADC Protocol is currently being revised and strengthened and will hopefully encourage more regional solidarity to initiate the redistribution of hydropolitical power between states, sectors and communities and, therefore, ensure more equitable distribution of water.

The goal of Green Cross International's ongoing efforts to promote integrated basin-wide management and the resolution of water conflicts is to arrive at regional solutions which can be applied to improve the future situation of all people regarding their water. We believe that such an initiative could secure great benefits, not least the practical gains which could follow the elaboration of concrete, technical solutions to relieving water-stress and the encouragement of private investment in water projects. To ensure that we journey in the right direction, we must allow our knowledge, experience and institutions to catch up with the overwhelming progress of science and technology, and learn how best to deal with the transboundary watercourses upon which so much and so many depend.

This collection of papers is part of Green Cross's contribution to the process of learning – our most important 'technology' as we face the future. The encouragement of dialogue and transparency between states and stakeholders is the essential first step towards resolving contentious issues in international basins and the realisation of a Vision of the world in which there is: *Water for Everyone; Water for the Future; Water for Peace* and *Peace for Water.*

Green Cross International

Water for Peace in the Middle East

A Vital Paradigm Shift to Maintain Habitability in the Middle East: the Integrated Management of International Watercourses

*By Dr. Bertrand Charrier & Fiona Curtin **

Water is one of the most critical issues which the people of the Jordan River Valley region will need to resolve in the very near future. High population growth and economic development will inevitably increase demand for the water of an already over-stretched ecosystem. Strictly nationally driven solutions to solve problems of water demand and supply, taken unilaterally by each of the region's countries, will inevitably result in continuing and severe tensions between them, as the water itself is taken from shared rivers and aquifers. Only the integrated, ecosystemic management of the network of international watercourses, based on a regional cooperation approach and with the broad endorsement of the people and the governments of the region, can bring about a peaceful and sustainable solution to the problem of water scarcity. The region should be defined in a broad perspective, including Jordan, Israel, the Palestinian Authority Areas, Lebanon and Syria.

When it comes to water in the Middle East, sharing is the basis of survival and regional cooperation is the key to stability, growth and peace. As so much of the already scarce water available is of a transboundary nature, no one nation will be able to solve her water problems alone but will require regional solidarity. Feelings of deprivation are an unsustainable basis for any agreement and it is therefore reassuring that key decision-makers from across the region appear committed to discussing ways to amicably solve lingering water disputes. Any settlements which neglect the needs and entitlements of people to adequate water supplies, and propagate inequalities in distribution, will inevitably be unsustainable. Basin-wide action is therefore imperative and will install greater security and trust amongst the different inhabitants of the region. The delicate common ecosystems demand the greatest possible degree of cooperation between the different Peoples in the Middle East; the challenge of achieving effective regional water management must be faced.

It is widely agreed that the water issue has the potential to be the origin of either conflict or cooperation; one way to encourage the latter is through the identification of possible national projects which can have synergetic effects for regional water management and conservation. The fundamental question is how to reconcile all the parties' water priorities into a regional vision. Transparency, confidence building and public awareness are all essential to the development and achievement of any regional solution. To this end it is vital that any vision be formulated through the participation and ideas of as representative a group as possible from all parts of the region and the different stakeholder groups.

Water is a vital element in the continued economic development of the region and the improved living conditions of its people, but the current water availability will not be able to accommodate any level of growth unless fundamental changes are made.

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1. Water needs in the Jordan River Basin

United Nations projections estimate that the population of the Jordan Valley could reach 34 million by 2050, compared with 14.4 million today. In the wider region, including Lebanon and Syria, the population may reach 79 million by 2050, more than double the 33 million in 1998.

The finite amount of renewable freshwater available throughout the entire 'Jordan Valley Area' from rivers and renewable aquifers is only approximately 2,700 million cubic meters (1,400 groundwater and 1,300 surface water) per year at average sustainable yields. Data from 1994 shows that water consumption is already very low in the Jordan Valley Area: on average, Jordanians use 221 m^3/person/year, Palestinians use 104, and Israelis use 359. Thus, the average for 'Jordan Valley Area' is only 262m^3/person/year. These figures should be compared to the Minimum Water Requirement of 125M^3/cap/yr that is needed to meet all of the basic hygienic, social and economic requirements for domestic/ urban/commercial/industrial uses, excluding agriculture, for a reasonably high standard of urban living in arid areas.

In the near future, the naturally available water will be just sufficient to meet the domestic and industrial needs of the population, with only a very limited quantity left over for agriculture. There will also be very little available for the natural survival of the ecosystem. In regions where economic development based on industry and services is not sufficient, priority will always be given to fulfilling basic domestic needs and food production. The loser in this equation will be Nature and the sustainability of the regional ecosystem, threatening the habitability of the whole region.

Figures clearly show that without a concrete and large-scale regional strategy, current water shortage problems will reach crisis levels in the next 10-20 years, even without taking into account the severe droughts which are occurring more and more frequently. Even now, according to the 1998 GTZ study, there is a deficit of about 170 Mm^3. Current water-extraction is also causing the unsustainable exploitation of groundwater resources. Growing demand is leading to a shrinking amount of water available per capita under existing systems of use, distribution and water supply. Distribution is a major issue, as even with equitable supply current disparities in distribution systems will ensure that many remain poorly serviced. This presents many opportunities for the private sector to have a role in the improvement of the water infrastructure in many areas.

1.1. Regional Cooperation

The idea of regional cooperation is rendered meaningless when in one part of a shared basin precious groundwater reserves are being over-exploited to grow water-intensive export crops, while elsewhere people do not have adequate, clean and reliable access to drinking water. What is needed is a regional commitment to sustainable and equitable water management. With proof of such a commitment will come security; and with security will come investment in the long-term projects required to improve the water situation for the people throughout the region.

1.2. Participation Process

Water management is so intimately related to land-use, education and poverty-alleviation that decisions should as much as possible be in the hands of the people directly concerned. Public awareness and stakeholder participation regarding water decision-making at every level is so crucial that it is considered by many to be an emerging human right and an essential part

of the democratic process. Private sector involvement and commitment to more efficient water management can be the key to achieving viable solutions to scarcity and water quality problems.

1.3. Sovereignty

The threat of a regional water crisis caused by the continued and widespread over-exploitation and pollution of water requires that a consensus be reached regarding the delicate balance between national sovereignty and the management of the network of shared underground and surface watercourses. The allocation of transboundary water resources necessitates the consideration of the limits of state sovereignty. National sovereignty involves more than the recognition of land borders, or allocations of authority, it involves also the domestic relations between the state and the people. Rigid interpretations of sovereignty over water contradict the very nature of water itself. Water flows across, and underneath, international boundaries, sustains entire ecosystems, is a fundamental component of many cultures and religions, and often dictates life-style choices. The question of who has the right, or entitlement, to what portion of water and for what purpose can be asked either at the level of riparian states or between different groups of people sharing a pump or a stream.

Ideally, national sovereignty should be a representative union between state and popular sovereignty, and thus is clearly a matter which goes well beyond international law to considerations of social security, human rights, political and public will, minorities, gender, culture and the environment, and calls for a change in the way water is valued and treated.

1.4. The Power to Control Watercourses

Water is a critical resource the possession of which confers power and summons many distinct images and significances for different people. Although water has been a political and military issue since antiquity, it is only in the 20th Century that we have developed the technical means to dramatically alter, store and divert the natural flow of rivers and tap the essential sources of deep underground water. This power has rested largely with state authorities, and the harnessing of water has become a vital component in the economic development of states. Now that states have the ability to abstract the entire volume of a transboundary river or aquifer, the questions remains as to what rights they have to the waters that flow through their territory, and what obligations they have to their fellow riparians, and to the people and environment of the entire basin in question.

1.5. Ratification of the UN Convention on the Non-Navigational Uses of International Watercourses

A comprehensive set of principles on how to share this precious resource should be developed, accepted and implemented. An excellent start would be the adoption of good water laws and priorities at the national level, but states who face a potentially thirsty future need also to look to their neighbours and develop agreements on protecting and fairly apportioning common watercourses and jointly developing ways to use their water more efficiently in order to pre-empt the crisis. A spirit of solidarity is required between up-stream and down-stream states, as well as the development of cross-border systems of compensation, trade-offs and information exchange, whether to deal with problems of scarcity, flooding or pollution. The ratification of the 1997 UN Convention on the Non-Navigational Uses of International Watercourses would be a gesture of good will on the part of states, and could serve to remove the misplaced feelings of suspicion and insecurity which hinder the establishment of regional,

basin level agreements. This should be seen as creating a system of effective interdependence, based on cooperation, sharing and a pooling rather than a restriction of each nation's sovereignty. Basin-wide cooperation entails opportunities for all, including the business sector, and provides the best chance for the protection of international watercourses for the benefit of future generations.

2. Integrated River Basin management

Green Cross International supports a vision of regional cooperation based on the concept of the unity of the river basin. The interdependencies in the hydraulic cycle dictate that any unilateral action to preserve shared water will be greatly limited in its effectiveness if not coordinated with the actions of fellow basin states. It seems so obvious, but the fact is that this principle and concept is not yet universally accepted. The water problem in the Jordan Valley and the whole Middle East has reached an extent beyond the scope of any individual state or people to solve. Basin-wide action is therefore imperative and will install greater security and trust amongst the different inhabitants of the region. National sovereignty should be used as a tool rather than a barrier in the integrated management of shared waters as the common ecosystem demands the greatest possible degree of cooperation between the different Peoples.

In the interest of everyone in the region, more efforts must be made towards greater cooperation to improve the daily lives of people during this transition period. Water is key to the economic development of the region and the advancement of its people; the current water availability will not be able to accommodate any level of growth under the existing allocation practices. Shared water creates a natural link which should be exploited to enhance all areas of cooperation. Effective integrated watercourses management requires a recognised institutional body with the adapted financial means to act. In the future, a Regional River Basin Authority should be created in the framework of an international Convention on the Protection and Development of Jordan Valley Watercourses.

3. New Water Paradigm

In this region the link between water and people is primarily food. Therefore it is here that the key to Water for Peace in the Middle East lies. There will not be not enough water here to feed the population, and the continued demographic and economic expansion now requires that the region adopts a new water paradigm. This realisation is not new, but it is being accepted only very reluctantly.

3.1. Value of Water

What is in question is the value of water, and this is not an easy one to answer. A person's supply of essential drinking and domestic water is so valuable that many argue that it cannot and should not be priced. The water used to irrigate crops is only as valuable as the amount it would cost to import those crops from elsewhere, or alternatively the amount it would cost to desalinate the water needed to replace it; in neither of these cases is this amount high enough to warrant any level of dispute. Naturally occurring water must be used, as an absolute and regionally respected priority, for the domestic needs of all people and the preservation of the environment before it is allocated to any other purposes. This is true of any region, but is essential in fragile, arid environments like the Middle East.

The environment must be respected as a water user. Water scarcity has led to serious over-pumping of aquifers in the region beyond their recharge rates. Many of these aquifers

are shared, and their permanent depletion could develop into a cause of conflict if not addressed. There are also widespread problems of land erosion, salt water intrusion in coastal areas and increased pressures from urbanisation. The fragile natural environment must be considered in any proposal as when properly managed it is both a water user and a water generator.

3.2. Full Cost Pricing of Water

Pricing water at what it costs to provide can increase access by those who need it, and prevent the poorest members of a society being forced to pay higher prices for water from private vendors. Pricing structures can also be designed to protect the interests of those who cannot afford to pay the full price. Pricing water encourages conservation and reuse and - in combination with the development of water markets - can facilitate the reallocation of water to the highest value use. This greater efficiency not only makes economic sense, it also, by reducing the total amount of resources used for human consumption, makes environmental sense.

Pricing water, establishing water markets and managing water resources for water supply, sanitation, irrigation, drainage and other human uses as "service businesses" will increase the involvement of the private sector. This has the potential to increase by orders of magnitude the funds available for investment and for research and development on water resources.

4. Water and Agriculture

First of all it is necessary to address the question of irrigated agriculture in the entire region as this is overwhelmingly the largest water user.

4.1. Importance of Agriculture in the economy

Certain sectors of the economies of the Palestinian Authority Areas, Israel and Jordan have already demonstrated that water resource-deficient regions can generate livelihoods and initiate development beyond that which stems from traditional rural activities. In Israel, agriculture accounts for only 3% of the GDP, yet water is still allocated in abundance for irrigation. Water is more than a simple liquid; in some circumstances it is also an economic good and as such it can be traded and substituted. Water can be made available to arid regions through the importation of agricultural products, and in particular food, far cheaper and with less hazardous consequences to the environment than attempts to produce the population's food requirements locally. This also frees large amounts of water for domestic, environmental and, once these needs are met, industrial and developmental activities. Water can be used far more efficiently, in terms of both income generation and employment opportunities, in business, services, tourism or manufacturing, thus increasing the nation's GDP and therefore the funds which they will need to purchase food via international markets. With greater economic productivity, a state can achieve total self-reliance and food security, which is more reliable and sustainable in an arid zone than attempts to achieve food self-sufficiency. All such major adjustments in a society must be accompanied by awareness raising and education programmes; no change will be sustainable if it out-runs a community's capacity to adapt to new circumstances.

4.2. Toward Regional Food Security

Urgent solutions are required, and any solution will necessarily involve a variety of measures as well as a drastic reappraisal of current agricultural practices. Many states in arid regions have already "run-out" of water in terms of being anywhere close to the ability to

claim self-sufficiency in food production. Yet the ideal of self-sufficiency has so long been connected with state-security and independence that authorities are loath to admit this, thinking it would be "political suicide" and weaken their position in relation to other states. This is a paradigm which should be encouraged to shift if the political, social and environmental consequences of water scarcity are to be averted. The alternative, and preferable policy choice is that of food security. This option was long ago adopted by states such as Japan, Singapore and Malta, resulting in massive increases in the development and wealth of the countries as there are much "higher returns" to water in service and industrial sectors than in agriculture. In the Jordan Valley, the regional food security should be actively sought.

4.3. Virtual Water

The water embedded in food traded on international markets is know as "virtual water" (Allan, 1995). The virtual water paradigm has been presented as a solution to the problem of balancing economic and population growth, ecological sustainability and the provision of an acceptable standard of living for all people. Importing virtual water is a way of achieving an equilibrium and therefore reconciling the sustainable development debate in the Middle East without curbing economic growth in the region. Food security and adequate supplies of water for domestic, industrial and certain agricultural needs can coexist under this new paradigm. Virtual water manages to reallocate the spatially unequal distribution of water resources by harnessing global soil water, mostly from temperate zones, for the benefit of all regions. There is almost no naturally occurring soil water in this part of the Middle East, which makes the use of natural surface and underground waters for irrigation an extremely expensive practice. Expensive in the sense that agriculture is not an efficient method of transforming scarce water resources into economic gains; expensive when considering that this water is currently being taken at a rate beyond that which can be naturally replenished; and, most of all, expensive in a region where not all people have access to clean water for drinking and sanitation.

4.4. Agricultural Biotechnology

In mid and long-term, agricultural biotechnology can also help to relieving the water crisis. The Jordan Valley farmers could produce more by, for example, developing new crop varieties that are drought-tolerant, resistant to insects and weeds, resistant to a certain level of salinity, and able to capture nitrogen from the air. Biotech can also make the foods farmers produce more nutritious by increasing the Vitamin A, iron and other nutrients in the edible portion of the plant. Modern biotechnology research, together with appropriate policies, better infrastructure and traditional research methods already developed in Israel in full cooperation with fellow riparian countries can bring benefits to farmers and consumers in the whole region. Governments must invest in biotech. research to help farmers, and the public and private sectors must work as partners.

4.5. Decision Making Support Models

Water is essential to life, development and the environment, and the three must be managed together, not sequentially. Research, public education and the management of watersheds and river basins by local communities can make this possible. Each water community, as part of the water planning process, should consider how much water to allocate to the natural environment that provides them with water for life. Decision-support models are available for this, in the form of the Water Allocation and Management Planning process, and experience using them should be observed carefully for their efficacy and with a view to applying the lessons learned elsewhere. International and national legislation should require this, as it does already in Australia and South Africa and should be developed in Middle East to assist the decision-makers to make the right choice.

4.6. Package of Solutions

The shift away from attempts at food self-sufficiency to a policy of self-reliance and food security, heavily inter-linked with the progress towards greater regional security, must also be complemented by other measures. There is no miracle cure to the region's water shortage, but a package of solutions including: improved agricultural efficiency "more crops per drop", the Blue Revolution, improved water efficiency "more jobs per drop", better distribution to reduce losses, greater public awareness and participation, a commitment to water equity and rights, information sharing, and the development of new water supplies through re-use, recycling and desalination. All involve an important value and perception change, from seeing water as a commodity to be exploited, often at the expense of one's neighbours and the environment, and a source of conflict, to seeing the region's water as a shared and fragile resource to be used for the benefit of all peoples and as an avenue towards greater cooperation and trust in the region.

5. Conclusions

Green Cross is an organization which promotes value change - cultivating a more harmonious relationship between humankind and the environment - which should never be sacrificed for short-term gains. Any Peace agreement which ignores the long-term and essential concerns of these two major stakeholders, People and Nature, will be just that - a short-term gain.

What is happening in the Middle East can be perceived as a laboratory of innovations in the domain of water conflict prevention and resolution. The world will use the experience gathered here because, if today the world experiences a severe crisis in water supply and sanitation—tomorrow's crisis will most probably be in food production. Because many parts of the planet do not or will not have enough water to produce their own food locally, a combination of institutional change, water saving technology and better water resources management must increase the food productivity per unit of water everywhere. In addition, regional and international trade agreements must ensure international food security so that countries can relax their objectives of national food self-sufficiency.

Changing the situation will require one or more paradigm shifts, and among the most urgent is the need for agriculture to shift from increasing land productivity to increasing water productivity. We are standing at the eve of a Blue Revolution. Water can contribute towards a lasting peace by uniting the people in the common and mutually essential pursuit of enough water for everyone and water and food security for the future.

Program for Efficient Water Use in Middle East Agriculture

*By Professor Samuel Pohoryles**

Agriculture is the dominant water consumer in the Middle East in general and in Jordan, the Palestinian Authority and Israel in particular.
This is the reason for the emphasis given to agriculture in the general verification of factors of water readjustment in the Middle East.
If a solution of efficiency is to be formed for 70% of the water consumption - this will be a crucial contribution to the entire dilemma.

1 Philosophy and Strategy for Water Development

The children of the great ancient civilizations on the banks of the great rivers, the Nile in Egypt, and the Tigris and the Euphrates in Mesopotamia, which built large irrigation systems, are required today by history to reclaim their failed water supplies. The active human involvement in water planning and management started 4,500 years before the Common Era. It is interesting to note that there was a position for Water Commissioner in Ancient Rome, or Curator Aquarum, which was performed by the Consul himself. His challenge was water development.

The need to create policies for water management is drawn from the biological, organic, chemical, ecological, physical, energetic, nutritional and economic importance of water for humanity, beyond the fact that 70% of our planet is covered by water and that water is the most fundamental element of our ecosystem.

Agriculture is the main factor in determining water use. 69% of the earth's water consumption is devoted to irrigation, and this includes the Middle East. In order to grow food for one human being, as much as a ton of water is needed per day. These bare figures underscore the importance of efficiencies of irrigation in the world, especially for areas such as the Middle East where agricultural development is limited by the scarcity of water and growing populations are putting increasing pressure on the region's water resources. Any solution for water management must begin with agricultural readjustment based on increased efficiency in irrigation.

Of all the regions in the world our Middle East region faces the most severe water shortage. With 5% of the world's population, it has less than 1% of all renewable fresh water. Some projections even suggest that by the year 2025 domestic, municipal, and industrial uses will require most of the freshwater available in the region, leaving none for agriculture in the countries of Jordan Basin.

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Edited by Dr. Arieh Sheskin. The preparation of this document was possible thanks to the contribution of Dr. Arieh Sheskin, Itzhak Abt, Inbar Grinstein, Keren Meron and Shmuel Kantor.

This dramatic scenario calls for immediate joint action. The transition to agriculture based on higher production per cubic meter is the key to solving these limitations and enabling the countries of the region to maximize their potential without stunting the economy or the availability of water. It is the only way of averting this fate and it is a strategic objective of the highest importance for the Middle East and the world as a whole. We must work together to cut down the use of water for agriculture in order to overcome the expected shortage. If technological, institutional and organizational changes take place in water use, we will be laying the ground for increasing agricultural production in the region with less water. Meanwhile reserves of fresh water will be released from agriculture for transfer to human consumption and urban uses.

The main steps to be taken are: increasing efficiency of water use, reducing pollution, controlling ground water extraction, recycling and reusing treated waste water, securing alternative sources of water through water delivery from abroad, and affordable desalination. Through interregional cooperation, international assistance and joint ventures we can all work together to stave off a future of water crises and eliminate a cause of war in a region that already has seen far too much of it. If these steps are taken immediately, water availability for domestic and industrial use can be increased by 50% and municipal water losses, now accounting for 50% of supplied water could be halved in the next 10 years.

There is quite a lot of room for improvement and it is within reach. In order to grow one kg. of tomato, Jordan uses 118 liters of water while Israel uses less than half that amount, or 40 liters. Between 1995 and 1998, and through improved irrigation methods and water-delivery restrictions, Israel reduced water use in agriculture by more than 200 million cubic meters.

Our common ecosystem intrinsically demands the highest possible degree of cooperation among us who inhabit the area. Ever more so is the case of the Palestinian Authority, Jordan and Israel. The issue of water development for agriculture should be addressed within the framework of an integrated system, combining soil, plants and animals. It is an interdisciplinary approach that requires the participation of experts from several different fields. Another approach is to integrate the various relevant efforts in the Middle East and lead gradually to cooperation related to the development of new water resources.

A very important and unique development in Israel is the substitution between water as physical category and agricultural high-tech, compensating water through genetics, genetic engineering, improved organization, computerization, etc. High-tech enhanced agriculture allows us to increase the output per 1 cubic meter of water at a level 3-4 times higher than what is current. It is also important to note that high-tech is the future of water management.

To conclude, the strategy of water development should be based on the following steps:

1. Increasing efficiency of water use in agriculture.
2. Desalinating of brackish water for agricultural uses and transfer of drinking water for human consumption
3. Recycling
4. Seawater desalination

2 The Current Situation

2.1 Diagnosis

The water resources in the Middle East are barely adequate to satisfy even current demand. And in view of the quantity and quality of water needed to sustain economic and social development, the situation is likely to become even more critical in the years to come.

Throughout this region, the origin of water stress is not limited to scarcity but stems from three interacting crises: Demand for fresh water in the region exceeds the naturally available and renewable supply.
Some of the regions limited water is being polluted from growing volumes of human, industrial, and agricultural wastes and from salination.

The same water is desired simultaneously by different sectors in the same country not considering if it comes from local resources or flows across (or under) an international border.

Moreover, because these three crises are interdependent, any solution must deal with all three - quantity, quality, and equity - at the same time if it is to be economically efficient, ecologically sustainable, and politically acceptable.

2.2 Natural constraints

The area of Jordan, Israel and the Palestinian Authority is classified as subtropical scrubland, semi –desert, and desert. Average annual rainfall varies from less than 30 millimeters in the southern and eastern part of the region to locally as much as 1,000 mm in the northwestern part. About 90 percent of the Jordan Rift Valley receives less than 300 mm of annual precipitation, and more than 60 percent of the area west of the Rift Valley receives less than 250 mm annually. As in typical of arid and semi-arid climates there is considerable inter-annual variability in rainfall. Precipitation in wet years is almost twice that of dry years. These year-to-year variations in rainfall in the Middle East have enormous implications for water system. In contrast to other geographical regions, extreme years must be treated as normal, not abnormal, and water planning and management must focus on risk minimization, not maximum use.

Solar radiation is another factor having significant impact on water availability, in the region. Open water evaporation is high in summer, accounting for as much as 70 percent of the annual total evaporation. Because more water is potentially lost through evaporation than asses by precipitation, the area displays desert characteristics.

Total precipitation over the region is about 16.4 billion m3 per year. Only a small percentage of this water is available for human use. The high evaporation rates combined with transpiration of soil moisture by plants return most of the precipitation directly to the atmosphere before it can infiltrate below the soil zone.

A recent study published by the FAO/Netherlands Conference held in September 1999[1] refers to a very important distinction between green and blue water. Green water is the water in the root zone supplies from rainfall for all non-irrigated vegetation. The blue water is available in streams, lakes and groundwater aquifers.

The green water remains the most important water source for most forms of agricultural activity. However, the figures mentioned above point out that in the case of the Middle East this water supply source is extremely limited. In some arid parts of the area, 100 percent of the precipitation returns to the atmosphere by evaporation and transpiration. In such conditions the green water does not play any substantial role in the water availability for the plants growth and irrigation is needed.

2.3 Water Availability and Uses

The blue water plays therefore a crucial role in the water supply in the Middle East.
Following is a by-country analysis of water sources and uses, conducted by Kally[2] in 1997:

2.3.1 Israel

Israel's population of about 6 million people has only 1/3 thousandth of the worlds water resources. The cost of pumping and transportation is relatively high.
35% on Israel's waters are pumped from the Sea of Galilee, 50% from underground reservoirs on the coastal plain and the foothills and 15% from other resources, including treated marginal water.
The Israeli agriculture annual water consumption is around 1.2 billion cubic meters, limited by water cost. A certain amount of fresh water for agriculture is replaced each year with marginal water resources.

2.3.2 Jordan

Jordan's population of about 4.5 million people has the following water resources: the Yarmouk river, with an annual average of 430 million cubic meters, other rivers - mostly seasonal streams - with a potential water production of 370 million cubic meters and 560 million cubic meters underground waters of annually. Out of these about 850 million cubic meters are used annually, of which 600 million cubic meters are used for agricultural production, 100 million cubic meters of which through the Ghor canal.

2.3.3 The Palestinian Authority

Most water sources in the Palestinian Authority are underground waters, which are collected in local aquifers. In the West Bank 120 million cubic meters are consumed, mainly for irrigation. Gaza Strip has the most acute water overdraft in the region, with continuous pumping of over the available 60 million cubic meters renewable waters in the coastal aquifers.

A study of the anticipated balance of water resources in Jordan, Israel and the Palestinian Authority was published at the beginning of 1998. The survey was conducted from 1995 to 1998 with the cooperation of all concerned and was consolidated by the GTZ[3], on behalf of the German government.

Below is a summary of the findings:
Water usage in the region today is 3041 million cubic meters per annum.

Forecast of water needs in the year 2040 and the calculations on which it is based:	
Population in 1994	11.4 million people
Population in 2040	33.9 million people
Usage per person in 1994	38-100 cubic meters/person/annum
Usage per person in 2040	83-145 cubic meters/person/annum
Agricultural usage of pure water in 1994	1580 million cubic meters per annum
Agricultural usage of pure water in 2040	1064 million cubic meters per annum
Comprehensive consumption in 1994	3041 million cubic meters per annum
Anticipated usage (low estimate) in 2040	5212 million cubic meters per annum
Anticipated usage (medium estimate) in 2040	7280 million cubic meters per annum
Anticipated usage (high estimate) in 2040	8286 million cubic meters per annum
Quantity of available water in 1994	3041 million cubic meters per annum
Quantity of water expected to be available in 2040	4999 million cubic meters per annum

Quantity of water lacking per annum in 2040 will reach the 2281 million cubic meters level (based on medium estimate).

Therefore over-pumping in these areas becomes a dangerous development.
Of the total water use, irrigation accounts for 66 percent, domestic water use – 30 percent and industrial use for 4 percent.

3 Amman Water Forum Resolutions

The Water Forum Workshop that was held in Amman, Jordan, on September 16, 1999, discussed the need for extensive action concerning the acute water shortage in Jordan, Israel and the Palestinian Authority. The principle recommendations and resolutions of the Forum were:

3.1 Regional Cooperation

The water problem in the Jordan Valley and the whole Middle East has reached an extent beyond the scope of any individual state or people to solve. Basin-wide action is therefore imperative and will install greater security and trust among the different inhabitants of the region. The integrated management of water in a common ecosystem demands the greatest possible degree of cooperation between the people of the Middle East.

Water is key to the economic development of the region. The current water availability will not be able to accommodate any level of growth. Shared water creates a natural link, which should be exploited to enhance all areas of cooperation.

3.2 Challenging water shortage

Figures clearly show that without a concrete and large-scale regional strategy, current water shortage is already reaching crisis levels. Water scarcity is a global problem, but nowhere are its effects felt as acutely as in this region. Ensuring sustainable water supplies in the Middle East is considered one of the most critical problems facing the region.

3.3 Water and Agriculture

Two strategies were presented by the participants:

3.3.1 The Palestinian Authority recommendations included the development of irrigation based on utilization of marginal water, maximization of commercial returns from agriculture through crop and land selection, increasing productivity through modernization and better equipment, education of farmers in water issues and careful allocation of water.

3.3.2 The Peres Center for Peace presented a solution based on water saving itself as the new source of water, primarily through greater efficiency of use in agriculture. The Center presented too a proposal for desalination plant. It was also recommended that the fragile natural environment of the region must be considered in any proposal.

3.4 Financing and Investment

The Forum recognized that international financing is essential to any solution, as the economic situation in the region is not conducive on its own to the realization of water development programs.

4 Short term solutions

As it was presented above the Middle East faces a future of increasingly acute water scarcity. According to data published by the World Bank a country or a region will experience periodic *water stress* when *renewable supplies fall below 1,700 cubic meters per person per year* and *water scarcity* when *supplies fall below 1,000 cubic meters.*
The three core parties of the Jordan Basin region, including Israel, Jordan and the Palestinian Authority, all lie under the absolute scarcity line of 500 cubic meters of water per person/year – far behind the figures mentioned above.
In a situation of scarce water availability, the immediate priority should be given to finding and implementing solutions for short and medium terms. Most of the existing options relate to improving the efficiency of water use - that is, they involve conservation and better use of proven technologies. Although new technologies hold some promise for increasing water supplies, none currently appears to be cost-effective for large-scale application. According to this approach the new technologies will be presented here as solutions for long-term, requiring still a considerable R&D efforts.

- The regional water constraints require adopting far-reaching reforms in water use practices. Changing the patterns of water use should be focused on following four areas:
- Changing production from crops with high water requirements to crops with lower water requirements.
- Improving irrigation technologies for better water use efficiency.
- Increasing supply by reusing water (wastewater reclamation), and by developing sources of lower quality water.
- Adopting economic policy, which implies effective measures to encourage conservation, including marginal cost pricing, time-of-use pricing, and water allocation management. These changes are already applied in the region but they need to be extended much more and implemented in short and medium terms.

4.1 Restructuring agricultural production

For improving agricultural water efficiency is necessary to develop species with a greater output per water unit or of salt-tolerant crops. Citrus trees for example cannot tolerate briny water at all, while olive, fig, and date trees can. Broccoli, tomatoes, spinach, beets, and other vegetables also tolerate a certain degree of salinity. Salt tolerance can be improved by selecting seeds and crossing species, as has been done to optimize other characteristics of crops since time immemorial. Brackish water is used in Israel to irrigate certain crops, and on an experimental level, tomatoes have even been grown with saline water. However, irrigating with saline water affects the soil and must therefore be practiced very cautiously.

Developing environmentally controlled agricultural production is also a good example for water use efficiency. Greenhouses technology widely applied in Israel, offers a huge water saving but, of course, requires a large capital investments. In this case, the need for integrated approach to water problem is very clear. Water saving examined separately from the economic parameters of production value and capital outlay, in addition to marketing options, offers only a very unsatisfactory solution to the problem.

Israeli experience of producing flowers and vegetables in greenhouses shows that a relatively small water input enables to obtain high commercial value products, mostly exported. However, this development requires a strong investment infrastructure, including government subsidy and a strong marketing structure both from the organizational aspects as well from market research view. For example, one hectare of greenhouse for roses costs about 600,000-700,000 dollars. Water requirement for a continuous production over a whole year amounts to 30,000 cubic meters only. Production of roses from one hectare of greenhouse amounts to 4 million units, gross value of which reaches US $285,000. Based on the current prices of roses it means net benefit of about US $75,000 per

hectare. Others flowers varieties are even less water intensive – 20,000 cubic meters per year with an investment of 200,000 dollars. Greenhouses for vegetables are also less expensive: with the same investments of 200,000 dollars, the water requirement amounts to 15,000-20,000 cubic meters per year.

Cropping within closed environment reduces too evaporative water loss. This method is economic with land and water use, avoids soil salinization, and, as mentioned above, produces high yields of exportable crops, such as ornamentals, fruit, vegetables, and herbs.

A long list of new crops, which can be adapted to the arid and semi-arid regional conditions, is under scrutiny and advanced research. It includes shrubs for mulching, fruit trees, and eucalyptus trees for honey as well as vegetables and flowers.
The restructuring of agricultural production is also very much needed in view of a strong competition from the industrial, domestic and municipal sectors. This competition is very substantial both from the production value as well from the employment multiplier aspects. The product value of one cubic meter of water consumed in industrial production is very much higher than for the same amount consumed for irrigated wheat fields or orchards. In Jordan, for example, productivity per unit of consumed water is 40 times higher in industry than in agriculture, and employment effect is 13 times higher. Comparable values can be assumed for other countries in the region.

4.2 Introducing improved irrigation technologies

Fresh water is no less an irreplaceable economic resource than a basic human-need. First of all, in semi-arid and arid countries water is a requirement for agricultural production. Rain-fed cultivation is possible only in the moister northern and coastal zones of the Jordan Basin region for field crops, or certain tree plantations like olives and nuts. All parts of the region require irrigation in summer for shallow rooted crops such as vegetables, and more water-intensive trees like citrus or avocados. In the dryer southeastern part and in the lower Jordan rift valley, irrigation is necessary all year round for all crops.

To get an idea of agricultural water demands in arid and semi-arid areas, one should keep in mind that 10,000 cubic meters of water to one hectare per year is a fairly typical irrigation rate. However, water requirements per hectare vary considerably depending on crops, irrigation methods, soil structure, and microclimatic conditions. Where modern irrigation techniques are used, these rates can be reduced by up to about half that amount. On the other hand, in arid areas and for water-intensive crops the irrigation requirements might be twice that and more. In Israel, e.g., the average irrigation duty was about 6,000 cubic meters per hectare in the mid-1980s, compared with 17,000 cubic meters per hectare in Egypt and some 11,000 cubic meters per hectare in Jordan. Translated into product output, these figures mean that growing citrus fruits consumes 418 liters of water per kilogram of output, bananas consume 1,383 liters of water per kilogram of output, and wheat consumes 2,352 liters of water per kilogram of output. Agricultural water requirements can be lowered by technology, but only to a certain degree.

Since 65-70% of water in the Jordan Basin region is used in agriculture, this is where conservation measures will have the greatest impact in absolute terms. As in the municipal sector one must discern water conservation at the network and end-user level. Intervention at the farm level offers the largest saving potential, although improvement in overall distribution systems may also help saving considerable amounts of water.

At the end-user level, water efficiency depends on the irrigation techniques applied. Modern sprinkler and micro-irrigation techniques have a saving potential on the order of 50 to 100% compared to traditional surface irrigation methods. Among the best-known micro-irrigation techniques is drip irrigation by which relatively small quantities of water are delivered directly to the roots of growing plants by means of perforated plastic piping. Because only a fraction of the soil is watered, water savings are substantial. When fully developed, so that water flow is controlled by sensors linked to central computers, this technique approaches an efficiency of 100%.
Micro-irrigation techniques have the further advantage of reducing adverse environmental impacts typical of land under continuous irrigation. Notably, they can avoid or reduce salinization of soils. Also, unlike surface irrigation, micro-irrigation techniques do not produce drainage returns which often affect the quality of nearby rivers or aquifers. On the other hand, micro-irrigation methods require previous water treatment such as filtration and mixing with fertilizer, pressurized pipes, and a reliable water supply. Thus they are not a cheap technique. Initial outlay typically amounts to some US $ 1,500-3,000 per hectare. Moreover, the system must be run by specialized personnel and requires continuous maintenance.

Yet these techniques are already widely applied in the Jordan Basin region. Israel has been the pioneer in developing water-saving irrigation technologies. Modern techniques are applied today on the whole irrigated area, and half of it is under drip (note that drip-irrigation is not applicable everywhere, and sprinkler irrigation performs better for some crops). The efforts to increase the efficiency of agricultural water use at the farm level have been highly successful. Total irrigation water consumption is slowly sinking, although agricultural output has continued to increase both in product quantity and value. Water consumption per hectare has declined from nearly 6,400 cubic meters per hectare to 4,500 and less during the last decades. Over the same period of time the volume of water consumed per US $ of agricultural output has declined by half, from 1.53 to 0.75 cubic meters.

In Jordan too, sprinkler and micro-irrigation techniques are not unknown methods. At the beginning of the 1990s, in 86% of the irrigated area modern irrigation techniques (sprinkler or drip) were applied. Water efficiency of Jordanian farms was estimated at 76% on the average. This is quite a good performance, which leaves small margins for further improvement. A greater potential for expansion exists in the Palestinian Authority, although at present application remains limited to small parcels of land due to the extreme lack of agricultural water.
Although water efficiency at the single farm can be generally regarded as satisfying, a greater field of conservation potentials is offered by systems feeding the single farmers. In irrigation schemes where water is pumped or diverted from nearby sources waste is usually low. But where water has to be stored and/or transported for long distances, losses can be very high. In open systems evaporation causes considerable losses which could be avoided by using closed pipes and/or storing water in natural underground aquifers. Moreover, as with municipal supply, careless and improperly maintained schemes can cause great waste.

In Jordan, 26% of irrigated land is still fed with open surface canals, above all the northern section of the King Abdullah Canal. After more than 30 years of operation, the condition of this network has markedly deteriorated and its conveyance efficiency averages only 60%. That means that 40% of the water carried is lost before reaching the farms. Moreover, farms fed by open conduits are more reluctant to introduce modern drip-irrigation systems, since they need further investment to pressurize the water. In the southern section of the King Abdullah Canal, which consists of pressurized pipes, losses still amount to 15% due to leaks in the conduits and improperly operated sluices and valves.

Therefore, while Jordan's water efficiency is fairly high at the farm level (75%, see above), the combined efficiency of water conveyance and farm irrigation is only 55%. Thus investments in modern conduit infrastructure, better monitoring and maintenance, and the synergy effects these would produce at the farm level would help to save considerable quantities of water.

4.3 Alternatives for increasing water supply

After having exploited all remaining natural resources, a supply-oriented water management strategy will go on to develop new resources. A first promising source of unconventional, technology-intensive supply consists in purifying and reusing industrial and domestic wastewater. It is assumed that about 65% of the water consumed by industry and the households can be recycled if collected by sewage systems and properly treated. For example, 50 million cubic meters of fossil water used for municipal supply can result in additional 35 million cubic meters reclaimed water.

At present, between 20 and 30% of total water consumption in the countries of the Jordan Basin region is attributable to the private and industrial sectors. This share is likely to increase rapidly as a consequence of population growth, improvement of living standards, and economic development. According to a study published in 1993[4], It is estimated that in the year 2023 Israel and the Palestinian Authority will have available some 650 million cubic meters/year and 325 million cubic meters/year of wastewater respectively. With similar standards applied to Jordan, the Kingdom will produce some 500 million cubic meters/year of wastewater as well. In sum, these quantities make for more than half of the presently available renewable fresh water sources in the area. Without fully developing these resources, there will be only small quantities of endogenous water for agriculture.

In the Middle East, Israel has been a pioneer in recycling wastewater. At present 60 t0 70% of the wastewater in Israel is seweraged, and about 70% was reused. By the end of the century, recycled wastewater could provide as much as 400 million cubic meters/year. Yet throughout the rest of the region, wastewater reclamation has a great expansion potential. On the West Bank and in the Gaza Strip most cities and all villages still lack a sewerage system to collect wastewater, although such systems are presently under construction in some towns. In Jordan, sewerage systems and treatment plants have been built or are under construction in most towns. However, only a minor part of that is being purified. Treated wastewater reuse provides about 59 million cubic meters/year of irrigation water. Compared to some 230 million cubic meters/year of water consumed in the domestic and industrial sector, this is an amount, which still leaves a great potential to be exploited.

Indications based on the Israeli experience are that the cost of conveying and treating wastewater effluents amounts to between US $ 0.26 and US $ 0.52 per cubic meter. Moreover, apart from largely solving environmental problems arising from dumping untreated sewage into natural water bodies or the landscape, recycled wastewater also contributes important nutrients to the soil. Thus, it can obviate addition of commercial fertilizers and organic matter to irrigation water. Taking into account these beneficial side effects, recycled wastewater is one of the least expensive and most attractive unconventional sources of water for agriculture. However, the technique requires high investments and must be applied with caution, since inappropriate use can harm the quality of soils.
Wastewater treatment plants represent a top priority of the water supply policy. Large amounts of capital were invested already in Israel and in Jordan. Important new projects for effluent treatment are under consideration in the region.

The Peres Center for Peace published a study of on Agricultural Initiatives in the West Bank and Gaza Strip of the Palestinian Authority[5]. According to this study the immediate sewage problem to be addressed in Gaza is the removal of the environmental nuisance caused by untreated sewage. The construction of a sewage treatment plant in this area as well as the preservation and supplementing of water sources require a substantial effort from the Palestinian Authority and an international involvement.

A few projects were prepared and are waiting for implementation. One such future reuse option is effluent disposal via conduit to the eastern border of the Gaza Strip, between Abasan and Raffah and development of agriculture in this area. There is no active aquifer, and use can be made of know-how acquired in Israel, including drip irrigation for a wide range of field crops.

It should be noted that there is a considerable water resource potential by recycling sewage water for which plans are available to provide 5-7 million cubic meters of water for agricultural use costing about US $10 million. Such a program will contribute too to the environmental improvement in Gaza and its surroundings.

The Jordanian Government is currently seeking funds to set up a $145 million wastewater treatment plant next year (2000) in the Khirbet Al Samra area, near Zarqa, to aid the existing sewage station. The government of Jordan and a Swedish firm are currently studying a JD330 million plan to establish several treatment plants to handle industrial wastewater in the area.

4.4 Economic considerations

According to the World Bank opinion presented by Ismail Serageldin, Vice President for Special Programs, a principal constraint in current water management is that most countries refuse to treat water as an economic good. Low value users are allowed to consume large quantities of water, forcing high value users to incur steep costs in securing water supply. The result is waste, depletion, less than fully productive investments and sometimes - ecological disasters.
Water pricing policy is, of course, one of the main issues in efficient use of this scarce resource. However, it is only one component of a broad range of economic policy measures, which includes incentives for efficient use, appropriate management practices and an effective legal framework for policy implementation.

Pricing policies that emphasize economic efficiency and promote economizing in water use may be adequate for the Jordan Basin area given its increasing water scarcity. In this context three following measures should be considered:

4.4.1 Marginal cost pricing, which ensures that appropriate signals are send to consumers about the true cost of the water.

4.4.2 Time-of-use pricing sets the rate higher during periods of peak use to ration water during these periods, but sets lower prices during off-peak or off-season periods of use.

4.4.3 Water surcharges are frequently employed to discourage excessive use. That is, a surcharge is imposed for using water above certain quantity. This is the case, for example, in Israel where a quota system is applied to water users in agriculture.

The need for a reform based on a sound economic policy is well recognizes in all areas under consideration. A recent National Water Conference in Jordan, which took place in

September 1999, proposed rationing water consumption according to national priorities. The Conference stressed that the agricultural sector, which consumes 70 per cent of the Kingdom annual water amounts, produces a financial return of only five per cent.
Although pricing practices do not augment available water supplies, they are technically feasible and, when they result in net savings of water, tend to preserve water resources now and for future generations.

5 Solutions for the Medium and Long Term

The remaining options for increasing substantially water supply to the region are generally still too expensive for widespread use. A partial exception must be made for brackish-water desalination, which, depending on location and salt content, can be appropriate alternative.
The progress in seawater desalination will be gradual and based on modular solutions, starting with a pilot plant of 50 million cubic meters.

In order to evaluate the medium and long-term solutions it is necessary to focus the attention on following topics:
Research and development
High-capital centralized solutions

5.1 Research as a part of the solution

Research priorities should cover three categories: technical, socio- and environmental-economic, and institutional. The following are the most pressing research gaps.

5.1.1 Technical studies

1) Agricultural techniques appropriate for water scarcity: use of poor-quality or saline water, degree of natural recycling under different conditions and long-term effects of recycling irrigation water and treated wastewater.
2) Technologies of seawater desalination, as large-scale seawater treatment and desalination would undoubtedly be part of a longer-term solution.
3) Aquifer hydraulics and potentials: discontinuous or karstic formations and fossil aquifers.
4) Alternative sources of supply: rainwater harvesting and savanization as well as micro-catchments for improved ecological conditions and farming.
5) Existing and alternative strategies in agriculture and industry for times of water stress.
6) Technological infrastructure for water transportation.

5.1.2 Socioeconomic and environmental-economic studies

1) Careful estimation of the elasticity of long-term water demand to combinations of price, income, and policy change.
2) Better definition of noncommercial services, such as recreation; of environmental services, such as habitat preservation; and of water in situ.
3) Evaluation of market-based options for national or regional water management.
4) Efficiency and equity effects of marginal-cost pricing and other pricing structures on various sectors, ecosystems, and classes.
5) Efficiency and equity effects of alternative quasi-market allocation techniques, methods for adjusting pricing for different qualities of water supply and of wastewater runoff.
6) Review of traditional methods of augmenting water supply and limiting water demand to see how they compare (in efficiency, equity, and gender effects) with modern methods.
7) Review of awareness and assimilation prospects of water recycling and conservation methods and patterns.
8) Evaluation, using various criteria, of the range of mega-projects and regional import options for major increments of water supply, to develop a preferred ranking under various conditions.

5.1.3 Institutional studies

1) Better identification of the barriers to the adoption of, or investment in, water-saving technologies; and design of policies to lower those barriers.
2) Comparison of market and non-market institutions for distributing water efficiently and equitably.
3) Options for joint or shared management of trans-boundary water resources, particularly with respect to water quality.
4) Options for community- or common-property management for water.
5) Measures to increase awareness of the need and the means to conserve water.
6) Improved design for water utilities that incorporate water supply and wastewater removal and reuse, supply-side and demand-side concerns and economic, ecological and social issues.
7) Institutional infrastructure for water transportation.

Regarding the latter research area, I have in mind a *structural readjustment* of water use policy and technology of the dominant water consumer - agriculture, reducing the pressure of agriculture on the general water-population equilibrium.

This developmental emphasis is of course interrelated with three other courses of action:
- Political efforts or interregional cooperation, including cooperation between former enemies. We succeeded, together with Egypt to develop in agriculture a prototype of such cooperation with universal significance.
- International assistance, and
- Joint Ventures.

The main conclusion of my analysis if that unless policy makers drastically change the way they manage their water resources, the Middle East and North African countries will suffer from severe water shortages and economic decline in the next 30 years. The growing water shortage could lead to a vicious cycle of under development, and to stagnant economic growth.

The water crisis can be averted. If steps are taken immediately, water availability for domestic and industrial use could be increased by 50% and municipal water losses, now accounting for about 50% of supplied water could be halved in the next 10 years. The main steps are: increasing efficiency of water use, reducing pollution, controlling ground water extraction, recycling and reusing treated wastewater, securing alternative sources of water through import and at a later stage, *affordable desalination*.

5.2 Implementation of new technologies

Additional regional water supplies can be obtained in a medium and long-term by developing sources of lower quality water (marginal quality water and desalinated brackish water and seawater), by importing water from outside the area and by increasing the renewable amount of water available by employing advanced technologies (cloud seeding). This chapter is devoted to a brief evaluation of two main alternatives of additional water supply.

5.2.1 Desalination of brackish water

Large supplies of brackish ground water exist throughout the region area, generally as part of complex ground-water flow systems, with freshwater occurring in shallow, or up-gradient, positions, and more saline water in deeper, or down-gradient positions. This is water with an amount of total solved solids between 1,000 and 5,000 mg. per liter, more than affordable for drinking and irrigating, but much less than the 35,000 mg contained in seawater.

Withdrawal of brackish water results in either increased or decreased salinity. If salinity increases, the cost of desalination will generally increase; if salinity decreases, part of the adjacent freshwater resource will be depleted. Therefore, brackish water resources cannot be considered a "free good" or unlimited resource, but must be evaluated to determine their yield, salinity changes with time, and the effect of withdrawal on adjacent freshwater resource.

Another source of brackish water for desalination is agricultural return flow. It has been suggested that drainage projects on both sides of the Jordan Valley could return flow that could be desalinated relatively inexpensively.

Brackish water desalination may offer an attractive alternative to increase the water supplies to increase the water supply in the region. Such desalination is technologically feasible and usually will not have negative environmental impact. Economic feasibility will depend on the quality of the brackish water, the technology used, and the relative economic attractiveness of the alternatives. A study of Ben-Gurion University and Tahal[6] assumes expenses of US $0.25 to 0.40 for treating brackish water, which is three to four times less than seawater desalination, and comparable to the cost of wastewater treatment.

5.2.2 Seawater desalination

The prospect of desalinating seawater and thus gaining an almost unlimited source of freshwater has been intriguing experts for a long time.

The main constraint to widespread use of seawater desalination is its cost. In fact, the technology remains very expensive, making it currently impracticable for most applications. A survey submitted by the Commission of the European Communities at the multilateral talks on water shows typical production costs between US $ 1 to US $ 1.7 per cubic meter, depending on process techniques and scale of application. Some Israeli companies active in the business have been offering plants on the drawing board, which are supposed to desalinate seawater at product water costs of US $ 0.65 to 0.70 per cubic meter. However, product costs of the plant do not include expenses for water storage and transport from plant to consumer. Thus, even if these relatively low figures are accepted as realistic, total water cost for the consumer would probably amount to at least around US $ 1. Costs of seawater desalination collected in a few operational plants in the USA, Mexico, Malta, Spain and Saudi Arabia fluctuated between US $3.17 to US $0.95 per cubic meter. (These costs must be put in relation to the product output per cubic meter of water used in agriculture, which is the largest consumer in the Middle East.) According to several recent studies, the volume of water consumed per US $ of agricultural output in Israel is about 0.75 cubic meters. Conversely, this means that the average value output per cubic meter of used water is about US $ 1.3.

Consequently, should desalinated seawater be used for irrigation, the value of the yields would just about cover the cost of the water. All remaining labor, investment, and operation costs, including the cost of irrigation facilities, would have to be subsidized. The maximum water cost that can be borne by agriculture is about US $ 0.25 per cubic meter which is the maximum product value for water for most irrigated crops grown under normal modern agricultural techniques.

In this context, one has to consider that the Israeli agricultural sector is among the most highly developed and water-efficient in the world. In Jordan and the Palestinian Authority the economic feasibility of using desalinated seawater might be even smaller, since it would be more difficult for the farmers to pay for the desalinated water. This would be the case in any crop that is not a cash crop grown under intensive conditions. In Jordan, moreover, large-scale seawater desalination has no practicable path, since the only shoreline of the country is at Aqaba on the Dead Sea, far away from the population and production centers. *Judging from these facts, seawater desalination is currently a practicable option only for domestic or industrial consumption in areas with no other fresh-water sources available, or for economic activities like tourism with inelastic water demand in relation to price.*

6 Regional cooperation

Our common ecosystem intrinsically demands the *highest possible degree of cooperation* among us who inhabit the area. Ever more so is the case of the Palestinian Authority, Jordan and Israel that share the ownership on several common bodies of water. The issue of water development for agriculture should be addressed within the framework of an integrated system, combining soil, plants and animals. It is an interdisciplinary approach requiring the participation of experts from several different disciplines. Another aspect of this approach is to integrate the various relevant efforts in the Middle East and lead gradually to the establishment of an integrative regional network.

Our comprehensive application of human inventiveness, liberal exchange of know-how, and joint efforts in expansive development projects can convert deserts into green, fertile fields and improve habitability in desert regions. It is an ambitious goal but it can be achieved by mobilizing the available scientific, technological, educational and organizational resources. The other side of the coin is to link agricultural development with the all important challenge to create conditions of habitability for populations living in desert regions. This responds to the "human factor first" approach which is the underlying principle of integrated development linking agriculture, industry and services to create and enhance "living" desert regions.

Our past experience has shown that arid and semi-arid zones can support a high level of agriculture - as high or higher than the level achieved in temperate climates. In the context of regional cooperation, Israel can contribute several of the necessary components: drip- and other irrigation equipment, local technologies of protected agriculture, seeds of high genetic quality, plants from tissue cultures, and new varieties of desert-resistant crops and livestock.

The natural and economic aspects of agriculture cannot be separated. Resources such as land and water must be integrated with human and technological factors. Engineering ingenuity can overcome obstacles of distance and elevation - moving water from areas of relative plenty to those of chronic shortage. Innovative agro-technology can come up with crop varieties, irrigation techniques and cultivation methods to maximize productivity. Macroeconomic policy can give priority to overall sociopolitical considerations in the early years of development, but eventually should allow market forces and local management

to be phased in.

An investment in a rational responsive institutional system which will enable the most efficient use of water supplies and agro-technological innovations while still achieving national objectives is no less important than is an investment in the resources themselves. Such an example is the proposed Irrigation and Soil Field Service:

6.1 Irrigation and Soil Field Service

A major measure to save water resources is the establishment of an active Irrigation and Soil Field Service. The proposed Irrigation and Soil Field Service is to operate as a part of the Extension Service as well as a consultancy entity to the Water Commissioner. The Irrigation and Soil Field Service will deal with extension and applied research in soil-water-plant relations including plant nutrition and the impact of salinity on the plant and soil. The main aim of this proposed entity is to improve the water use efficiency in agriculture, the main sector consuming scarce water resources.

6.2 Water development and the environment

Environment is also a major consideration in water resource development. Salination and pollution are among the main sources of water quality deterioration in our as well as other regions. Water salination is caused by natural processes, such as evaporation, as well as by human activities, such as inefficient irrigation techniques that lead to over-pumping, while pollution is mainly caused by human activities. Wasteful pesticide use, industrial waste, etc. are all causes to water deterioration - which knows no boundaries. Therefore, environmental solutions must be combined within any water development program and those, by definition, must be cooperative, joint regional activities.

Of the various regional key activities proposed, the top priority issue of water management in the Middle East is the efficiency of water use and development of new water sources and new water technologies. In particular, *water saving*, especially by efficient use, can actually be regarded a *new source of water*. This subject is increasingly being regarded as a crucial issue in various national, regional and international meetings. Large scale water treatment and desalination would undoubtedly be part of a longer-term solution, but practices of water saving will allow usage regulation and the reduction in water sources development costs, and this issue has not yet been adequately exploited.

Notes:

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Water: A Means for Confidence-Building and Cooperation in the Jordan River Basin.

*By Dr. Ayman Rabi**

1. Background

A large area of the Middle East region is characterized by long-dry and short-wet seasons which render them as arid and semi arid areas. The focus of this paper, however, is on a small portion of the Middle East region, the three riparian countries of the Jordan River Basin namely Jordan-Palestine-Israel. They will be denoted as the Lower Jordan River Basin (LJRB) for the purpose of this paper.

The total surface area of the basin is 116,911 km2. 77% of which lies east of the Jordan Rift Valley and 33% west of it. The basin has a total population of approximately 13 - 14 million people. 5.5 million of whom are in Jordan, 2.5 million in West Bank and Gaza (Palestine) and 5.5 million in Israel.

Despite the general resemblance of the climate and hydrologic conditions throughout the study area, temporal and spatial variation in these conditions has a tremendous impact on precipitation distribution and consequently on the natural distribution and availability of renewable freshwater resources. The northwestern part, which receives nearly 1100 mm/year of precipitation, is influenced by Mediterranean weather conditions, while the eastern and southern parts receive less than 30 mm/year and are influenced by the sub-Saharan weather conditions. In addition, the central and northern hills west of the Rift Valley receive an average of 600 mm/year while the hills east of the Rift receive an average of 400mm/year.

Precipitation only occurs during winter months (November – March) and is considered the only source of replenishment of all renewable water resources within the basin. The total volume of precipitation which falls over the three countries is estimated at 16.4 bcm. Only a small part of it is available for use either in the form of surface water or groundwater. This is because large parts of the basin are desert; nearly 69% of the total surface area receives less than 200 mm/year of precipitation and almost 13% receives less than 250mm/year.

Accordingly, total renewable fresh water available annually within the basin account for less than 20% of precipitation volume. It is estimated at nearly 2.8 bcm/year in the form of shared surface and groundwater resources.

Water availability from shared and national resources for each one of the countries in the basin varies substantially. For example, the current annual average freshwater available for Israeli use is 1.5 billion cubic meters. The Jordanian portion is nearly 0.9 billion cubic meters, but for Palestinians it is completely different. Although, the total renewable resources originating within the Palestinian boundaries reaches 750 MCM/year the use is restricted to only one third of this in both the West Bank and Gaza.

The scarce nature of the resources in the basin renders it a water stress area and the available quantities will not be sufficient to meet all the conflicting demands. To maintain a good quality of life, per capita water availability must be at least 300 m3/capita/year, although it

exceeds 2000 m3/capita/year in the water rich countries such as northern Europe and Canada; but the average per capita availability should be 500 m3/c/year in order to maintain an average requirement of good social and economic life conditions.

NRC (99), have attributed the economic and social development which took place in both Israel and Jordan over the past four decades to the availability of fresh water resources through the National Water Carrier and the King Abdallah Canal respectively. Conversely, the lack of social and economic development within the West Bank and Gaza during the same period was attributed to the non - availability of sufficient fresh water quantities.

Furthermore, the extensive development of these resources which has taken place over the past five decades, to meet the needs of various social and economic development activities, have altered both the quantity and quality of the water.

The combined impact of the natural scarcity conditions, conflicting demands as well as the shared nature of these resources increases the potential conflicts over their control and use among the riparian countries on one hand and among various sectors within each country on the other. Therefore, it is crucial to understand the exact magnitude of the resources of adequate quality for various uses, and consider some appropriate trade-offs among such uses. Furthermore, it is crucial to look into the other alternatives that help in using such resources in the best possible way. Such alternatives may vary from adopting various water conservation techniques to waste water treatment and re-use.

The following subsections will elaborate on the magnitude of the resources available as well as the alternatives to insure their optimum use.

2. Available Water Resources in the LJR Basin

2.1 Conventional Resources

The magnitude of surface water available within the boundaries of the basin varies from 1.4 bcm to 1.43 bcm. Meanwhile, the magnitude of the groundwater resources also varies from 1.36 – 1.534 bcm, NRC (99), GTZ (96). Groundwater is considered the main water sources in the basin, particularly in Palestine. The Jordan River is the major surface water body in the basin, holding nearly 90% of the overall surface water potential.

2.2 Non-Conventional Water Resources

Wastewater is considered the major non-conventional water resource that is still misplaced in the basin. It is not fully utilized. GTZ (96) estimated the total production of wastewater in the basin at 450 mcm / year. Only a very limited quantity of treated wastewater of 213 and 59 mcm / year is being used in both Israel and Jordan respectively. Meanwhile, the situation in the West Bank and Gaza is slightly different at the time being. A small percentage of the effluent produced is being collected in the West Bank and Gaza and almost non of it is being treated. Today's conditions reflect that approximately 60 percent of the urban areas are being connected to sewerage systems, therefore almost non of the rural areas and 40 percent of the urban areas are not yet connected. According to Ministry of Planning and International Cooperation (1998) the current annual wastewater collection in the West Bank and Gaza might reach 10 Mcm.

Nonetheless, it is recognized that population growth and urban development will necessarily require more fresh water use. Such water is likely to be diverted from agriculture and the later will depend largely on the treated wastewater. It is anticipated that the wastewater generation in the basin will be nearly 1.8 bcm in the future, GTZ (96).

3. Water Use in the Basin

Water use is currently varied within the region. It may also vary within each country. The variation in both Jordan and Israel is pretty much related to the variation in the available resources within each country. However, the variation within Palestine is related more to the political constraints and physical limitations imposed on supply. The current water use levels in the basin reflects that the Palestinians are using almost 8.2% of the total available water resources in the Basin. In the Mean time Israel is using 57.1% and Jordan is using 34.7%.

Agriculture is the prime user of the freshwater resources in the basin. Both Israel and Jordan are using nearly 60 and 71% of their total available resources, or 33.66% and 24.82% respectively of the total regional water supply, for agriculture. In the mean time Palestinian agriculture uses 63% of the available water in Palestine while this accounts for only 5.2% of the regional water resources.

The regional total per capita water use is estimated at 257 m3/year. However, the average per capita water use in Israel is nearly 344 m3/year. Meanwhile, it is nearly 93 m3/year in Palestine (given that 25% of the population still lack any running water supply) and it is almost 244 m3/year in Jordan, NRC (99). The domestic per capita water use, however, is estimated at 98 m3/c/year in Israel, 56 m3/c/year in Jordan and nearly 34 m3/c/year in Palestine.

The variation in the per capita water use in the case of Palestine doesn't reflect the actual demand. It merely reflects what water is being made available for use and reflects a suppressed demand.

This situation is expected to become more acute in the near future especially when demand increases on the available limited supply. For example, population growth in the region, both natural *(estimated at 3%)* and un-natural, as well as economic development requires additional water quantities. If it is to be supplied from the existing limited sources, it means that the resources will continue to be used over their capacity. The current over pumping of groundwater is estimated at 0.4 billion cubic meter per year, NRC (99). If this continues the quantities will diminish and their quality will deteriorate very rapidly. Accordingly, all life and ecosystems dependent on this water will be in jeopardy.

Bearing all these complexities in mind, one can not afford to talk about the water issue in a very narrow perspective. It must be dealt with in a regional, cooperative context in order to overcome all possible constraints and in order to insure lasting, comprehensive and just peace for the present and future generations.

4. Water Conservation

In arid and semi arid environments where water resources are scarce in nature and especially if resources are shared by more than one nation, efficient utilization and conservation of resources is not only a necessity it is a must.

Water conservation programs including technology, pricing and public education has to be a major components in any water management strategy.

Water Conservation Technology

Technology could play an important role in water use efficiency, both indoors and outdoors, through introducing water saving devices such as shower heads, toilet flushing devices, washing machines ... etc. Table (1) illustrates a comparison between the conventional and improved devices for domestic water use.

Table 1: Comparison Between Conventional and Non Conventional Appliances in the Domestic Water Use

Item	Conventional Liter	Improved Liter	Use Frequency Time/Time Step	Saving/Month m^3
Toilet Flush	16 ltr/flush	Low Flow 61/Flush	5/person/day	1.5
		Displacement device 8.7 - 12.3 l/flush		0.825
	Shower Head at full capacity	18.7 - 30 l/m low flow 7.5 L/M	Pressurized 1/Person/D (10 M)	3.36 - 6.75
Washing Machine	Full Automatic 131 - 263 L/wash	Manual 40 - 60 L/wash	3 cycles / wash	1
Total				6-9

Notes:M, Minute; D, Day; L, Liter

It can be noticed that at least 6-9 m3/month can be saved per capita if water conservation appliances to be used. This quantity means a lot for a water scarce region where each drop of water has its weight.

Public Education

Human water use practice needs also to be adjusted in a way that insures adopting the best possible practice. Awareness programs need to be introduced to the community at all levels, particularly in schools, so as to educate young generations in the importance of protecting and conserving available scarce natural resources. Moreover this is essential if we are to initiate an environmental friendly generation who will protect the environment and preserve resources for a sustainable future.

Water Pricing and Cost Recovery

It is true that water pricing could play a major role in water conservation. But it si also true to insure charging actual water cost. The notion of the water as a free gift of God is no longer valid, especially because water production and distribution has cost. Yet, water pricing has to be evaluated in line with other factors impacting water use. Of these factors water availability and adequacy, economic situation and per capita income, physical losses are a few examples.

However, insuring cost recovery of water production is an objective that needs to be fulfilled by all water supply utilities in order to enable them to keep their system in good conditions and to improve their services. Hence, reducing physical losses and avoiding associated quality deterioration. The current pricing mechanisms are substantially different from one

country to another, and from one locality to another in the case of Palestine. The average price per m3 is estimated at 0.6$. However, it may reach nearly 3$ in some localities where no proper water supply systems exist. Water obtained by Tankers costs generally double or even triple the normal price a regular customer may pay for water supplied by a running water system. At the same time, the quality is much lower. Despite that, people are still willing to pay such a high price for water. This is a vivid indicator highlighting the opportunity for directing investment to the places which are still lacking such basic services. It is also a good chance to encourage private sector involvement in this issue, given that almost 20% of the population in Palestine.is still lacking totally services.

5. Conclusions and Recommendations

People, whoever they are, whatever their nationalities or origins are, who lives under the same natural conditions, must enjoy the same rights of using such resources and obtain water in quantities and qualities equal to their needs. A concept established some two decades ago which should really be the basis for handling the water issue in the basin.

Parties should understand the needs of others and should cooperate in protecting and sustainably managing the available limited resources and increasing the available quantities in order to reduce the potential tension. Clear norms and standards will have to be developed for the same resources under similar conditions in a given region.

Emphasis should be strongly on the importance of sustainable management of resources and on balancing water supply with demand. More precisely, to considering the natural replenishment capacity and the hydrological uncertainty of the resources as the basis for water supply planning and development.

Governments and stake-holders need to develop policies and strategies that do not favour the unjustified use of one sector at the expense of another. There is a need to modify the water use in the basin in a way that suits the scarce nature of the resources and ensures their equitable distribution. Furthermore, it is important to maximize the productivity of scarce freshwater resources through re-evaluating the traditional role of agriculture in the national economies.

The public needs to be involved in managing the resources as a responsible body. They have to ensure the adoption of the most efficient use practices during their daily lives. They also must cooperate to ensure the implementation of governmental policies, which should protect the sustainability of resources for the current and future generations.

Appropriate technology must also be introduced to help protect the scarce resources and to facilitate the adaptation and implementation of the most efficient use of them.

The disparity of fresh water availability and use among the peoples living in the area is recognized as one of the key issues that needs to be dealt with carefully. However, no matter how difficult and complicated the situation is there are always some peaceful ways to overcome it. It must be realized that any solution will be expensive and will not be sustainable if it does not properly incorporate the role of public, government, and technology / Private sectors.

Equitable and wise use of available resources among all people living under the same conditions is the basis for *confidence building and lasting peace. Furthermore, peace and sustainability starts from the glass of water that someone saves in one country to sat-*

isfy the thirst of someone else in a neighboring country, particularly in the water-short countries of our region. In addition, no matter what agreements are signed, they will not bring peace without the public acceptance and cooperation to solve each other's problems. Therefore, water, the elixir of life, needs to be always considered as the source of cooperation and confidence building among nations to sustain a good human life for all.

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The Water Issues on the Jordan River Basin between Israel, Syria and Lebanon can be a Motivation for Peace and Regional Cooperation

*By Prof. Hillel I. Shuval**

Abstract

This paper will examine whether the conflicts in the Jordan River basin between Israel, Lebanon and Israel are as intractable as some hold, and such a major obstacle to the peace process, or can be a motivation for peace through regional cooperation? The Syrians and Lebanese have in the past claimed as their own all of the sources of the Jordan River which arise in their territory. International water law, as approved by the UN, provides a strong legal basis to assure the water rights and continued use of water by a down stream riparians, such as Syrian use of the Euphrates River which arises in Turkey and similarly, the case of Israel's use of the Jordan River , based on prior use in an international river basin. This paper will evaluate the geopolitical, agricultural and economic implications for Israel, Syria and Lebanon of a possible peace agreement which might involve Israel giving up control of all or most of the Golan Heights up to the recognized international border and forgoing the continued use of certain amounts of water from the sources of the Jordan River that were approved by the Israel Government under the so-called Johnston Plan of 1956. That is, 35 million m3/yr. (mm3/yr) for Lebanon from the Hasbani River and 42 mm3/yr. from the Banyas Springs and Jordan River for Syria. One possible way of evaluating the impact is by the economic approach to water conflicts. If we assume that at some time in the future, the 80 mm3 the water allocated under a peace agreement to Syria and Lebanon would be needed by Israel for domestic/urban use and would have to be replaced by sea water desalination,, the maximum replacement cost for that amount of water by desalination may be, at that time, about $0.70/m3 or, some $56,000,000 per year. This amount of money is not large when compared to the other costs of reaching a peace agreement. In an era of peace, development of the shared water resources of the Jordan and contiguous water systems, in a program of regional cooperation, can bring benefits to all of the partners on the Jordan River Basin. The paper also shows that Israel does not have to hold onto the entire area of the Golan Heights to assure its water security and that a 1-3 km water security zone along the Syrian side of the international border under joint and international monitoring and control would be an effective water security measure. The conclusion, based on this analysis, is that the Syrian/Lebanese/Israeli water issues can resolved in a fair and equitable manner meeting the realistic needs of all sides and should not be considered an insurmountable barrier to the peace negotiations: in fact, regional cooperation on water resource development can be a motivation for peace.

1. INTRODUCTION

There is a popular perception shared by some journalists and political leaders that the issue of water security is so existential that the conflicts over water between Israel and here neighbors concerning the ultimate fate of the shared trans-boundary water resources of the Jordan River Basin and the Mountain Aquifer are so deep and intractable that they alone will be one of the major obstacles to peace between the Israel, Syria, Lebanon, Jordan and the Palestinians and might even lead ultimately to exacerbation of the conflict between the countries of the region. Dr. Boutrus Boutrus Ghali, former Foreign Minister of Egypt, and former Secretary General of the United Nations once said that the "next war in the Middle East will be over water." Other Middle Eastern leaders, including the late King Hussein of Jordan have in the past made public statements containing similar dire predictions about future wars over water in the Middle East. Journalists, political scientists and veteran water experts, have quoted, re-quoted and reformulated the "water wars" hypothesis so often, that it has become accepted by many laymen and politicians as one of the conventional wisdoms of the Middle East's geopolitics. Joyce Star's " Water Wars" (1991) , Gleick's " Water, War and Peace in the Middle East (1994) and Bulloch and Darwish's "Water Wars"(1993) are but a few examples of this apocalyptic view.

Since the reopening of peace talks between Syria and Israel in December 1999 the issue of the fate of the water resources of the upper Jordan River are particularly relevant and timely. Some of the features of the area under consideration are shown in Figure 1.

This paper will examine the issues of the shared Jordan River Basin water resources at stake between Israel, Syria and Lebanon as a case-study in an attempt to evaluate whether or not the conflicts of interests are indeed so great that they are intractable or that a basis for an accommodation is nevertheless feasible. The paper will be devoted mainly to an analysis of the past and present water conflicts between Syria and Israel who share the transboundary waters of the upper Jordan River Basin, based in part on an earlier study prepared for the Harvard Center for Middle Eastern Studies (Shuval, 1998).

These nations will hopefully be attempting to reach an accommodation over their conflicts in the peace process initiated by the United States and Russia at the Madrid Conference in 1992 which has assumed new momentum with the peace initiatives of Prime Minister of Israel, Ehud Barak elected in 1999 and the declarations of Syria's President Hafas El Assad that it is Syria's strategic goal to achieve peace with Israel based on the principle that "territories taken by force in war should be returned as a condition for peace". These developments have received new impetus by the initiatives of US President Bill Clinton in December 1999.

Figure 1. The Upper Jordan River Basin showing the sources of the Jordan with the 1923 International Border Between Israel and Syria and the 1949 Truce Lines and Demilitarized Zones. Source: Peace with Security: Israel's Minimum Security Requirements in Negotiations with Syria, by Zeev Shiff, Policy Paper No. 34 (Washington D.C-The Washington Institute for Near East Policy, 1993) p 8.

However, to provide a framework for a better understanding of the Syria/Lebanon/Israel case study a general evaluation of the water resources available to the five riparian nations on the Jordan River Basin-Syria, Lebanon, Jordan, Israel and the Palestinians will be presented since they are closely inter-related.

2. WATER SCARCITY

According to the study of Population Action International (Engelman and LeRoy, 1993), many countries in the Middle East now face or will be facing severe water shortages as their populations grow and their water resources remain fixed. The intensity of the differences over water resources in the Jordan River Basin appear to be particularly grave since three of the five partners to the disputed waters-Jordan, the Palestinians and Israel face serious, long term, water problems, particularly when considering the expected doubling of populations within the next thirty years or so.

It has been suggested by various researchers (Falkenmark, 1992; Gleiek, 1991) as well as by the World Bank that for a country to be considered as having sufficient water for all purposes it would be desirable to have at its disposal at least 1000 cubic meters/person/year(CM/P/Yr.). This estimate apparently assumes that this amount of water is required to assure enough water for agriculture to provide self-sufficiency in the production of most food for local consumption. These are totally unrealistic estimates of water requirements for most of the truely arid areas of the Middle East, most of whom will never have sufficient amounts of water from natural sources to grow all of their food locally. Growing food with high cost desalinated water is totally unfeasible for an economic point of view. Major long distance water transport projects are also often not economically feasible. On the other hand, I have estimated, that the absolute minimum water requirement- MWR for essential domestic/urban/commercial and industrial needs for a truly arid country, with little or no allocation of fresh potable water for agriculture or food production is a little more than 10% of that figure or some 100 to 125 CM/P/Yr.(Shuval, 1992). Food security in such cases can be obtained mainly by earning enough foreign currency through commerce, industry, trade and tourism to purchase most of the basic food requirements and staples such as grains, oil, beans, butter, meat etc abroad. This concept has been called the import of " virtual water" which is by far the most economical water source for truly arid areas (Allan, 1995)

Israel's estimated potential renewable fresh water resources for the year 2000, assuming a return to normal mean rainfall for the region after the extremely severe drought of 1998-99, are about 270 CM/P/Yr. (Israel Hydrological Service, 1998) with somewhat less for the Hashemite Kingdom of Jordan at 200 CM/P/Yr. It has also been estimated that the current figure for the year 2000 for the Palestinians in the West Bank and Gaza is about 90 CM/P/Yr.,

The two up-stream Jordan River riparians, Syria and Lebanon, currently have considerably more abundant water supplies at their disposal and will not face the same sort of conditions of extreme water scarcity in the future, even with a doubling of their populations, that will be faced by their three less fortunate down-stream neighbors. The potential total water resources available to Syria on a per capita basis estimated by international sources for the year 2000 is about 900CM/P/Yr. or some three times as much as is available to Israel and some ten times as much as is available to the Palestinians on per capita basis (Engelman and LeRoy, 1993). While there are severe water shortages in Damascus, this is mainly a result of lack of proper water transport infrastructure within Syria which could pump water available in the north and east to the capital. The estimated water resources available to Lebanon in the year 2000 is estimated at some 1200 CM/P/Yr. or four time greater than Israel and some twelve times greater than available to the Palestinians on a per capita basis.

For purposes of a graphic comparison of what is often referred to as the water stress index Fig 2 shows the estimated annual fresh water availability in the year 2000 per capita in cubic meter/person/year- CM/P/Yr. for Israel, Jordan, Syria, Lebanon, and the Palestinians as well as for Turkey- the country with the most bountiful water resources of the region.

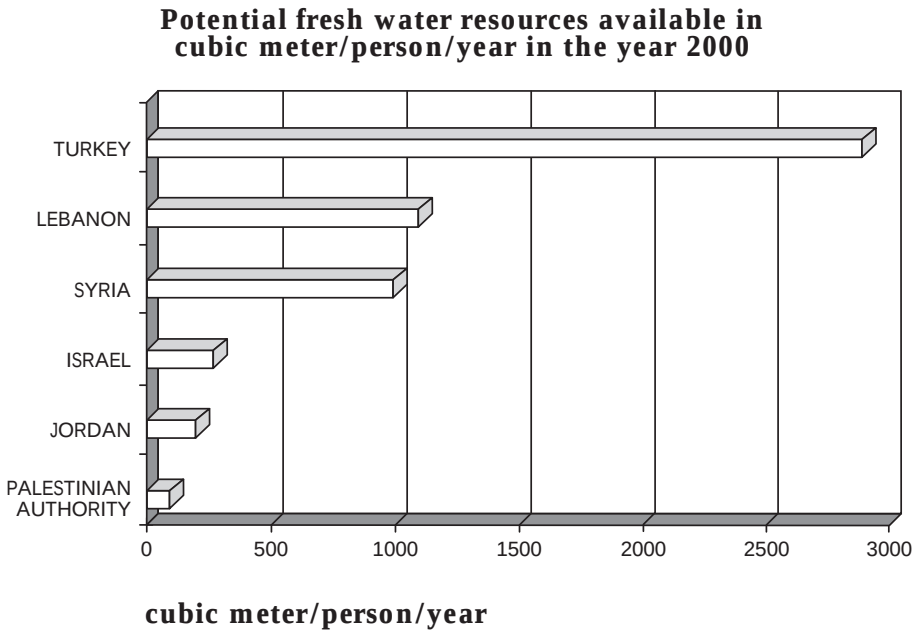

Figure 2 - Water Stress Index on the Jordan River Basin (based primarily on data from -Engelman and LeRoy, 1993)

From the above analysis, with all of its tentative and possibly inaccurate estimates of the availability of water resources some 25-30 years in the future, one thing is clear however, Jordan and Israel will have serious shortages of water and will have available to them just about the minimum of 125 cubic meter/person/year (CM/P/Yr.) considered by many as the Minimum Water Requirement- MWR (Shuval, 1992) for human survival to meet all the needs of domestic/urban/commercial and industrial uses at a reasonable hygienic level and standard of living. The Palestinians will face a still more extreme degree of water shortage with less than half of the amount of water per person considered essential for a minimum hygienic standard of living—that is unless they achieve greater water allocations from Israel and possibly their northern neighbors in the framework of the peace agreement and programs for regional cooperation. It is noted that Lebanon and Syria are estimated still to have available to them, in 25 years time, significantly more water than the absolute minimum for survival based on the MWR concept.

3. THE 1956 "JOHNSTON PLAN" FOR ALLOCATION OF THE JORDAN WATERS

In order to understand one of the important background issues in the current Israel/Syrian/ Lebanese water conflict it is essential to go back to the year 1955 when Israel stared to construct it's National Water Carrier-NWC. The plan was to transport water in a 108 inch pipeline, for a total of some 300 km from the Jordan River in the north to the arid south and Negev. This huge project was the flag-ship endeavor of the Israel water master-plan to increase irrigated agriculture and food production and establish homes and farms for the millions of refugees who had and would arrive in Israel from the concentration camps in Europe after World War II and other areas where there was economic and political unrest. The Syrians objected to Israel constructing the initial diversion canal at Gesher B'not Ya'akov, a point on the Jordan River which was then in the Demilitarized Zone established in the 1949 truce between Israel and Syria. Syrian tanks fired at Israei construction workers and equipment. In order to prevent an armed conflagration, US President Dwight Eisenhower called for a cease-fire and appointed Eric Johnston as his personal envoy and roving ambassador to seek a comprehensive program to develop the Jordan Rivers water resources 'on a regional basis'.

Johnston skillfully avoided legalistic discussions of water rights and succeeded in achieving consensus among Israeli, Jordanian, Syrian and Lebanese water experts at the technical level as to the amounts of water each of the riparians could rationally use for agricultural development schemes, with particular emphasis on promoting refugee resettlement projects for both sides. Stevens (1965) reports that the following was the proposed apportionment of the Jordan River Waters under Ambassadors Johnston's final proposal which latter became to be known as the "Johnston Plan" (Table 1.). It must be stated at this point that there are a number of different interpretations as to the final water allocations included in the Johnston proposals. It is worthwhile noting that the amount of water allocated by the "Johnston Plan" to Syria of up to 132 million cubic meter/year (MCM/Yr.) and Lebanon of up to 35 MCM/Yr., were exactly the amounts requested by the Technical Committee of the Arab League, which under Egyptian leadership formulated the "Arab Plan" for allocation of the Jordan Basin waters.

TABLE 1.

VOLUME OF THE JORDAN RIVER BASIN'S FLOW APPORTIONED BETWEEN THE STATES IN THE FINAL FORM OF THE " JOHNSTON PLAN" (Stevens, 1965)
(In million cubic meters/ year - MCM/Yr.)

Jordan	480	MCM/Yr
Syria	132	MCM/Yr (42MCM/Yr from Banyas & Jordan)
Lebanon	35	MCM/Yr
Israel	466	MCM/Yr
Total Annual Flow	**1113**	**MCM/Yr**

Of the 132 MCM/Yr allocated to Syria, up to 20 MCM/Yr. was to come from the Banyas and up to 22 MCM/Yr. from main stream of the Jordan River. The Jordan water was "to be delivered by Israel" for irrigation of nearby farms along the eastern banks of the Jordan, since Israel had, according to the international border, full and sole access to the Jordan River. Up to an additional 90 MCM/Yr. was to come from the Yarmuk River which arises and flows through Syria. Those are the amounts of water that Lebanon and Syria themselves demanded and claimed that they needed, and could rationally use in the limited agricultural areas in the vicinity of the Jordan sources. These figures, proposed by the Arab League and approved fully by the Johnston Plan, are worth noting when it comes to the discussions of the Lebanese and Syrian claims and demands in the water negotiations which are part of the current peace talks that will hopefully take place.

Israel was ambivalent, at first, about the Johnston proposals. Wishart (1990) quotes recently declassified internal US State Department documents which indicate that in June 1955 Israel, however, agreed to the basic terms of the plan that Johnston had drawn up. From Brecher's (1974) study of documents and the minutes of cabinet meetings it is revealed that in the final internal Israeli debate which approved the Johnston Plan, Foreign Minister Moshe Sharett, Levi Eshkol, head of the Israel water negotiating team, as well as former Prime Minister, David Ben Gurion, who had just returned to the Government as Defense Minister, all supported the comprehensive view that acceptance of the Johnston Plan would, in the long-run bring Israel major geo-political, economic and strategic advantages including a potential opening of cooperation, defacto recognition and ultimately peace agreements with her Arab neighbors-Syria, Lebanon and Jordan. Despite the acceptance of the Johnston Plan by Israel and the official Arab representatives at the technical level, the plan failed to win the official approval of the Arab Governments and the Arab League (Wishart, 1990). On October 11, 1955 The Technical Committee of the Arab League forwarded the Unified Johnston Plan, which it had approved, to the Political Committee of the Arab League where it failed to win approval. Brecher (1974) and Lowi (1990) cite Arab concern "that their agreement would imply indirect recognition …" of Israel. It should be pointed out that after the breakdown of the Johnston negotiation in 1955 and during the period of absolute Syrian and Lebanese control of major sources of the Jordan River Basin up until the War of 1967, there were only very limited local initiatives in Syria and Lebanon to utilize those sources which continued as before to flow freely down stream into Israel.

On the practical level however, informal agreement to comply with the Johnston formula both by Israel and Jordan did provide the basis for the major American financial assistance to Israel in the construction of its National Water Carrier (NWC) which enabled Israel to develop important irrigation projects in the south and in the Negev and to Jordan in the construction of the Eastern Ghor Canal (now known as the Abdullah Canal) providing for major irrigation development projects along the eastern banks of the Jordan River. Both countries have cooperated informally ever since in allocations of Yarmuk water along the lines of the Johnston proposals. It was understood that under this arrangement Jordan would eventually build the Western Ghor Canal and supply the Palestinians on the West Bank with 150-200MCM/Yr.

Israel, meanwhile continued to plan and work on construction of the National Water Carrier, but shifted the point of water diversion from the controversial site in the Demilitarized Zone at Gesher B'Not Yaakov to one at Eshed-Kinerot (near Tabcha) on the shores of Lake Tiberias, thus avoiding the issue of construction in the Demilitarized Zone and a direct military confrontation with Syria. Israeli worked intensivly on the construction of the National Water Carrier which was slated for completion and operation by 1965.

4. THE 1960 ARAB LEAGUE PLAN TO CONSTRUCT WORKS TO DIVERT THE FLOW OF THE SOURCES OF THE JORDAN RIVER TO PREVENT ISRAEL'S USE.

However, based on a decision of the Arab League in the early 1960's a plan was developed to prevent Israel's utilization of the sources of the Jordan River involving the construction of diversion canals and tunnels to be built by Syria from the Banyas Springs to the Yarmuk and by Lebanon from the Hasbani River to the Litani which empties into the sea. These diversion works would have deprived Israel of some 300 MCM/Year of the flow from the sources of the Jordan which had been allocated to it under the Johnston plan and which where vital to it for resettlement of refugees and production of food for the millions of new immigrants who had meanwhile found safe haven in the country. Israel objected to the United Nation's claim that these diversion works were a violation of international law and an infringement on its national sovereign rights as a down stream riparian of the Jordan River. When the United Nations failed to intervene and Syria and Lebanon refused to stop construction of these major water diversion works, Israel decided that it had no alternative but to take military steps to cease the construction work and destroy the canals, which it did in 1964. This led to military tensions and limited confrontations between Israel and Syria for a period of time but the work on the diversion project ended and the canals were destroyed.

5. THE CURRENT SYRIAN-ISRAEL PEACE NEGOTIATIONS

At the time of writing, during the early stages of the current Israel-Syrian peace negotiations, there is as yet no clear indication that water issues per say, have been discussed directly or indirectly. The press has reported from the Shepherd's Town negotiations, under the auspices of US President Clinton in February 2000, that the Syrians have suggested that the water allocations be based on international water law as approved by the UN. The authenticity of this statement is not known. However, one critical water-related issue has emerged indirectly in connection with the opening Syrian and Israeli positions on the question of the final borders. The official Syrian position, as stated by President Assad, his Foreign Minister, and in the press, is that they expect the peace agreement with Israel to be based on an Israeli return to the borders that existed between Israel and Syria on June 4, 1967 prior to the outbreak of the " Six Day War" These are presumably based on the cease-fire lines established in the Armistice Agreement of 1949 between Israel and Syria at the end of the 1948 war- Israel's War of Independence-and additional areas occupied through military actions afterwards by the Syrian armed forces. For example, the cease-fire line of the Armistice Agreement of 1949 included within Israel control the entire 10 meter strip along the eastern fringe of Lake Tiberias, as delineated by the 1923 International Border between Mandatory Palestine and Syria, and the Hamat Gader (El Hama) Springs area contiguous to the Yarmuk River. The Syrian army occupied these areas by force after the Armistice Agreement. These lines were never clearly established and there are several different interpretations of them. However, the June 4th lines clearly included within Syrian control critical water resource areas on the western side of the 1923 International Border between Syria and Mandatory Palestine, never previously under Syria sovereignty, which where captured and occupied by the Syrian Army during its attack against the newly founded State of Israel in 1948 and in the period after that, right up to 1967 (Hof, 1999). Press reports have suggested, unofficially, that based on the precedent of its peace agreements with Egypt and Jordan, where a return to the recognized international borders provided the basis for the agreement, Prime Minister Ehud Barak of Israel might be prepared to consider that in the case of Syria aswell, the 1923 international borders that existed between Syria and Mandatory Palestine in 1948 before the war, might provide the point of departure for the negotiations with some minor adjustments (Ha'aretz November 10,1999).

The Israelis point out that the cease fire lines of 1949 and later Syrian armed occupation of critical water sensitive areas along the Jordan River and Lake Tiberias, were the result of aggression and military conquest and that Syria cannot logically demand for Israel to give up the Golan Heights captured during the 1967 war while allowing themselves to hold strategically important areas on the western side of the international border that it captured in the 1948 war and afterwards. Israelis point out that the very same international border of Mandatory Palestine provided the basis for the peace agreements with Jordan and Egypt and will also be the basis of the border settlement with Lebanon, and that only by a return to the international border with Syria will there be symmetry and in accordance with the principle that land taken in war by either side should be returned as part of the peace agreement. It should be pointed out that the official international Syrian/Palestine Mandate borders of 1923, which under the United Nations decision of 1947 served as the legal basis for the borders of what

was to become Israel, are the only internationally recognized borders of Syria. While these borders have been disputed by Syria, they were the only official international border of Mandatory Palestine established by the League of Nations and later recognized by the UN.

5. THE ISSUE OF "WATER SECURITY"

There are a number of groups in Israel who oppose giving up part or all of the Golan Heights to Syria in return for peace. They differ greatly in motivation and ideology. For some, security considerations are of uppermost importance, while for others ideological and personal considerations as home owners, farmers and settlers dominate. Others are concerned about "water security" and protecting Israel's water sources which arise in the Golan.

One possible approach to assure water security within the framework of a peace agreement which I have suggested would be based on the assumption that Israel and Syria will reach an agreement on the final borders which will involve Israel withdrawal from all or most of the Golan Heights up to an agreed upon border. Once the border issue and the security aspects of the peace agreement are settled, then I have suggested that the peace treaty include a special water security zone, which will be under Syrian sovereignty, but joint Israel/Syrian and international monitoring and control. This water security zone would include a strip of some 1-3 kilometers or so in width all along the entire eastern side of the agreed upon border within Syria and Lebanon which would include all the main water sources including the shores of the Jordan River, the Banias Springs, the Hasbani River, El Hama (Hamat Gader) and the shores of Lake Tiberias (see Figure 3.). The justification for the above water security zone proposal is the deep concern felt by the Israeli public that Syria and Lebanon might once again attempt to divert the sources of the Jordan River in order to prevent Israel's use of the Jordan water as they did in 1964/5.

6. THE EXTENT OF THE WATER DISPUTE BETWEEN ISRAEL, SYRIA AND LEBANON

As of the time of writing this paper, press reports to date do not provide a clear picture as to the Syrian expectations or demands for a settlement concerning water. According to the Johnston Plan, Syria was to be allocated only 20 MCM/year from the Banyas, 22 MCM/Yr. from the Jordan River and 90 MCM/Yr. from the Yarmuk for a total of 132 MCM/Yr. (Brecher, 1974). Lebanon was also allocated an additional 35MCM/Yr. from the Hasbani. These figures where based on an independent Arab League evaluation of the amount of agricultural land that Syria and Lebanon could economically irrigate with waters taken at those low elevations.

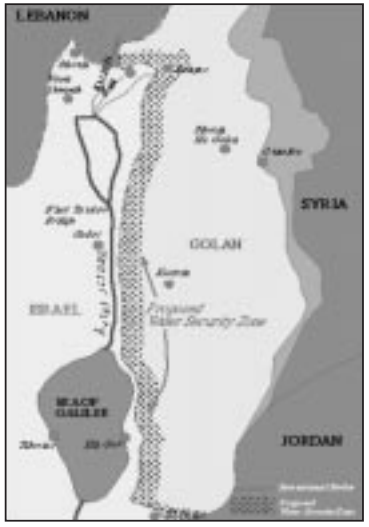

Figure 3. The proposed water security zone:
The Golan Heights, the Upper Jordan River and Lake Kinneret schematically showing the 1923 international border between Israel and Syria(dashed line) and a conceptual presentation of the author's proposed Water Security Zone (hatched area) along the eastern side of the international border with Syria which could be under Syrian sovereignty but with joint and international inspection, monitoring and control with joint patrols which would assure Israel's water security without the need to hold on to all or most of the Golan.

At the time of the Johnston negotiations in 1955, Syria demanded that those amounts of water be allocated for its use. Johnston included the Syrian demands in full in his final plan which was apparently approved by the Government of Israel. While prior to 1967 Syria had not utilized the flow of the Banyas or the Jordan to any great extent, it has during the period of 1974-1987 diverted far more from the Yarmuk and its groundwater sources than the amount allocated under the Johnston Plan.

As a rough first estimate of possible Syrian and Lebanese demands it could be assumed that the amount of water that Syria might claim that it could usefully divert from the Jordan sources and economically utilize for agricultural purposes within the lower reaches of the Golan Heights would be the 42 MCM/Yr.; requested by Syria in 1955 and included in the Johnston Unified Plan. That would be enough water to irrigate some 5,000-10,000 ha.

One scenario assumes that under a peace agreement, Israel will return all or most of the area of the Golan Heights to Syria, in exchange for adequate security arrangements including demilitarization of the Golan, normalization of relations in all fields, full diplomatic relations, and a detailed agreement on water both concerning quantity and protection of its quality. While there was only very limited Syrian irrigated agriculture on the Golan prior to its occupation in 1967, Israeli settlements with the help of the "Mei Golan" Water Cooperative and the Mekorot Water Company have meanwhile developed some irrigated agriculture on the Golan, mainly through the construction of some 15 small dams which can supply some 30 MCM/Yr. of water in good years. Practically no water is collected by these dams in drought years. Prior to the Israeli occupation of the Golan in 1967, most of this water would normally have drained into the Lake Tiberias and become available for use by the Israel National Water Carrier. In addition, a well-field pumping some 6.5 MCM/Yr. has been developed at Alonie Bashan in the central Golan at an elevation of 600 m above sea level (Amon, 1994). It can be assumed that under a peace agreement which returns all or most of the Golan to Syria, these water works in the Golan Heights would revert to Syria and that Israel would view the 40-45 MCM/Yr. of Golan water as part of the Jordan River Basin waters allocated to Syria under the original Johnston Plan.

Pumping water up from Lake Tiberias, which is at minus 210 meters below sea level, or from the Banyas Springs, at plus 350 meters, to the agricultural areas on the central Golan/Kunetra Heights at levels ranging from up to 800-1000 meters above sea level is very expensive. It has been estimated that the cost would be about $0.30-0.35/m3 on average (Amon, 1994). Water at this price is most probably far too expensive and totally unfeasible for Syrian agriculture. The Syrian press has reported plans to resettle the Golan with some 400,000 refugees after its return to Syria under a peace agreement with Israel. It not possible at this time to validate how realistic such plans may be, but it is questionable that there is an economic basis for settling that many people in light of on the limited agricultural resources of the Golan and the very high cost of pumping water to that area. It appears that, as in the past, the water sources of the Jordan River and Lake Tiberias have played and may still play only a very minor role in Syrian water resource utilization mainly for economic reasons due to their inconvenient location both in terms of distance and elevation.

At one stage in the early water disputes between Israel and Syria in the 1950's, Syria claimed that all of the water of the Jordan River is derived from rainfall in Syria and Lebanon and thus is "Arab Water" that belongs to those two upstream countries. Under such a rationale the Syrian's maximum claim might include the entire flow of the Banyas of 120 MCM/Yr. and the flow of 30 MCM/Yr. from the Golan side wadis dams for themselves and the entire flow of the Hasbani, of 150 MCM/Yr. for the Lebanese, for a total of some 300 MCM/Yr. They might justify these claims based on the argument that the sources of these tributaries to the

Jordan River arise in Syria and Lebanon and thus are fully their property. However, prior to the occupation of the Golan in 1967 and prior to the establishment of Israel in 1948 neither Syria or Lebanon actually used much water from those sources, which have always flowed naturally downstream in the Jordan River. For the past 40-50 years or so these water been exploited by Israel as one of its main sources of water for domestic and agricultural use, which is the legal right of a down stream sovereign riparian.

The Syrians today would have difficulty in justifying such a claim under modern precepts of international water law which does not recognize upstream, source countries, as the sole and absolute owners of all water flows in an international river basin. Just the opposite, international law gives considerable weight to the rights of down-stream users to continue their use of that portion of an international water basin which they have previously used for human uses and economically productive purposes (Caponera,1992). The UN approved version of the International Law Commission report of 1997, gives priority to the rights of historical or prior use and considers depriving a down-stream riparian that currently uses the water for economic and social uses as unacceptable since it will result in "appreciable damage" to the current user.

A clear example of such a situation, with which Syria is fully familiar, are the undeniable historic rights of Syria itself, which derives much of its waters from the Euphrates River that emanates in the territory of their upstream neighbor- Turkey. Another well known example is that of Egypt. International water law fully recognizes the historic rights of Egypt to the use of the waters of the Nile River, which it currently uses and has used for thousands of years, despite the fact that essentially 100% of its flow emanates from upstream countries. Today, Syria apparently fully accepts the principles of international water law as approved by the UN relating to the prior use and historic rights of the down stream riparian. They demand this right for themselves.

Another factor in international water law that would weigh heavily against such a Syrian claim would be the fact that the Syrian overall fresh water resources potential per capita is estimated for the year 2000 to be some 900 CM/P/Yr. or about three times that of Israel's 270 CM/P/Yr. Syria would have a difficult time proving that it has an overriding objective need for the additional allocation of water resources it never, in fact, used, as compared to its water poor downstream neighbors.

7. WHAT MIGHT BE THE BASIS FOR AN AGREEMENT ON THE WATER ISSUES?

It is beyond the scope of this paper to anticipate the outcome of the direct negotiations between Israel, Syria and Lebanon on the peace agreement in general, and the issues of borders and water agreement in particular. There may be maximalist claims and demands in the early stages of the negotiations, however there have been some press accounts from unofficial sources close to the Syrians which suggest that there is a growing degree of recognition as to the urgent needs of Israel for the continued use of the major portion of the sources of the Jordan River which have historically and naturally flowed down-stream from the Golan Heights and from Lebanon and have not in fact ever been utilized by those two countries in the past. Thus it may not be unreasonable to believe that a pragmatic "compromise" proposal might be possible. Such a Syrian/Lebanese/Israeli compromise might be the based on the Syrian/Lebanese demand that they be allocated their share of Jordan water as defined under the Johnston Plan, which was approved by the Israel Government in 1955--that is 35MCM/Yr. for Lebanon and 42 MCM/Yr. for Syria. Except for the specific amounts of water from the sources of the Jordan River which by mutual agreement would be allocated to Syria, the remainder of the water from these

sources would continue to flow freely into the Jordan River for Israeli use as it has for the past 40-50 years The Syrians have already taken more than their share of the Yarmuk as defined by the Johnston Plan. It should be pointed out that the Jordan--Israel agreement used the allocations of the Johnston Plan as the point of departure for their negotiations.

8. IMPLICATIONS OF A COMPROMISE BASED ON THE "JOHNSTON PLAN

I take no position on the feasibility or justification of such a proposal but present it as one possible example and an illustration so that we can examine the water resources, agricultural, social and economic implications for Israel of such a possible Syrian-Lebanese proposal for a compromise settlement. Let us assume that Syria and Lebanon propose to reduce Israel's use of the headwaters of the Jordan River sources by about 80 MCM/Yr., which are the volumes of water that theoretically would have been allocated to them under the Johnston Plan. This represents some 5% of Israel's current annual renewable fresh water resources of some 1600 MCM/Yr. This would, in the first instant, result in a direct reduction of good quality fresh-water allocation to agriculture in Israel by about a 10%. With Israel's deep historic and ideological commitment to support its agricultural base, such a reduction of the water allocation to agriculture would be painful indeed and would most likely be opposed by the water and agricultural lobbies as well as raise questions in the minds of a part of the Israeli public as being a possible threat to Israel's water and food security. It would undoubtedly increase the public opposition to reaching a peace agreement with Syria.

At this point we must ask what would be the economic and social impact, in financial terms, of such a reallocation of water resources to Syria and Lebanon as part of the price of peace? What was originally called The Harvard Middle East Water Project (HMEWP)(Fisher, 1996; Shuval, 1995) has made an evaluation of the value of water to the Israel economy and has developed some concepts of water markets for the Israeli, Palestinian and Jordanian economies. In our work on this project we have among other things, evaluated the economic value of the water involved in the water disputes between Israel and the Palestinians. In other word, we have monitized the size of the water in dispute. As Professor Fisher (1996) puts it- when the water dispute is viewed in monitory terms it is easier to see that , "Such a sum of money is small enough for countries to negotiate over rather than to go to war over."

The earlier stages of the studies by the HMEWP, in which the author participated, have shown that the maximum current value of the Jordan River water for Israeli agriculture has been estimated roughly at about $0.20/M3 (Fisher, 1996). Let us, however, assume that at some time in the not to distant future, say in the year 2010, the 80 MCM/Yr. of water that hypothetically Syria and Lebanon are allocated in the peace agreement are indeed fully utilized by them and are urgently needed in Israel for additional for water for domestic/urban use along the coast of Israel at Tel Aviv. This 80MCM/Yr of water could then be replaced by sea water desalination in the south of Israel. It is not unreasonable to assume that, with technological improvements already on the horizon, there will be a significant reduction in the cost of desalination. Thus the predicted replacement cost for that amount of water for Israel by desalination along the Mediterranean coast by that time would be about $.70/M3 or some $ 56,000,000 per year. Some experts predict that desalination costs will be even lower than that. However, these optimistic estimates often neglect to include additional costs such as transport of the desalinated water from the plant to the distribution system, operational storage, mixing and treatment facilities. In any event, even this amount of money, that might be forfeited at some date in the future, is not great, particularly when compared to the other costs associated with the peace process and withdrawal from the Golan. It must be emphasized that water is, after all, an economic good which can be replaced and purchased in unlim-

ited quantities by seawater desalination at a known price which is, more or less, the price that Israelis now pay for urban water supply.

9. REGIONAL COOPERATION FOR WATER RESOURCES DEVELOPMENT

Various studies have shown that on complex multinational watersheds, regional cooperation is essential in optimizing the development of the water resources for the benefit of all of the riparians. Rogers (1993) has shown, based on the experience in the India-Pakistan water dispute and others, that in most situations cooperation by the riparians in the development of the water resources can benefit all the partners to the river basin dispute. It is beyond the scope of this paper to discuss in detail all the possible advantages that can be gained by all partners, through the development of regional water projects under conditions of peace in the region. Some of these have been described elsewhere (Shuval, 1992; by Kally in Assaf et al, 1993 and Kally, 1990) and might include:

9.1. Purchase Of Water From Lebanon-

Purchase of water from Lebanon and the construction of pipelines from the Litani and Awali rivers which could supply water directly or indirectly to Jordan, The Palestine Authority (PA) and Israel. A simple 10 km tunnel from the Litani could deliver the flow of the Litani River in Lebanon directly to the Jordan River which could transport it to down stream users. The water of the Awali River might be diverted in a similar manner. Lebanon might be able to supply as much as 500 MCM/Yr. from these sources for a period up to 25-30 years, which would cover the economic life of the projects which would bring a good profit to Lebanon and relatively cheap water, as compared to sea water desalination, to the downstream partners. At the moment, most of this water flows into the sea, since there is little suitable land for agricultural utilization in the proximity of those two rivers. Estimates indicate that the cost of water from such a project would be about one third the cost of desalination of seawater. An alternative alignment for a relatively inexpensive Awali/Litani pipeline would be along the Lebanese coast directly to Israel where it could be pumped up to the West Bank for Palestinians use or used directly by Israel which would transfer water from the mountain aquifer for Palestinian use in exchange. Water projects such as these from Lebanon may well be the least expensive and most feasible both from and engineering and geopolitical point of view in a future era of peace.

9.2 Dams On The Yarmuk-

The construction of a dam or dams on the Yarmuk which could supply electrical power to Syria and Jordan and water to Jordan and the PA. This project might make possible the construction of the Western Ghor Canal which was originally planned by Jordan to transport Yarmuk water across the Jordan River for the benefit of the water short Palestinians on the West Bank. While not inexpensive it might be feasible from a geopolitical point of view since it would not require direct Israeli participation, but would require Israeli agreement as the down stream riparian on the Yarmuk.

9.3 Transport Of Water From Turkey-

Such a project would involve the purchase of water from Turkey, which could be supplied to Syria, Jordan, the PA and Israel through a regional over-land or under-sea pipeline system or alternatively by sea transport, in refurbished oil tankers or with special large plastic bag/tankers called "Medusa Bags". 1000-2000 MCM/Yr. or more might be supplied to the

area by Turkey through such projects. Of course, a project involving Syrian cooperation would require that Turkey, Syria and Iraq reach an accommodation over their long-standing disputes over the Tigris and Euphrates Rivers. The concept of an under-sea pipeline from Turkey is not as far fetched technically as might appear at first hand, since there are numerous successful examples of such sea bottom pipelines for gas, oil and water. Such a pipeline which would pass through international waters, would overcome most of the geopolitical objections to such a project. The undersea pipeline would be attractive to Turkey since, with it, they could supply water to the Turkish Zone in Northern Cyprus, which suffers from a severe water shortage. Another attractive low cost alternative, first proposed by us in 1993 (Assaf et al, 1993) would be based on an agreement between Turkey and Syria for the purchase of an increased supply to Syria through the natural river systems, mainly the Tigrus. Syria could then increase the flow of the Yarmuk to Jordan who would transport a portion to the Palestinians through a pipe under the Jordan River as envisioned in the original Western Ghor Canal. Another option would be for Syria to transport the Tigris water in a new pipeline which could also supply water to Damascus, to the headwaters of the Hasbani in Lebanon for release into the Jordan River system with the understanding that this would also lead to an increased allocation for the Jordanians and Palestinians. This option would not involve any major pipeline construction work and might be reasonably economical. Of course all of the beneficiaries would have to share in the costs and the payments to Turkey for the water sold to the project. All of these projects could only be considered in an era of stable peace and mutual trust.

9.4 Economic Cooperation Through Water Markets-

The approach developed in the early stage of the HMEWP has clearly shown that in the case of Israel, Jordan and the Palestinians, economic cooperation within the context of a limited water market approach, among the riparians sharing the water resources, is more beneficial to all of partners than going it alone (Fisher, 1996). Other studies on the economic approach have reached similar conclusions.

While the engineering feasibility and price of water from the Litani and Awali has been estimated to be promising, the geopolitical aspects and economics of the other two water import projects are less clear and require further study (Kally in Assaf et al, 1993). While they undoubtedly will be more expensive they still may possibly prove to be less expensive than sea water desalination. Another factor that might weigh in favor of water transport or pipeline projects is that once the capital investment has been made the pumping and other operational costs and energy requirements are relatively low. Desalination, on the other hand, has very high energy demands and would result in a very heavy long term commitment to import fuel which is not naturally available to Israel, the Palestinians or Jordan. This is in itself a serious security factor that must be considered. It must also take into consideration that in the long run the costs of imported fuel may well increase significantly which could, with time, change the optimistic estimates of the cost of seawater desalination.

10. CONCLUSIONS

In this paper I have shown that it may be possible to reach a reasonable compromise between Israel, Syria and Lebanon over their water conflicts which would take into consideration both realistic Syrian and Lebanese needs and interests as well as Israel's water needs and deep water security concerns, without resulting in a serious negative agricultural or economic impact on Israel. I have also shown that it is not necessary for Israel to hold onto the entire area of the Golan Heights since a 1-3 km water security zone under joint and international monitoring and control on the Syrian side of the border could ensure Israeli and Syrian water security needs.

There are groups in Israel that claim that a country must physically maintain an absolute hold over all of its water sources to assure its water security. The term control over the water sources are essentially code words for some of these groups, who want to maintain full political control over all or most of the Golan. However, experts in international water law would hold that the claims that only by the physical occupation of the territories, which serve as a source of its water resources, can a country assure its water rights, is not generally supported by the normal practice of peaceful nations or international water law. If this were so, Iraq and Syria would be justified in taking over the vast water sources in Turkey to assure the continued flow of the Tigris and Euphrates Rivers. Egypt would have to occupy most of Sudan, Ethiopia and some eight other African countries which are the source of the Nile. Holland would have to take over much of Germany and France to assure its control over the Rhine River, its major source of water. There are numerous examples of agreements between nations living in peace on international rivers and transboundary water sources who have achieved agreed-upon modes for joint inspection, monitoring and environmental control which assure the water rights and the protection of the environment for each partner through joint management and cooperation.

Even long term enemies such as India and Pakistan have reached peaceful accommodations over their bitter water conflicts.

Whatever final agreement is reached on the division of the waters of the Jordan River Basin, and the fate of the Golan Heights and the borders, it will be essential to establish a joint Jordan River Management Board (JRMB) which will have the task of assuring mutual monitoring and control on both sides of the final borders to assure that all parties to the agreement take no more than their agreed upon share and that agreed upon pollution control measures to protect the quality of the water sources be strictly enforced. For example, the peace agreement should assure that no sewage flows from the Golan be allowed to enter the Jordan River or Lake Tiberias which is the main source of drinking water for Israel. The JRMB would hopefully also be given the task of developing and managing joint regional cooperation projects. The peace agreement must also include methods of resolving disagreements and disputes at varies levels and stages mainly by direct negotiations, but including additional procedures for conflict resolution such as facilitation, mediation, arbitration; and if all of those fail to resolve the dispute, there should be a final obligation to resort to binding arbitration or adjudication before an agreed upon court.

Those in Israel who are prepared to accept a major territorial compromise with Syria on the Golan Heights, in return for lasting peace with adequate security arrangements and diplomatic, economic and social normalization, have accepted the reality that it will most likely be necessary to reach an agreement which could formally return to Syrian sovereignty most or even all of the Golan up to the recognized Syrian-Israel international border, possibly with minor adjustments. However a reasonably high degree of water security for Israel could be assured if this peace agreement would contain a proviso that would assure that there be a special water security zone with joint and international monitoring and control. These areas- a strip of 1-3 km wide along the Syrian side of the border for special joint and international monitoring and control - would include the critically sensitive water source areas such as the Hasbani, El Hama and Banyas Springs which are the main tributaries of the Jordan River. These special water security zones should also include a sufficiently wide strip of land contiguous to the eastern banks of Lake Tiberias and Jordan River to be monitored and patrolled by Israelis and Syrians together with an international group to assure water security for the partners to the peace agreement. The area involved is a relatively minor portion of the total area of the Golan Heights. In this way it will be possible to carry out the needed monitoring and control

of most of the important water sources and assure that there will be no unregulated water extractions or pollution flows to the Jordan River and Lake Tiberias which is the main source of drinking water for Israel..

Scare stories have been spread by certain groups in Israel, that warn that in the event of a peace agreement with Syria involving withdrawal from the Golan, regardless of the water allocations for each side agreed upon in the peace treaty, Syria plans to covertly divert all of the water sources of the Jordan River basin and in this way deprive Israel of what they claim is 30% of Israel's water supply. It is obvious that such a diversion, if it was ever to be attempted, would involve major engineering projects easily detected under the inspection and control system proposed. Both Syria and the world community at large are fully aware of the fact that any such attempt to divert Israel's vital water resources would be viewed as a causis beli and as an act of war to which Israel would respond vigorously and without hesitation as it did in 1964/5 when such diversion schemes were first attempted. Such machination on the part of those who oppose the peace process for other reasons are highly exaggerated and totally unrealistic but have succeeded in causing a high degree of concern among the Israel public who have a naturally degree of sensitivity and feelings of insecurity about the serious water shortages faced by the country. A recent opinion poll in Israel showed that 79% of the public are seriously worried about the water security implications of a possible peace agreement with Syria involving a withdrawal from the Golan and foregoing control over the sources of the Jordan River. This reinforces the need for a water security zone with active Israeli participation in the monitoring and patrolling of all the water sensitive zones to assure that the terms of the water agreements are strictly enforced.

Hopefully the sides to the water conflicts in the Jordan Basin can achieve an agreement over water which assures each of them their appropriate water rights, national interests and needs based on a reasonable degree of water sharing coupled with strict joint inspection, monitoring, control and management of critically sensitive water sources which will provide the needed degree of security. In the final analysis regional cooperation on developing the shared water resources of the Jordan River Basin can and should be a real motivation for peace by which all of the partners can benefit.

Acknowledgments: Special thanks must be given to Professor Frank Fisher of the Massachusetts Institute of Technology, Professor Lenore Martin, of the Center for Middle Eastern Studies, of Harvard University, Mr. Moshe Yizraeli, of the Office of the Israel Water Commissioner, and Professor Nurit Kliot, of Haifa University for their detailed review of the manuscript in its early stages and many insights and helpful suggestions. The author was awarded the 1999 International Water Resources Association Distinguished Lecturer Award for an earlier version of this paper, presented at the 7th International Conference of the Israel Society for Ecology and Environmental Quality Sciences, Jerusalem, June 1999.

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Trends in Transboundary Water Disputes and Dispute Resolution

*By Dr. Aaron T. Wolf and Jesse H. Hamner**

BACKGROUND

"Water" and "war" are two topics being assessed together with increasing frequency. The approximately 250 international watersheds cover more than one half of the land surface of the globe, and affect 40% of its population. Water is a resource which ignores political boundaries, fluctuates in both space and time, has multiple and conflicting demands on its use, and whose international law is poorly developed, contradictory, and unenforceable. As a consequence, recent articles in the academic literature (Cooley 1984; Starr 1991; Gleick 1993; and others) and popular press (Bulloch and Darwish 1993; World Press Review 1995) point to water not only as a cause of historic armed conflict, but as the resource which will bring combatants to the battlefield in the 21st century.

The historic reality has been quite different from what the "water wars" literature would have one believe. In modern history, only seven minor skirmishes have been waged over international waters -- invariably other inter-related issues also factor in. Conversely, over 3,600 treaties have been signed historically over different aspects of international waters, many showing tremendous elegance and creativity for dealing with this critical resource.

Despite the fact that countries seem not to go to war over water, the relationship between historic water scarcity and acute conflict still needs to be assessed. However, such an investigation should focus on more subtle relations between water and its users: historic evidence does suggest, for example, a relationship between access to clean water supplies and political stability. No better example exists, perhaps, than the Bangladeshi relationship with the Ganges -- as the river's flow decreased as a consequence of Indian diversions, not only did severe environmental degradation result, but farmers and town-dwellers whose water supply became salinized formed a wave of environmental refugees, many thousands of whom flooded into India. This water-induced instability has recurred throughout the Middle East, Africa, and Asia.

Once cooperative water regimes are established through treaty, however, they turn out to be tremendously resilient over time, even between otherwise hostile riparians, and even as conflict is waged over other issues. International water regimes continued to function in the Mekong basin since 1957, despite the Vietnam War; the Jordan basin (between Israel and Jordan) since 1955, even as these riparians until only recently were in a legal state of war; and along the Indus, even through India-Pakistan warfare.

Given this critical role of transboundary water agreements, the processes which lead to their necessity, negotiation, and structure have been surprisingly poorly studied. This paper describes three components of transboundary water issues. The first section investigates the history of transboundary water conflicts and suggests that the "water wars" literature simply is not based

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on an historic reality. The second section offers insight into the much richer history of water dispute resolution as exemplified in water treaties which have been negotiated over time. The major findings of the Transboundary Freshwater Dispute Database are presented as evidence for the cooperation-inducing characteristics of transboundary waters. Nevertheless, an argument for the future based on the past would be disingenuous. Moreover, as Lowi and Shaw describe in the Introduction to this work, security issues are much broader than "simple" questions of war and peace. Lowi's chapter shows in detail how water, while not leading to warfare, has tremendous impacts on regional security issues. In light of this, the third section describes possible indicators to anticipate future water-related tension, based on fourteen detailed case studies of the Database.

"WATER WARS" AND WATER REALITY[1]

As mentioned earlier, there is a growing literature which describes water both as an historic and, by extrapolation, as a future cause of interstate warfare. Westing (1986) suggests that, "competition for limited...freshwater...leads to severe political tensions and even to war"; Gleick (1993) describes water resources as military and political goals, using the Jordan and Nile as examples; Remans (1995) uses case studies from the Middle East, South Asia, and South America as "well-known examples" of water as a cause of armed conflict; Samson and Charrier (1997) write that, "a number of conflicts linked to freshwater are already apparent," and suggest that, "growing conflict looms ahead"; Butts (1997) suggests that, "history is replete with examples of violent conflict over water," and names four Middle Eastern water sources particularly at risk; and Homer-Dixon (1994), citing the Jordan and other water disputes, comes to the conclusion that "the renewable resource most likely to stimulate interstate resource war is river water."

A close examination of the case studies cited as historic interstate water conflict suggest some looseness in classification. Samson and Charrier (1997), for example, list eighteen cases of water disputes, only one of which is described as "armed conflict," and that particular case (on the Cenepa River) turns out not to be about water at all but rather about the location of a shared boundary which happens to coincide with the watershed. Armed conflict did not take place in any of Remans' (1995) "well-known" cases (save the one between Israel and Syria, described below), nor in any of the other lists of water-related tensions presented.

The examples most widely cited are wars between Israel and her neighbors. Westing (1986) lists the Jordan River as a cause of the 1967 war and, in the same volume, Falkenmark (1986), mostly citing Cooley (1984), describes water as a causal factor in both the 1967 war and the 1982 Israeli invasion of Lebanon. Myers (1993), citing Middle East water as his first example of "ultimate security," writes that "Israel started the 1967 war in part because the Arabs were planning to divert the waters of the Jordan River system." In fact, in the years since Israel's invasion of Lebanon in 1982, a "hydraulic imperative" theory, which describes the quest for water resources as the motivator for Israeli military conquests (both in Lebanon in 1979 and 1982 and earlier, on the Golan Heights and West Bank in 1967) was developed in the academic literature and the popular press (see, for example, Davis et al. 1980; Stauffer 1982; Schmida 1983; Stork 1983; Cooley 1984; Dillman 1989; and Beaumont 1991).

The only problem with these theories is a complete lack of evidence. While shots were fired over water between Israel and Syria from 1951-53 and 1964-66, the final exchange, including both tanks and aircraft on July 14, 1966, stopped Syrian construction of the diversion project in dispute, effectively ending water-related tensions between the two states -- the 1967 war broke out almost a year later. The 1982 invasion provides even less evidence of any relation between hydrologic and military decision-making. In extensive papers investigating

precisely such a linkage between hydro-strategic and geo-strategic considerations, both Libiszewski (1995) and Wolf (1995) conclude that water was neither a cause nor a goal of any Arab-Israeli warfare.

To be fair, I should note that I am only describing the relationship between interstate armed conflict and water resources as a scarce resource. I exclude both internal disputes, such as those between interests or states, as well as those where water was a means, method, or victim of warfare. I also exclude disputes where water is incidental to a the dispute, such as those about fishing rights, access to ports, transportation, or river boundaries. Many of the authors which I cite, notably Gleick (1993), Libiszewski (1995), and Remans (1995), are very careful about these distinctions. The bulk of the articles cited above, then, turn out to be about political tensions or stability rather than about warfare, or about water as a tool, target, or victim of armed conflict -- all important issues, just not the same as "water wars."

In order to cut through the prevailing anecdotal approach to the history of water conflicts, we investigated those cases of international conflict where armed exchange was threatened or took place over water resources per se. We utilized the most systematic collection of international conflict -- the International Crisis Behavior (ICB) dataset, collected by Jonathan Wilkenfeld and Michael Brecher (citation needed of their forthcoming work). This dataset contains only those disputes which were considered to be international crises by the principal investigators. Their definition of an international crisis is any dispute where (1) basic national values are threatened (e.g. territory, influence, or existence), (2) time for making decisions is limited, and (3) the probability for military hostilities is high. Using these guidelines, they identified 412 crises for the period 1918-1994. Joey Hewitt, of the University of Maryland at College Park, searched the text files of the ICB dataset for water-related key-words, and found four disputes where water was at least partially a cause. These have been researched and supplemented by three others at the University of Alabama. The complete list includes seven disputes:

1948 Partition between India and Pakistan leaves the Indus basin divided in a particularly convoluted fashion. Disputes over irrigation water exacerbate tensions in the still-sensitive Kashmir region, bringing the two riparians "to the brink of war." Twelve years of World Bank led negotiations lead to the 1960 Indus Waters Agreement.

February 1951 – September 1953 Syria and Israel exchange sporadic fire over Israeli water development works in the Huleh basin, which lies in the demilitarized zone between the two countries. Israel moves its water intake to the Sea of Galilee.

January – April 1958 Amidst pending negotiations over the Nile waters, Sudanese general elections, and an Egyptian vote on Sudan-Egypt unification, Egypt sends an unsuccessful military expedition into territory in dispute between the two countries. Tensions were eased (and a Nile Waters Treaty signed) when a pro-Egyptian government was elected in Sudan.

June 1963 – March 1964 1948 boundaries left Somali nomads under Ethiopian rule. Border skirmishes between Somalia and Ethiopia are over disputed territory in the Ogaden desert, which includes some critical water resources (both sides are also aware of oil resources in the region). Several hundred are killed before cease-fire is negotiated.

March 1965 – July 1966 Israel and Syria exchange fire over "all-Arab" plan to divert the Jordan River headwaters, presumably to preempt the Israeli "national water carrier," an out-of-basin diversion plan from the Sea of Galilee. Construction of the Syrian diversion is halted in July 1966.

April – August 1975 In a particularly low-flow year along the Euphrates, as upstream dams are being filled, Iraqis claim that the flow reaching its territory was "intolerable," and asked that the Arab League intervene. The Syrians claim that less than half the river's normal flow are reaching its borders that year and, after a barrage of mutually hostile state-

ments, pull out of an Arab League technical committee formed to mediate the conflict. In May 1975, Syria closes its airspace to Iraqi flights, and both Syria and Iraq reportedly transfer troops to their mutual border. Only mediation on the part of Saudi Arabia breaks the increasing tension.

April 1989 – July 1991 Two Senegalese peasants were killed over grazing rights along the Senegal River, which forms the boundary between Mauritania and Senegal, sparking smoldering ethnic and land reform tensions in the region. Several hundred are killed as civilians from border towns on either side of the river attack each other before each country uses its army to restore order. Sporadic violence breaks out until diplomatic relations are restored in 1991.

As we see, the actual history of armed water conflict is somewhat less dramatic then the "water wars" literature would lead one to believe: a total of seven incidents, in three of which no shots were fired. As near as we can find, there has never been a single war fought over water.[2]

This is not to say there is no history of water-related violence – quite the opposite is true – only that these incidents are at the sub-national level, generally between tribe, water-use sector, or state. Examples of internal water conflicts, in fact, are quite prevalent, from interstate violence and death along the Cauvery River in India, to California farmers blowing up a pipeline meant for Los Angeles, to much of the violent history in the Americas between indigenous peoples and European settlers. The desert state of Arizona even commissioned a navy (made up of one ferry boat) and sent its state militia to stop a dam and diversion on the Colorado River in 1934 (Fredkin 1981).

Too, one need look no further than relations between India and Bangladesh to note that internal instability can both be caused by, and exacerbate, international water disputes. At issue is a barrage which India has built at Farakka, which diverts a portion of the Ganges flow away from its course into Bangladesh, towards Calcutta 100 miles to the south, in order to flush silt away from that city's seaport. Adverse effects in Bangladesh resulting from reduced upstream flow have included degradation of both surface and groundwater, change in morphology, impeded navigation, increased salinity, degraded fisheries, and danger to water supplies and public health. Environmental refugees out of affected areas have further compounded the problem. Ironically, many of those displaced in Bangladesh have found refuge in India (Biswas and Hashimoto 1996).

So, while no "water wars" have occurred, there is ample evidence that the lack of clean freshwater has lead to occasionally intense political instability and that, on a small scale, acute violence can result. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are inversely related.

THE TRANSBOUNDARY FRESHWATER DISPUTE DATABASE[3]

The UN Food and Agriculture Organization has identified more than 3,600 treaties relating to international water resources dating between AD 805 and 1984, the majority of which deal with some aspect of navigation (UN FAO 1978; 1984). Since 1814, states have negotiated approximately 300 treaties which deal with non-navigational issues of water management, flood control, hydropower projects, or allocations for consumptive or non-consumptive uses in international basins. Including only those signed in this century which deal with water per se, and excluding those which deal only with boundaries, navigation, or fishing rights, the authors have collected full and partial texts of 145 treaties in a Transboundary Freshwater Dispute Database at the University of Alabama. The collection efforts continue in an ongoing

project of the Department of Geography and the Center for Freshwater Studies, in conjunction with projects funded by the World Bank and the US Institute of Peace.

Negotiating notes and published descriptions of treaty negotiations are also being collected in the Database -- at present the Database includes fourteen detailed case studies. These cases include nine watersheds -- the Danube, Euphrates, Jordan, Ganges, Indus, Mekong, Nile, La Plata, and Salween; two sets of aquifer systems -- US-Mexico shared systems and the West Bank Aquifers; two lake systems -- the Aral Sea and the Great Lakes; and one engineering works -- the Lesotho Highlands Project.

At present, few authors have undertaken systematic work on the body of international water treaties as a whole, although some use treaty examples to make a point about specific conflicts, areas of cooperation, or larger issues of water law (see for example Vlachos 1990; Teclaff 1991; McCaffrey 1993; Eaton and Eaton 1994; Housen-Couriel 1994; Dellapenna 1995; and Kliot et al. 1997). In two of the most thorough exceptions, Dellapenna (1994) describes the evolution of treaty practice dating back to the mid-1800's, and Wescoat (1995) assesses historic trends of water treaties dating from 1648-1948 in a global perspective. In addition, McCaffrey (1993) offers theories about trends in treaty-making, specifically the move towards integrated management from unilateral development, the move away from navigation as the primary use, and the trend towards "equitable utilization." Hayton (1988, 1991) has argued that international law should account more for hydrologic processes.

Treaties can tell about regional hegemony, about how and which water needs are met, about the relative importance of water in the political climate, about development issues, and whether earlier treaties have successfully guided or guaranteed state behavior. To organize and analyze these treaties, Jesse Hamner has developed a systematic computer compilation which catalogs the treaties by basin, countries involved, date signed, treaty topic, allocations measure, conflict resolution mechanisms, and non-water linkages.

MAJOR FINDINGS

The contents of the Database are qualitatively and quantitatively assessed for their provisions regarding the following criteria: basin involved; principal focus; number of signatories; non-water linkages (such as money, land, or concessions in exchange for water supply or access to water); provisions for monitoring, enforcement, and conflict resolution; method and amount of water division, if any; and the date signed (treaty dates and titles are listed as Table 1). Preliminary descriptions of our findings follow (Table 2 provides a statistical summary):

Treaty Signatories:

One hundred and twenty-four of the 145 treaties (86%) are bilateral. Twenty-one (14%) are multilateral; two of the multilateral treaties are unsigned agreements or drafts. It is unclear whether so many treaties are bilateral because only two states share a majority of international watersheds or because, according to negotiation theory, the difficulty of negotiations increases as the number of parties increases (Zartman in Kremenyuk, ed., 65-77).

In multilateral basins, this preference towards bilateral agreements can preclude the regional management long advocated by water resource managers. One who ignores the watershed as the fundamental planning unit, where surface- and groundwater, quality and quantity are all inter-related, also ignores hydrologic reality. The Jordan basin, for example, has been characterized by bilateral arrangements -- the only regional talks on the basin, the Johnston negotiations of 1953-55, went unratified. As unilateral develop-

ment in the basin proceeded in the absence of agreement, each state's goals and plans abutted against those of the other co-riparians, leading to inefficient development and even to exchanges of fire in the early 1950's and mid-1960's. Similarly, India has a long-standing policy of adhering to bilateral negotiations, presumably because it can best address its own needs vis-a-vis each of its neighbors separately. Partly as a consequence, neither the Ganges-Brahmaputra nor the Indus River systems have ever been managed to their potential efficiency. All but three multilateral agreements lack definite allotments, although a few establish advisory and governing bodies among states.

Of the 21 multilateral treaties/agreements, developing nations account for 13. Only one multilateral treaty, the treaty regarding water withdrawals from Lake Constance signed by Germany, Austria, and Switzerland in 1966, exists between industrialized nations for access to a water source. None of the preindustrial-nation multilateral agreements specified any water allocations -- all involved hydropower and/or industrial uses.

The states surrounding the Aral Sea have an agreement, dated 1993, that deals with several joint issues, but the text lacks allocations and provides too little detail for planning water use. Like the Aral Sea, Lake Chad also suffers from intense, poorly managed use and current deficit water withdrawals. The Chad Basin treaty (1964), among Cameroon, Niger, Nigeria, and Chad, deals with economic development inside the basin, the lake's tributaries, and industrial uses of the lake, but lacks allocations. The agreement does create a commission, which, among other things, arbitrates disputes concerning implementation of the treaty. The commission prepares general regulations, coordinates the research activities of the four states, examines their development schemes, makes recommendations, and maintains contact among the four states.

Principal Focus:

Most treaties focus on hydropower and water supplies: 57 (39%) of the treaties discuss hydroelectric generation, and 53 (37%) distribute water supplies. Nine (6%) mention industrial uses, six (4%) navigation, and six (4%) primarily discuss pollution. Thirteen of the 145 (9%) focus on flood control. The Database includes one treaty which primarily discusses fishing (<1%) (included for other treaty elements).

Great Britain is a signatory in 27 (19%) of the treaties. Of that number, 17 (63%) relate to water supply, all but one (in Canada) of an African or South Asian colony.

Monitoring:

Seventy-eight (54%) treaties have provisions for monitoring, while 67 (46%) do not. When monitoring is mentioned, it is addressed in detail, often including provisions for data-sharing, surveying, and schedules for collecting data.

Information-sharing generally engenders good will and can provide confidence-building measures between co-riparians. Unfortunately, some states classify river flows as secrets, and others use lack of mutually agreeable data as a stalling technique in their negotiations (Kaye 1989, 17). Most monitoring clauses contain only the most rudimentary elements, perhaps due to the time and labor costs of gathering data.

However, data collected by signatories of the treaty can provide a solid base for later discussions. India and Bangladesh eventually agreed on Ganges flow data and based a workable agreement on that data in 1977, where previously both parties could not agree to the accuracy of each other's hydrologic records. The cooperation between engineers or

among council members can result in the formation of an epistemic community -- a community of trans-boundary professionals -- another positive outcome of data gathering/sharing. Treaties have not commonly included provisions to monitor compliance, but such additions may bolster trust and increase strength of these epistemic bonds.

Method for Water Division:

Few treaties allocate water: clearly defined allocations account for 54 (37%) of the agreements. Of that number, 15 (28%) specify equal portions, and 39 (72%) provide a specific means of allocations. In other work, Wolf (in review) finds four general trends in those treaties which specify allocations: 1) A shift in positions often occurs during negotiations from "rights-based" criteria, whether hydrography or chronology, in favor of "needs-based" values, based on irrigable land or population, for example; 2) In the inherent disputes between upstream and downstream riparian and existing and future uses, the needs of the down-stream riparian are more-often delineated -- upstream needs are mentioned only in boundary waters accords in humid regions -- and that existing uses, when mentioned, are always protected; 3) Economic benefits have not been explicitly used in allocating water, although economic principles have helped guide definitions of "beneficial" uses and have suggested "baskets" of benefits, including both water and non-water resources, for positive-sum solutions; 4) The uniqueness of each basin is repeatedly suggested, both implicitly and explicitly, in the treaty texts.

This last point is exemplified in the unique measures which negotiators have devised: the 1959 Nile Waters Treaty divides the average flow based on existing uses, then evenly divides any future supplies (projected from the Aswan High Dam and the Jonglei Canal Project); the Johnston negotiations led to allocations between Jordan riparians based on the irrigable land within the watershed -- each party could then do what it wished with its allocations, including divert it out-of-basin; and the Boundary Waters Agreement, negotiated with a hydropower focus between Canada and the US, which allows a greater minimum flow of the Niagara River over the famous falls during summer daylight hours, when tourism is at its peak.

Hydropower:

Fifty-seven of the treaties (39%) focus on hydropower. Power-generating facilities bring development, and hydropower provides a cheap source of electricity to spur developing economies. Postel (1997) and others, however, suggest that the age of building dams will soon end because of lack of funding for large dams, a general lack of suitable new dam sites, and environmental concerns.

Not surprisingly, less-developed mountain-nations at the headwaters of the world's rivers are signatories to the bulk of the hydropower agreements -- Nepal alone, with an estimated 2% of the world's hydropower potential (Aryal 1995, 160), has four treaties with India (the Kosi River agreements, 1954, 1966, 1978, and the Gandak Power Project, 1959) to exploit the huge power potential in the region.

Groundwater:

Only three agreements deal with groundwater supply (the 1910 convention between Great Britain and the Sultan of Abdali, and the 1994 Jordan-Israel peace treaty and the Palestinian-Israeli accords (Oslo II)). Treaties that focus on pollution usually mention groundwater, but do not quantitatively address the issue.

The complexities of groundwater law have been described by more than a few authors (see, for example, Hayton 1982 and Utton (1982)). Overpumping can destroy cropland through salinity problems, either by seawater intrusion or evaporation-deposition, and

therefore allocating too much water (or one party's overpumping) can decimate future freshwater supplies.

The Bellagio Draft Treaty, developed in 1989, attempts to provide a legal framework for groundwater negotiations. The treaty describes principles based on mutual respect, good neighborliness, and reciprocity, which requires joint management of shared aquifers (Hayton and Utton 1989). While the Draft recognizes that obtaining groundwater data can prove difficult and expensive, and its acceptance relies on cooperative and reciprocal negotiations, it does provide a useful framework for future groundwater diplomacy.

Non-Water Linkages:

Negotiators may facilitate success by enlarging the scope of water disputes to include non-water issues. If pollution causes trouble in a downstream country, an upstream neighbor may opt to pay for a treatment plant in lieu of reduced inputs or reduced withdrawals. In such a case, lesser amounts of high-quality water may improve relations more than a greater quantity of polluted or marginal-quality water. Such tactics "enlarge the pie" of available water and other resources in a basin. Non-Water Linkages include capital, 44/145 (30%); land, 6/145 (4%); political concessions, 2(1%); other linkages, 10/145 (7%); and no linkages, 83/145 (57%).

In the 1929 Nile agreement, the British agreed to give technical support to both Sudan and Egypt. In lieu of payments, the Soviet Union agreed to compensate lost power generation to Finland in perpetuity (the 1972 Vuoksa agreement). Britain even established ferry service across newly-widened parts of a the Hathmatee in India, in compensation for the inaccessibility problems created by their dam project in the late 1800s.

Compensation for land flooded by dam projects is common. British colonies usually agreed to pay for water delivery and reservoir upkeep. However, capital can provide compensation for a greater array of possibilities, flooded homes, and construction of new water facilities (the India-Nepal Kosi River Project Agreements, signed in 1954 and 1966 provide two examples).

Treaties which allocate water also include payments for water -- 44 treaties (30%) include monetary transfers or future payments. As early as 1925, Britain moved towards equitable use of the rivers in its colonies -- Sudan agreed to pay a portion of the income generated by new irrigation projects to Eritrea, since the Gash river flowed through that state as well. Treaties also recognize the need to compensate for hydropower losses and irrigation losses due to reservoir storage (the 1951 Finland/Norway treaty and the 1952 Egypt/Uganda treaty both include such compensation). Again, this fact emphasizes the monetary aspect of water: it does not describe water as a right or commodity.

Enforcement:

Treaties handle disputes with technical commissions, basin commissions, or government officials. Fifty-two (36%) of the treaties provide for an advisory council or conflict-addressing body within the government. Fourteen (10%) refer disputes to a third-party or the United Nations. Thirty-two (22%) make no provisions for dispute resolution, and 47 (32%) of the texts are either incomplete or uncertain in the creation of dispute resolution mechanisms.

Historically, force or the threat of force can ensure that a water treaty will be followed (e.g., British colonial treaties and the 1947 Allied peace treaty with Italy). Power is an unfortunate guarantor of compliance. Britain could oversee its colonial water treaties

because it had one of the most powerful administrative and military organizations in the world. Agreements on the Nile generally favor Egypt, while those on the Jordan River favor Israel for similar reasons.

While the conflict resolution mechanisms in these treaties do not generally show tremendous sophistication, new enforcement possibilities exist with new monitoring technology -- it is now possible to manage a watershed in real time, using a combination of remote sensing and radio-operated control structures. In fact, the next major step in treaty development may well be mutually enforceable provisions, based in part on this technology.

INDICATORS OF FUTURE WATER-RELATED TENSIONS[4]

One can assume that each water treaty represents a dispute which has been resolved -- some issue must arise for the parties to enter negotiations to begin with. It would stand to reason, then, that by assessing the variables which immediately preceded the negotiation of a treaty, one might be able to determine what factors act as indicators of impending dispute.

For example, many of the most virulent examples of water conflict came about immediately following the internationalization of a previously national waterway -- such was the case on the Jordan, Indus, Nile, and Aral basins. The existence of ethnic minorities or political subgroups along major waterways, then, may point to regions with the potential for future hydropolitical stresses -- Kurdish regions along the Euphrates, or the Punjab between India and Pakistan, for example.

In contrast, and somewhat counter-intuitively, climate seems not to be a major variable in water disputes. This may be because water has multiple uses which are all critically important, but which change depending on climate conditions. The hydropower or transportation offered by a river in a humid climate, for example, is no less important to its riparians than is the irrigation water provided by a river in an arid zone. We see, then, hydropolitical disputes across the climatic spectrum, from the Plata and Ganges in the humid zone, to the Nile, Jordan, and Tigris-Euphrates, each of which have humid-zone headwaters, but which flow primarily through arid areas.

To do an extensive analysis of each of the basins represented by the treaties in our Database is beyond the scope of this paper, but the fourteen case studies mentioned above do suggest patterns which may be useful in allowing for anticipation of likely conflict.

In general, a pattern which emerges is as follows. Riparians of an international basin implement water development projects unilaterally first on water within their territory, in attempts to avoid the political intricacies of the shared resource. At some point, as water demand approaches supply, one of the riparians, generally the regional power[5], will implement a project which impacts at least one of its neighbors. [See Figure 1.] This might be to continue to meet existing uses in the face of decreasing relative water availability, as for example Egypt's plans for a high dam on the Nile, or Indian diversions of the Ganges to protect the port of Calcutta, or to meet new needs reflecting new agricultural policy, such as Turkey's GAP project on the Euphrates.

This project which impacts one's neighbors can, in the absence of relations or institutions conducive to conflict resolution, become a flashpoint, as described above. Each of these projects is preceded by indicators of impending or likely water conflict, which might include:

Water quantity issues.

Often, simply extrapolating water supply and demand curves will give an indication of when a conflict may occur, as the two curves approach each other. The mid-1960's, a period of water conflict in the Jordan basin, saw demand approaching supply in both Israel and Jordan. Also, major shifts in supply might indicate likely conflict, due to greater upstream use or, in the longer range, to global change. The former is currently the case both on the Mekong and on the Ganges. Likewise, shifts in demand, due to new agricultural policies or movements of refugees or immigrants can indicate problems. Water systems with a high degree of natural fluctuation can cause greater problems than relatively predictable systems.

Water quality issues.

Any new source of pollution, or any new extensive agricultural developing resulting in saline return flow to the system, can indicate water conflict. Arizona return flow into the Colorado was the issue over which Mexico sought to sue the US in the 1960s through the International Court of Justice, and is currently a point of contention on the lower Jordan between Israel, Jordanians, and West Bank Palestinians.

Management for multiple use.

Water is managed for a particular use, or a combination of uses. A dam might be managed for storage of irrigation water, power generation, recreation, or a combination, for example. When the needs of riparians conflict, disputes are likely. Many upstream riparians, for instance, would manage the river within their territory primarily for hydropower where the primary needs of their downstream neighbors might be timely irrigation flows. Chinese plans for hydropower generation and/or Thai plans for irrigation diversions would have an impact on Vietnamese needs for both irrigation and better drainage in the Mekong Delta.

Political divisions.

A common indicator of water conflict is shifting political divisions which reflect new riparian relations. Such is currently the case throughout Central Europe as national water bodies such as the Aral Sea, the Amu Dar'ya, and the Syr Dar'ya become international. Many of the conflicts presented here, including those on the Ganges, the Indus, and the Nile, took on international complications as the central authority of a hegemon, in these cases the British empire, dissipated.

Along with clues useful in anticipating whether or not water conflicts might occur, patterns based on past disputes may provide lessons for determining both the type and intensity of impending conflicts. These indicators might include:

Geopolitical setting.

As mentioned above, relative power relationships, including riparian position, determine how a conflict unfolds (for a detailed examination of this issue, see Lowi 1993). A regional power which also has an upstream riparian position is in a greater situation to implement projects which may become flashpoints for regional conflict. Turkey and India have been in such positions on the Euphrates and the Ganges, respectively. In contrast, the development plans of an upstream riparian may be held in check by a downstream power as, for example, have Ethiopia's plans for Nile development by Egypt.

The perception of unresolved non-water related issues with one's neighbors, both water-related and otherwise, is also an exacerbating factor in water conflicts. Israel, Syria, and Turkey each, and respectively, have difficult political issues outstanding, which makes discussions on the Jordan and Euphrates more intricate.

Level of national development.

Relative development can inform the nature of water disputes in a number of ways. For example, a more-developed region may have better options to alternative sources of water, or to different water management schemes, than less-developed regions, resulting in more options once negotiations begin. In the Middle East multilateral working group on water, for instance, a variety of technical and management options, such as desalination, drip irrigation, and moving water from agriculture to industry, have all been presented, which in turn supplement discussions over allocations of international water resources.

Different levels of development within a watershed, however, can exacerbate the hydropolitical setting. As a country develops, personal and industrial water demand tends to rise, as does demand for previously marginal agricultural areas. While this can be somewhat balanced by more access to water-saving technology, a developing country often will be the first to develop an international resource to meet its growing needs. Thailand has been making these needs clear with its relatively greater emphasis on Mekong development.

The hydropolitical issue at stake.

In a survey of fourteen river basin conflicts, Mandel (1992) offers interesting insight relating the issue at stake with the intensity of a water conflict. He suggests that issues which include a border dispute in conjunction with a water dispute, such as the Shatt al-Arab waterway between Iran and Iraq and the Rio Grande between the US and Mexico, can induce more severe conflicts than issues of water quality, such as the Colorado, Danube, and La Plata rivers. Likewise, conflicts triggered by human-initiated technological disruptions -- dams and diversions -- such as the Euphrates, Ganges, Indus, and Nile, are more severe than those triggered by natural flooding, such as the Columbia and Senegal rivers.

One interesting lack of correlation is also found in Mandel's study -- that between the number of disputants and intensity of conflict. He suggests that this challenges the common notion that the more limited, in terms of number of parties involved, river disputes are easier to resolve.

Institutional control of water resources.

An important aspect of international water conflicts is how water is controlled within each of the countries involved. Whether control of the resource is vested at the national level, as in the Middle East, the state level, as in India, or at the sub-state level, as in the United States, informs the complication of international dialog. Also, where control is vested institutionally is important. In Israel, for example, the Water Commissioner is under the authority of the Ministry of Agriculture, whereas Jordanian control is at the ministerial level, with the Ministry of Water. Theses respective institutional settings can make internal political dynamics quite different for similar issues.

National water ethos.

This term incorporates several somewhat ambiguous parameters together which determine how a nation "feels" about its water resources, which in turn can help determine how much it "cares" about a water conflict. Some factors of a water ethos might include:

- "mythology" of water in national history, e.g., Has water been the "lifeblood of the nation?" Was the country built up around the heroic fellah? Is "making the desert bloom" a national aspiration? In most countries, in contrast, water plays little role in the national history.
- importance of water/food security in political rhetoric;
- relative importance of agriculture versus industry in the national economy.

CONCLUSIONS

There is a large and growing literature warning of future "water wars" -- they point to water not only as a cause of historic armed conflict, but as the resource which will bring combatants to the battlefield in the 21st century.

The historic reality has been quite different. In the modern times, only seven minor skirmishes have been waged over international waters -- invariably other inter-related issues also factor in. Conversely, over 3,600 treaties have been signed historically over different aspects of international waters -- 145 in this century on water qua water -- many showing tremendous elegance and creativity for dealing with this critical resource. This is not to say that armed conflict has not taken place over water, only that such disputes generally are between tribe, water-use sector, or state. What we seem to be finding, in fact, is that geographic scale and intensity of conflict are inversely related.

War over water is neither strategically rational, hydrographically effective, nor economically viable. Shared interests along a waterway seem to overwhelm water's conflict-inducing characteristics and, once water management institutions are in place, they tend to be tremendously resilient. The patterns described in this paper suggest that the more valuable lesson of international water is as a resource whose characteristics tend to induce cooperation, and incite violence only in the exception.

Nevertheless, 145 treaties which govern the world's international watersheds, and the international law on which they are based, are in their respective infancies. More than half of these treaties include no monitoring provisions whatsoever and, perhaps as a consequence, two-thirds do not delineate specific allocations and four-fifths have no enforcement mechanism. Moreover, those treaties which do allocate specific quantities, allocate a fixed amount to all riparian states but one -- that one state must then accept the balance of the river flow, regardless of fluctuations.

While wars do not seem to be fought over water, water-tensions do crop up regularly which, if one considers each treaty the manifestation of a dispute resolved, are exemplified by the very prevalence of such treaties. By examining the conditions in each set of co-riparian states immediately before the resolution of their disputes, one finds patterns which not only may indicate a future water dispute, but may offer clues to the type and intensity of an impending conflict. These indicators might include water quantity issues; water quality issues; multiple uses of the water; political divisions; the geopolitical setting; level of national development; the hydropolitical issue at stake; water institutions; and depth of any national water ethos.

Notes:

[1] The material from this section was drawn from a paper presented at a NATO Advanced Research Workshop on Environmental Change, Adaptation and Human Security, Budapest, Hungary, 9-12 October, 1997.

[2] This in not quite true. The earliest documented interstate conflict known is a dispute between the Sumerian city-states of Lagash and Umma over the right to exploit boundary channels along the Tigris in 2,500 BCE (Cooper 1983). In other words, the last and only "water war" was 4,500 years ago.

[3] This section is drawn from Hamner and Wolf (in press).

[4] Some of the following section is drawn from Wolf (1997).

[5] "Power" in regional hydropolitics can include riparian position, with an upstream riparian having more relative strength vis a vis the water resources than its downstream riparian, in addition to the more-conventional measures of military, political, and economic strength. Nevertheless, when a project is implemented which impacts one's neighbors, it is generally undertaken by the regional power, as defined by traditional terms, regardless of its riparian position.

Solving the Problem of Fresh Water Scarcity in Israel, Jordan, Gaza and the West Bank

*By Wayne Owens and Kenley Brunsdale**

One of the Center for Middle East Peace and Economic Cooperation's major efforts over the last six years has been to study, explain and encourage sea water desalination by all parties, at the same time as the sides dispute and negotiate their respective water "rights". The pool of fresh water available is dwindling and also deteriorating in quality, and even if the parties are not willing to acknowledge cooperation in increasing the amounts of fresh water available, all three, including Jordan, do, in fact, appear to be proceeding individually at the same time as Israel and the Palestinians prepare to do battle over water rights.

This Paper attempts to summarize the dramatic evolution of desalination technology and decrease in costs, and to relate those largely unknown realities to the water needs of the Jordan River Basin while pointing out that the peace process can be made easier by large-scale sea water desalination. In fact, there need be neither water shortage nor water disputes; the matter is economic, not political. Water scarcity need not – and must not – be an impediment either to regional peace nor to regional prosperity.

After desalination, the second major factor of importance today is to implement, as rapidly as possible, the demand management practices that can dramatically extend existing supplies. But desalination must not wait for such improvements. A complete and total solution to the fresh water shortages will require both efforts simultaneously.

The average price of desalinated sea water is today only one-tenth of what it was twenty years ago, dropping dramatically from $5.50 per cubic meter in 1979 to $0.55 in 1999, including interest, capital recovery and O & M. Today's cost of construction of a reverse osmosis desalination facility remains constant at about $3 million per million cubic meter per year yield (hence, a 100 million cubic meter per year sea water desalination plant will cost about $300 million to construct), regardless of where it is built in the world. Construction is modular, and can be built incrementally to the capacity needed.

Fresh water supplies in the Jordan River Basin are at an all-time low in terms of availability per capita. Water quality and environmental problems are serious. And a fresh water shortfall of at least 20% by 2010 is forecast by almost all credible experts when the current population of 13 million people will have increased to as much as 20 million.

Complicated by disparity of usage patterns (Israelis use about 100 cubic meters per year for domestic purposes, Jordanians about 50 and Palestinians about 30) water rights issues promise to be very difficult to resolve between Israelis and Palestinians and also between Israel and Syria, but would be much easier if there were large, new amounts of fresh water available.

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This Paper analyzes possible sources of new water and strongly argues that only sea water desalination offers a secure, long-term solution to the worsening fresh water crisis. Israel is believed to be very close to finalizing an emergency agreement to buy fresh water from Turkey, to be delivered by unused oil tankers. Whether that resource is dependable, practical or desirable when compared with sea water desalination, are valid questions which this Paper discusses, urging that desalination is the only valid solution in the long run. The use of natural and man-made water storage and distribution mechanisms throughout the region can permit water equity as fast as new water supplies are available and political decisions are achieved.

The careful study of desalination cost data has convinced us that Israel could desalinate as much as 1 billion cubic meters of sea water at a cost of $0.55 to $0.70/m3, probably closer to the lower figure, and that the economy will largely justify and support that investment. A proposal to build the first Israeli sea water desalination plant on the Mediterranean (50 million cubic meters per year) is being considered by the Israeli Government. The Palestinians are also considering a 50 million cubic meter sea water desalination plant at Gaza, and the Jordanians are preparing to desalinate as much as 50 million cubic meters per year of brackish water at Wadis Hisban. Without any formal decision to coordinate those efforts, simultaneously proceeding on the three projects in effect could be presented to the world as a regional program for funding assistance purposes.

It must be clearly understood that the authors do not intend that this Paper be interpreted to favor in any way, any position relating to the respective water rights of the parties, which are properly and uniquely the subject of negotiations between the parties. Nor do we desire to affect in any way or to any degree the outcome of those negotiations, except, hopefully, to help facilitate their successful completion.

The Problems

A 1997 UN study reported that consumptive water use has been increasing more than twice as fast as population during this century and that the resulting shortages have been worsened by contamination that is destroying already inadequate supplies. No place in the world is that problem more acute than in the region which is the focus of this paper.

A 1994 study by Arthur Andersen & Co. SC, commissioned by the Center, sets forth what Arthur Andersen & Co. called the current status of the regional water crisis at that time, which – five years later – is even more strikingly accurate, even more pronounced:

- The regional demand for water is outpacing supply.
- The demand is projected to increase between 71% - 100%, total demand reaching approximately 4,700 mcm by the year 2020.
- The demand rates for Israel, Jordan, Gaza and the West Bank are predicted to grow 18%, 91% and 456% respectively.
- The current supply will not be able to accommodate any levels of growth.
- Over-pumping of major aquifers has reached critical levels.
- The peace treaty outlines an approach to water management that calls for international/regional cooperation and provides an environment conducive to foreign investment.

The water problems faced by Syria and Egypt add further complexity to the issue. Egypt is approaching full exploitation of its groundwater and Nile River water resources. Egypt is largely (some say as much as 98%) dependent on the Nile River for water. Perhaps as much as 85% of the Nile originates in Ethiopia and Sudan, which will double their population in the

next 20 years. The Euphrates River is almost as important to Syria as the Nile is to Egypt. Development by Turkey of the South-East Anatolia Project (22 major dams - now half complete) is reducing Syria's water supply. Most of Syria's other fresh water sources appear to be nearing full exploitation.

Water has almost always been a source of potential conflict in the Middle East, and is at present a seriously contested issue among Israel, the Palestinians, Syria and, to some extent still, the Jordanians. It has potential to disrupt the delicate peace Israel has achieved with Jordan, and is a limiting factor to Egypt's plans for growth. Serious drought conditions currently exist, exacerbating normal conflicts over disputed water rights, polluted supplies and increasing populations. These factors combine to create the worst fresh water crisis in the region's history.

A Regional Plan is Essential

This paper argues that desalination is a major element of the solution for the region's fresh water problems, but that other steps must be taken in parallel if the very serious water shortage is to be averted. Cooperation on water management and demand management practices must be implemented region-wide in the near future. At the same time, regional governments must undertake immediate plans for large scale brackish and sea water desalination on a priority basis. Only then would the region be assured that adequate fresh water supplies will be available to all of the peoples in the region, and reduce the increasingly serious consequences of drought.

An agreement to develop large new water supplies, along with creating the external financing, might introduce an optimistic beginning to those "final status" negotiations. It could mean that water, as one of those five issues, could be put into a new perspective. It could establish a positive win-win precedent for resolution of remaining final status conflicts.

It defies intelligence and judgment if regional countries do not cooperate to increase fresh water availability when the size of the available pool of water is so grossly inadequate, even though they are still trying to divide up the small amount of existing water available.

Water Quality Concerns

Ground water is the primary source of water in every part of the region. The only significant surface water supply is the Sea of Galilee, which also has its own endemic water quality problems. Many experts believe that the entire region's ground water supplies are now being extracted at, or beyond, their recharge capacity. The worst example is in Gaza, where extraction is approximately 120 million cubic meters per year and normal recharge is 80 million cubic meters per year. But Israel's Coastal Aquifer, which supplies approximately 1/3 of Israel's water needs is also being seriously overexploited.

The Israel State Comptroller's report on local authorities for 1995 devotes an entire chapter to water quality, pointing to the steady deterioration of water quality due to surface contamination and over-pumping, especially ground water in the coastal area. The lack of adequate and coordinated waste water treatment and surface contamination control on the West Bank is threatening the critically important Mountain Aquifer. The inadequate amount of tap water in Gaza is also far below World Health Organization minimums and growing worse. These problems are not because the governments don't care – to the contrary, they are working hard to do everything they can.

Three Elements of a Solution to the Middle East Water Problem

The following sections in this paper describe three components of a water management and supply strategy for this region of the Middle East. These elements could be combined, expanded, or elaborated upon as needed. This list is not exhaustive; other ideas not included here are worthy of consideration.

The concept of a regional approach to water problems is not new; many individuals and groups have argued and worked for years for that approach. Such a movement would, of course, require voluntary compliance among peoples never before achieved, and approaches have foundered before for lack of a willingness or political ability to agree. This paper is based on the argument that there is a new political opportunity at this time in the region, and that such an approach would beneficially affect the peace process.

Each of the proposed three components can stand alone as good ideas that could contribute to a solution, whether applied separately or as part of a larger strategy. The proposal is that governments in the region and other interested stakeholders consider these ideas, working together for a joint solution on the basis of mutual self interest.

First: Demand Management

It is widely argued by credible international institutions and groups that the projected regional freshwater deficit can in large part be averted by widespread demand management reforms. These changes would include: reducing municipal, industrial and agricultural water waste by aggressive adoption of conservation practices; reallocating larger amounts of fresh water used for low-value agriculture to domestic use; reusing steadily increasing amounts of treated waste water for agriculture; elimination of water subsidies and water price reforms that will direct scarce water resources towards highest economic use; and reducing losses in transmission and distribution. Some experts believe that up to half of the projected fresh water deficit could be solved by aggressive use of such demand management practices.

Second: Using Natural and Man-Made Storage and Distribution Mechanisms

Even with the best regional cooperation, ideal conservation and drought plans and near perfect demand management region-wide, new fresh water supplies will still be desperately needed, and that need will likely grow at significant levels over the next 10 to 15 years.

The Final Report of Joint Management of Shared Aquifers, the cooperative research project between the Harry S Truman Research Institute at Hebrew University in Jerusalem and the Palestine Consultancy Group, Ramallah, points to the deteriorating quality of the aquifers Israel and the West Bank and Gaza share, and the need to protect those aquifers from permanent damage. "Israelis and Palestinians share several aquifers. These serve as long-term water storage to both sides. There is a need to manage the shared aquifers jointly in order to reach optimal results. Otherwise, crucial storage capacity and quality levels may be lost, to the detriment of future generations of both Israelis and Palestinians. Therefore, the real choice the two sides face is between a lose-lose situation if they do not cooperate, and a potential win-win situation if they do."

The fact that Israel and the Palestinians share several aquifers presents an opportunity for peace which must not be missed. It centers on the already existing capability to deliver additional

water every place in the region, including Jordan, through water exchanges - when there are additional water supplies available. For example, if there were large desalination plants along the Mediterranean Sea, those waters could be distributed through existing systems to population centers in Israel. Through water exchanges, Jordan could take more from the Kinneret and the Palestinians could take more from the Mountain Aquifer. Large amounts of desalinated water (or any other source of outside fresh water) would solve water shortages and could solve water equity claims, and thus permit the political solution of existing serious water conflicts.

Third: Begin Large Scale Desalination of Sea Water

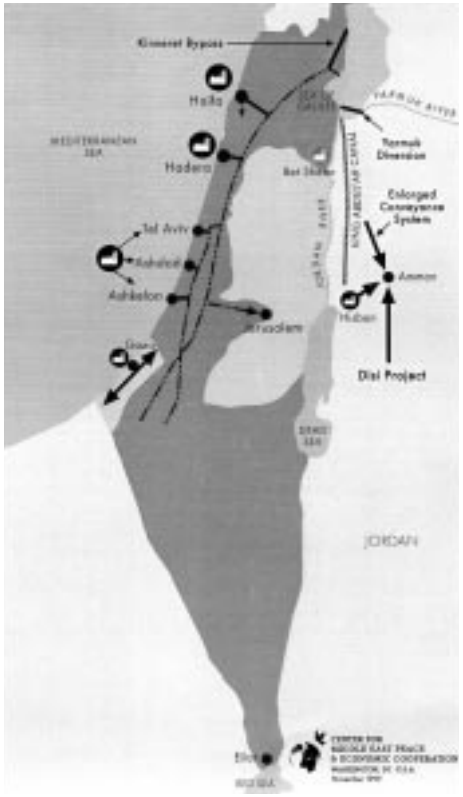
It has taken water shortages in the Middle East to reach a crisis state to bring focis to the fact taht the cost of making drinking water from seawater has dramatically decreased. In the 70s, desalination was a luxury, affordable only to the wealthy countries of the Persian Gulf. Due to major advances in technology, the cost to desalinate a cubic meter of sea water is roughly half the retail cost of tap water paid by an Israeli household in Tel Aviv.

The following table is a compilation of existing ideas, which could be considered for the first phase of new water development. If all these projects below were implemented, the new water would be roughly equivalent to the yield of the Mountain Aquifer, at the cost of less than 1 day of the ground war in the 1991 Gulf War. Some of them can be developed by the private sector with commercial funding. Others will require an initial subsidy to get them started.

Table 1: Phase One Development Strategy

Location	New Supply Million m^3/yr	Total Development Cost (Million US$)	Source Water	Costper $/$m^3$
In Israel at any or all of the coastal power plants at: Ashkelon, Ashdod, Hadera, Haifa	300 Combined capacity	$900	Seawater	$0.55
Bet- Shean Area	50	$75	Brackish water	$0.35
In Jordan, the Wadis Hisban Project	50	$75	Brackish water	$0.35
In Gaza with the new power plant underway	50	$150	Sea water	$0.55
In Egypt on the Red Sea	50	$150	Sea water	$0.55
In Jordan at Aqaba	50	$150	Sea water	$0.55
In Egypt on the Mediterranean Sea	50	$150	Sea water	$0.55
Totals	**550**	**$1.65**		**$0.55/avg**

**The use of $0.55 in the Table above as the cost per cubic meter for seawater desalination is based on Tampa Bay, Florida, USA project as reported in the International Desalination & Reuse quarterly, Vol 9/1.*



The graphic mapillustration "Desalination: the new Regional Water Supply Alternative for Israel, Jordan, Gaza and West Bank" was developed by our Center to illustrate a logiocal configuraion of desalination facilities, as shown in Table 1.

It should be mentioned that Jordan is pursuing the construction of a pipeline from the DISI Aquifer in Southern Jordan to Amman to carry 100 Million m3/yr. Construction costs are estimated at $600 million, with a cubic meter operating cost of $0.18.

Building a large desalination capability on the Mediterranean Sea along the coast of Israel would not preclude a Med-Dead or Red-Dead project; the proposals are not mutually inconsistent. However, in addition to being the lower cost alternative, the process for large scale coastal desalination capability can be "fast tracked" to deliver fresh water within two to three years, should Israel so decide.

The Med-Dead or Red-Dead projects are longer term, require much more study, are probably significantly more expensive (estimated at $5 to $7 billion), create more environmental complications, and would certainly take a great deal longer to plan, engineer, permit, build and become operational. But the 400 meter elevation drop-off between the Mediterranean or the Red Sea and the Dead Sea, offering significant opportunity for electricity generation and desalination using waters en route, would also respond to the long term need to provide more water to stabilize the Dead Sea and return it to historical levels. We recommend serious studies of these possibilities.

Conclusion

The Center convened on September 15 and 16, 1999 -- in cooperation with the Peres Center for Peace, Green Cross International and the International Arid Lands Consortium -- a workshop in Amman, Jordan in which some 60 experts and other eminent persons considered the impending fresh water shortages. Participating were Israeli, Jordan and Palestinian water officials, business leaders, academics and non-governmental organizations, as well as others from the United States and Europe. The following is the unanimous resolution adopted by the workshop group:

"There is a critical need for political and private action to address the intensifying water scarcity in Israel, Jordan and Gaza and the West Bank. Persons from government, business, universities, NGO's and local communities met as individuals in Amman on September 15-16, 1999, as the Amman Water Workshop Group. The Group agreed that the solution to the growing fresh water shortage will require a package of technical, institutional, financial and social changes reflecting a vision of assuring reliable water supplies and water equity within the region.

The Amman Water Workshop Group will work to help improve cooperation between the three peoples and to implement conservation and other demand management practices to the full extent possible. The Group will be supportive of water projects of each of the three governments, while working to advance efforts towards regional cooperation. The Group encourages environmentally compatible development of any affordable new water sources including water reuse, water conservation and desalination of brackish water and sea water."

At the workshop some water managers suggested group convenors should ascertain from water managers in Israel, Jordan and the Palestinian Water Authority what each considered its highest water production priority, and that the Amman Workshop Group then support those priorities as a "regional project".

Following that recommendation, we have ascertained that the highest Israeli priority is a 50 million m3/yr sea water desalination plant (for which the tender offer is prepared and awaiting final government approval); that the Jordanian preference is for a 30 to 50 million m3/yr brackish water desalination plant at the South Rift Wadis, to be called the Hisban Project, and the Palestinian priority -- after establishing their water rights vis-à-vis the Israelis -- is for an immediate project is a 50 million m3/yr sea water desalination plant in Gaza.

Feasibility work is underway in Jordan for the large brackish water desalination plant. This new source of water for Amman is less than 20 kilometers from Amman (where household tap water is presently being rationed due to drought and shortage).

To be completely accurate, the highest Palestinian priority is to conclude satisfactorily their water rights equity claims, which will be the subject of final status negotiations with the Israeli Government, which are expected to begin shortly. As israel and the Palestinina Authority are headed inti complex final status negotiations where water is only one of the at least five very though issues to be addressed, we offer the following as an idea.

The three projects referenced above (an initial 50 million cubic meter per year plant in Israel, the same in Gaza and the Wadi Hisban project in Jordan) could be packaged as a united initiative to increase the region's seriously inadequate fresh water pool, while still negotiating respective water rights and obligations with regard to the dwindling water supplies. This joint undertaking would constitute the first regional cooperative water project ever and would increase world-wide interest in helping finance the unified effort as a foundational first step, even though everyone recognizes that it is more packaging than unity.

Combining these three virtually comparable desalination projects (two sea water and one brackish water), as the top water creation priority of each of the three governments, to assist in searching for support, was an idea which sprang from the Amman Workshops held by the Center, Green Cross International, the Peres Center for Peace and the International Arid Lands Consortium, in September 1999.

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Water for Peace
in Southern Africa

The papers on Southern Africa appear thanks to a joint initiative sponsored by Green Cross International and ACCORD, The African Centre for the Constructive Resolution of Disputes, and were first presented at an African Dialogue Lecture on 24 February 2000, organised by the African Water Issues Research Unit (AWIRU) at the University of Pretoria.

Water and the Environment as a Locus for Conflict in Southern Africa

*By Dr. Ebenizário Chonguiça**

1. Introduction

In order to attempt to discuss a complex topic such as this it is important to begin with a review of our understanding of the term "conflict"? As outlined by Krugmann, 1998, in some recent research works on resource-related conflicts, the term "conflict" could be assumed as a surrogate or variant of the term "security". As the notion of conflict tends to be associated with violence and war, the use of its surrogate variable "security" would allow a better understanding of how wide the notion of conflict can be.

Security can be defined in a multitude of varying manners depending on the level of objectivity and perceptions of the analysts. According to Krugmann, 1998, security can be viewed as: a/ protection from danger, b/ feeling safe or even c/ being free from doubt. The opposite aspect of those three varying contexts of security would mean in fact a situation of "insecurity" probably the key direct driving force to conflict.

Putting those concepts in the perspective of the subject of this paper, we should observe the following:

Some analysts argue that "if human life is intrinsically dependent on natural resources for survival, patterns of resources ownership, tenure rights that dictate the degree of access and use of such resources, might trigger situations of "insecurity" – then conflict." From the evolution of the various attempts to define "human security" since the 1998 UN Commission of Disarmament and Security, one of the most updated definitions from UNDP include variables such as: economic, food, health, environmental, personal, community and political forms of security (cf. Krugmann, 1998). Absence of these types of security dimensions in any given societal organization or geographical setting might trigger insecurity – and therefore provide room for the generation of conflict. On this basis, the Environmental Change and Acute Conflict Project (EACP) research findings suggest three types of possible resource based-conflicts: i/ simple scarcity conflict (resource wars) between states; ii/ group-identity conflicts (e.g. ethnic) arising from scarcity induced population movements and iii/ deprivation conflicts resulting from scarcity-induced economic hardships and socio-institutional disruption.

In other words one could state that situations of reduced rights to access resources could be dictated by the prevalence of cases of social injustice and marginalization of individuals from certain segments of the social fabric. These types of situations can occur both within and outside the geographical boundaries of a given country. Therefore, conflict should not be only viewed in terms of armed conflict between two or more countries. Conflicts can happen within a country and not necessarily in terms of the military dimension of it. Absence of war, or official presence of peace, does not necessarily mean that there is no conflict.

From those observations it can be stated that there is a shifting paradigm in the understanding the notion of conflict and subsequently the ways of resolving them. The classic notion

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of objective/military conflict is usually dealt with in military terms and is viewed as a result of threat or vulnerability of military powers and the capacity to respond. Under the new approach, conflict is viewed in terms of "issues facing human kind in terms of the interconnectedness of components within complex integrated systems inter-linking essential ecological processes and those of human production, distribution and consumption" (cf. Krugmann, 1998).

2. Current use patterns of shared natural resources in Southern Africa

This section intends to examine the prevailing use-patterns of shared regional resources to facilitate judgement as to want extent such use patterns may trigger "conflict" within the dimension discussed in the previous section. Focus will be on transboundary resources or development initiatives namely: water, nature conservation areas and the spatial development initiative (SDI's).

The directive question to be posed for such an assessment would be:
"under the prevailing regional policies and management practices, is there sufficient and equitable access and use of shared transboundary resources among SADC countries to prevent insecurity?"

Southern Africa is currently known, (despite variations on a country-by-country basis), for the richness of its natural resources and uniqueness of its biodiversity. Natural resources management strategies and policies are variable countrywide, however, some regional joint efforts are being undertaken for a more integrated approach to management, particularly for those resource category of transboundary dimensions (e.g. water and conservation areas).

2.1. Water resources

2.1.1. Background

For the successful management of water resources there is a need to understand the fundamental principles that drives the structure and functioning of freshwater systems. Freshwater systems in structural terms, are basically delimited within the boundaries of a river basin that also represents " a functional unit of significance for understanding of fluvial and other geomorphological processes and land forms, including those induced by man as a geomorphological agent" (c.f. Gregory and Walling, 1973). To understand the structure and dynamics of such systems over time, it should be noted that they correspond to open cascading systems where the different components (i.e. intrinsic and extrinsic variables) should be considered as strongly inter-related sub-systems. Under such circumstances the "holism" principle, which according to Schultink, (1992 p. 207) states that the " …whole is more than the summation of parts," needs to be applied. The conceptual basis to operationalise such understanding is based on the fact that "relationships between interacting components of a system of this nature, cannot be derived from laws which apply to individual parts but only from the whole" (ibid). For adequate management of river basin systems, one needs to understand their adjustment and nature over time, the complexity of the relationships among their integrated components as well as the multivariate character of the geomorphic phenomena adequately placed in the appropriate temporal and spatial parameters. (cf. Gregory and Walling, 1973; Verstappen, 1983; Goudie et al., 1990).

In managing river systems of a transboundary nature, it should also be observed that any phenomena and/or activity upstream of a given catchment section, such as the natural processes (related to climate, vegetation, soils and geomorphology) and human land use, will

influence downstream river basin systems.

These influences can be visualized in terms of changes in existing stocks and fluxes of matter and energy with an impact on downstream river basin capacity to provide goods and services of ecological, social or economic importance. From a human perspective, such goods include wood, water, rich soils for cropping, grazing forage, fish and wildlife as commodities, wildlife as amenities, wild plants for food, medicine and export crops as well as biological and genetic diversity. Services would include regulation of the flux of nutrients, water and sediment from uplands to stream, groundwater recharge etc.

It is in line with this type of concern that the concept of environmental flow assessment (EFA) and/or in-stream flow requirement (IFR) was developed. IFR is understood as the "water that is purposefully left in an aquatic ecosystem or released from an impoundment to maintain that ecosystem". "Determinations of how much water should be released, and when, are referred to as Environmental Flow Assessments" (cf. King, 1999). Such technical tools are critical for effective management of river systems. The application of these principles in the context of transboundary river basins is fundamental for any successful management that addresses insecurity and/or conflict issues.

2.1.2. Selected case studies

Downstream water availability (quantity and quality) and related consequences

Case study 1 – The Umbeluzi basin water use; Swaziland/ Mjoli Dam;
Primary water development projects within the Umbeluzi basin shared between Swaziland, Mozambique and South Africa were initiated during early seventies in connection with the construction of M'njoli Dam in Swaziland (cf. Chonguiça, 1995). In relation to the downstream impact of the construction of the M'njoli dam in Swaziland, an analysis of downstream water availability to Mozambique, before and after the construction of the dam, from the assessment of flow duration, it is revealed that:

- Before the regulation of the Black Mbuluzi through the M'njoli Dam, daily mean discharges to Mozambique, at station E-10 were of 12.1 m3/s with a median discharge of 6.6m3/s.

- After the construction the mean daily discharge was still of 11.2 m3/s but with a med an of 3.7 m3/s.

- These statistical figures indicated that before the Dam construction water made available to Mozambique was equal or lower that 6.6 m3/s for 50% of the time while after the dam was built the figure dropped to almost half (3.7 m3/s).

What were the implications of such changes in terms of satisfying water accessibility to downstream riparian functions (ecological, economic and social)? On what basis were those flows were made available? Was there any joint analysis and decision making for such management practices? These and other questions could be assessed in the context of possibilities of generating reduced access to water resources, goods and services within any given section of the river profile. Such an assessment could be done also in terms of water availability for competing overall demands between the two countries economic needs or among sectors. Any level of water scarcity resulting from the prevailing supply side could trigger water conflict of varying degrees of intensity between the two coun-

tries or among sectors. For the particular case of the downstream ecological impact of river regulation, cases of increased salt-water intrusion along the lower Umbeluzi are well known and documented. It is a situation which did not result in any visible confrontation between the parties but it is know that communities relying on the cultivation of the riparian flood plain zone along the lower Umbeluzi suffer from reduced soil agricultural productivity that undermines their food security.

Case study 2 - The Driekoppies Dam in South Africa

Built in 1998 on the tributary to the Komati river with 251,106 m3, the purpose of the dam was to supply water for irrigation of downstream commercial agriculture. At full supply levels, the surface of the reservoir area reaches about 1 900ha, extending into Swaziland territory given the topographical conditions. Concerns being raised are related to the reduction of communal cropping land in Swaziland due to flooding, as well as the extended travel/distance time of students to go to school as relocation promises have not yet been implemented.

Again, a situation of reduced access to resources and marginalization has occurred related to management practices of neighboring country. What can this mean in terms of triggering conflict?

Case study 3 - Kariba, Kafue and Cahora Bassa triangle

Within this dam triangle, we are in the presence of two of the major hydraulic structures and water reservoirs in Southern Africa (Kariba and Cahora Bassa), in terms of volume and energy potential. Despite the important economic role that energy generation plays within the region, what can be said in terms of their cumulative impacts to the inundated area and downstream riparian regions/communities? The construction of Kariba reservoir in 1959 resulted in the displacement of 57 000 people in Zimbabwe. The impoundment of the Zambezi river at the Cahora Bassa reservoir in Mozambique required the resettlement of 25 000 people into new villages (cf. Chonguiça, 1995). These types of river regulation mechanisms, based on whatever management approaches being adopted, have significant impacts on the social and economic conditions of the affected people. Such impacts might be associated with the loss of land within the inundated area, as well as from the resulting involuntary resettlement with high potential to ignite conflict (cf. Goodland, 1995).

The regulation of the Zambezi from Cahora Bassa also resulted in the reduction of sediment/nutrient supply to the downstream riparian zone and Delta ecosystems with the related social and economic consequences. Coastal abrasion is underway impacting on mangrove areas. It also did impact the marine ecosystem's function which is related to the shrimp recruitment heavily dependent on freshwater and nutrient supply from the delta (figures 1a, 1b and 1c).

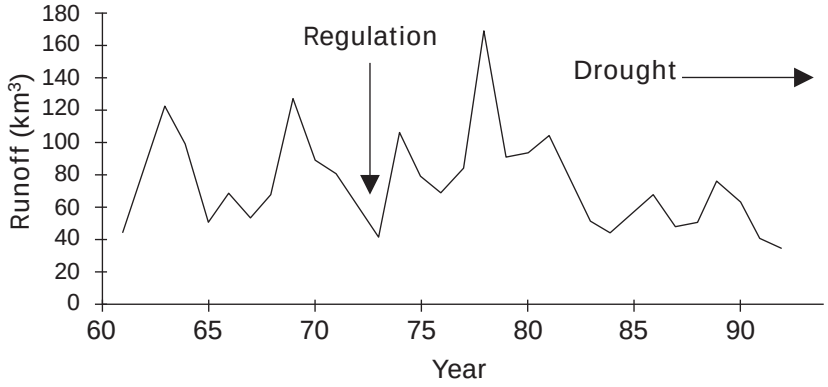

Figure 1a: Time series plot of the changes in annual (October-September) Zambezi runoff pattern before and after regulation though Cahora Bassa Dam (Source: Hoguane, 1999)

According to Hoguane, 1998, it is observed that "fluctuations in shrimp abundance are: positively correlated to the Zambezi river runoff during the wet season and negatively correlated to the dry season runoff. Zambezi runoff is further found to have a significant influence on the dynamics of the shelf, which in turn, influences the availability and distribution and of nutrients, and the recruitment of shrimp".

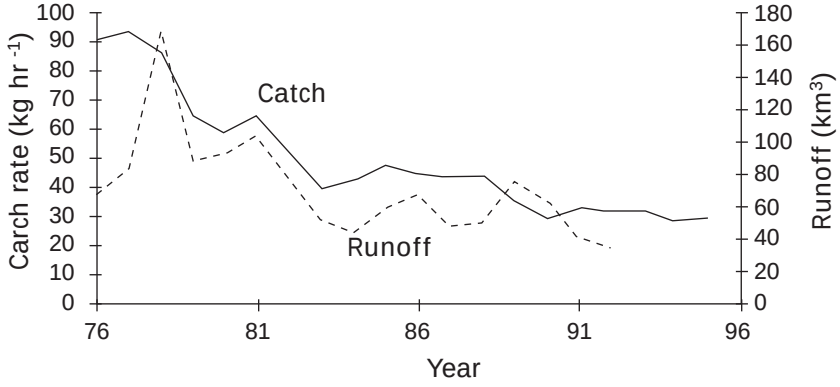

Figure 1b: Time series illustrating the correlation between shrimp catch rate (thick line) and annual (October-September) Zambezi runoff (dashed line). (Source: Hoguane, 1999)

From the study conducted it was found that shrimp catch rates reduced from 90 Kg/hr to 30 kg/hr, following the reduction in runoff (figure 1c). This corresponds to a reduction in 10 to 30 million USD per annum in shrimp export from Mozambique. This illustrates another dimension of water-related conflict, here manifested in sector terms. The management approach adopted for hydro-energy generation appears to be in conflict with the fishery industry in Mozambique that accounts for more the 60% of the national export earnings.

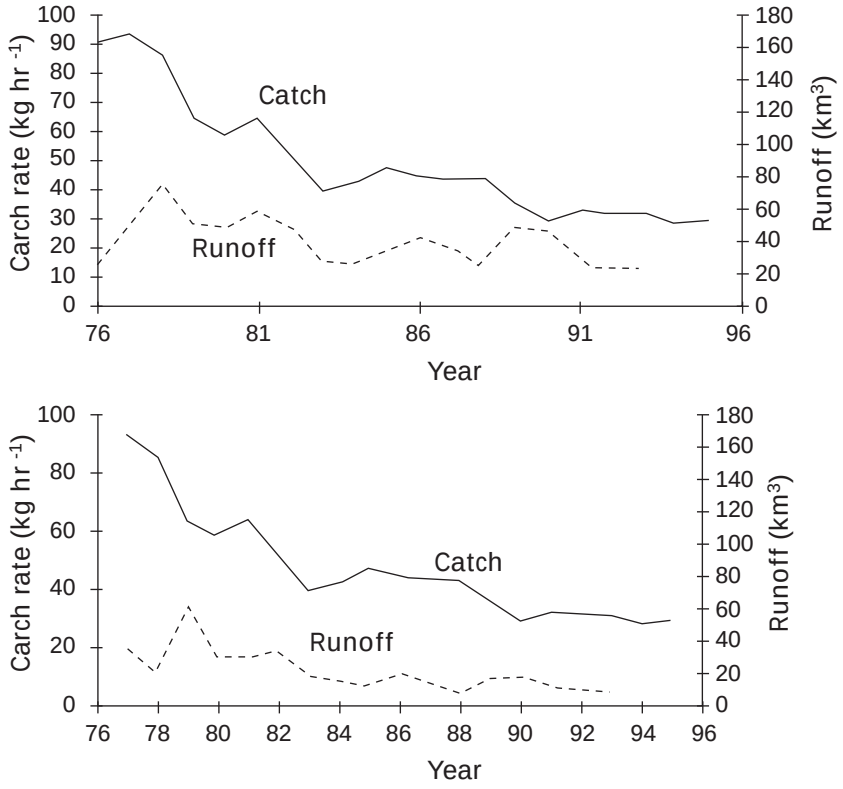

Figure 1c: Time series plot of catch rates and: the flood season runoff – top - and the dry season runoff - bottom - (Source: Hoguane, 1999)

From the examples provided of the downstream impact of river regulation it becomes clear that the concept of conflict cannot be confined to military dimension. Neither does it might occur only between independent countries. Conflict can occur within a single country involving upstream and downstream riparian communities or in between economic sectors. It is, however, important to observe that the current impacts on downstream Zambezi riparians results from the cumulative effect of the Kariba, Kafue and Cahora Bassa dams. In the absence of Cahora Bassa, the same pattern of observed impacts would have occurred anyway, probably with a slightly different order of magnitude.

I this type of analysis, t is also important to consider the correlation of economic/military power between upstream and downstream countries. Currently there is no evidence of possible violent conflict in the case studies outlined above as the downstream country, Mozambique, is also the weakest economically and militarily. The scenario is very different in a situation where the downstream country also has a stronger economic and military position as compared to upstream countries. If this were the case for Mozambique and South Africa it is possible that a situation similar to the Nile, where Egypt as a downstream country commands the water use pattern within the basin, could have developed.

2.2. Trans-border nature conservation areas and resource use

2.2.1 Background

Within the Southern Africa region there is a growing concern for the adoption of new systems and approaches to natural resources management that can take advantage of the changing geopolitical set up particularly as related to the end of the apartheid regime in South Africa. With respect to nature conservation areas for example, it is clearly evident that some of the boundaries that follow political and administrative borders are completely artificial and create barriers for the adoption more sound management practices rooted for example on the ecosystems approach to resources management. Migratory routes of certain animal species have been fragmented disrupting the natural oscillatory movement of animals from one region to another. Under these circumstances the concept of implementing transfrontier parks or conservation areas is gaining significant political and technical recognition.

2.2.2. The constraints

Despite of the validity of such a new approach to resources management, there are a number of issues related to differences between countries in terms of institutional set-ups, legal and natural resources, management frameworks, technical expertise and availability of financial resources, different economic development agendas and priorities, that if not properly addressed may undermine such a technically brilliant initiative. Currently there some cases that requires careful analysis for example with regards to who/which country owns specific wildlife species that in normal conditions tend to migrate cross borders? Given the prevailing insecurity in Mozambique related to the prevalence of landmines and ineffective enforcement capacity with respect to illegal pouching, it is understandable that South Africa national park authorities prevent the normal migration of wildlife to Mozambique as a measure of protection. In the case where wildlife species manage to cross the border anyway, official claims are delivered to track back those animals that happen to be monitored and traced through chip systems attached to them.

To what extent can such an approach to provide a national identity to cross-country migratory species be sustainable without conflict? With all the types of country differences, to what extent would the adoption of the cross-border resources management approaches being proposed guarantee effective equity in costs and benefits among involved counties?

Other cross border resource management issues that require attention with respect to the topic of this paper are related to the exploitation of forest resources. It is known that the tobacco industry in Malawi is continuously being supplied by Mozambique firewood (unfair trade) with the related cost of deforestation and all associated environmental consequences.

The issues being raised with respect to the transfrontier conservation areas could also apply for the case of the cross border spatial development initiatives. Public concerns are being raised, for example, with respect to the degree of Mozambican private firms participating in the Maputo corridor business initiative as compared to South African firms. The same applies to the biggest aluminium smelter (Mozal) with respect to the labor policy being adopted whereby significant imbalances are being claimed when comparing again to which side the benefits of the undertaking are being drained. Even in terms of the environmental implication, some degree of environmental insecurity can be raised with respect to such types of regional migration of the South African industry.

3. What can be expected current use patterns?

From the prevailing pattern of resource use within the region, two scenarios can be expected:

The business as usual scenario – to perpetuate current pattern of inequitable access and use – leading to continuous marginalization and reduced access to resources for specific social segments or economic sectors;

The business as unusual scenario – to achieve regional harmonization and integration. This scenario would require a change in the approach to resources management within each of the member states or sectors, with very strong regional and national enforcement capacities backed with effective political will.

4. Way forward

Under the two scenarios previously presented, two alternative way forward are possible:

- Maintenance of the business as usual approach
  - Would mean increased insecurity leading to conflict in all of its dimensions.
- Change management – that should be rooted on:
  - Increased level of dissatisfaction with the current resources management approaches and practices;
  - Proper selection of what should be the ideal model or desired state in the region;
  - Smart determination of the process to achieve such a desired state;
  - Motivation to really overcome resistance to change;
  - Move away from rhetoric and go to actual implementation;
  - Adoption of resources management practices that advocate:
    - Ecosystems approach to management.
    - Environmental impact assessment (EIA's) and EFA – looking at downstream impacts – recognizing the importance of social, economic and ecological functions of river basin ecosystems.
    - Assigning economic value to natural resources (direct, indirect, consumptive and non-consumptive) and internalize costs of resources degradation in the national accountings and decision making process.
    - Stakeholder participation in project design/planning, management and monitoring.
    - Equity in shared costs and benefits.
    - Science based management of natural resources.
    - Cross country institutional co-ordination.
    - Mechanisms to reduce inequity and poverty.
    - Shared river management with the concept of sustainable development.
    - Strategies to resolve potential conflicts via dialogue and collaboration, cooperative rather then confrontational behaviour and approaches.

5. Conclusions and Recommendations

In more conclusive terms and specifically related to trans-border management of natural resources there is a need to:

- Develop national/regional capacity required to support decision making in integrated river basin management of shared watershed systems and the associated estuaries, as well as other transfrontier resource categories;
- Develop integrated watercourse management model for the shared river basins and other trans-border resource categories, to support the development and evaluation of management scenarios and to direct research and monitoring;
- Enhance national capacity with respect to technologies, management processes, communication and information management;
- Move away from the continuous rhetoric of good regional policy statements to real application and pragmatism.

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Southern African Water Conflicts: Are they Inevitable or are they Preventable?

*By Dr. Peter Ashton**

Abstract

The rhetorical question posed in the title to this paper reflects the concern felt by large numbers of individuals and institutions in southern Africa. In the past, several different types of conflict and dispute have occurred in or near to water; there is little doubt that many of these conflicts will continue to occur in the future. However, despite the escalating demands and pressures that continue to be placed on our finite water resources, it is highly unlikely that full-scale military conflict, a so-called "water war", will ever occur in southern Africa.

The role of water in virtually all of the water-related conflicts that have occurred in southern Africa has been secondary to considerations of territorial sovereignty. In most cases, these disputes have been driven by perceptions that the territorial integrity or sovereignty of one country is compromised or threatened by the claims of a neighbouring territory. Many of the international boundaries in southern Africa are aligned with rivers and water courses; the locations of these boundaries are the legacies of surveys and treaties conducted by earlier colonial powers. However, because rivers are dynamic systems that frequently change their courses in response to flood events, we can anticipate future disputes over the precise locations of international boundaries when rivers change their shape and configuration.

We can also anticipate that almost all future disputes or conflicts involving water, or concerned with some aspect of water, will tend to be local in scale. These conflicts will be amenable to institutional and government intervention and the rights and responsibilities of individuals are well protected in national legislation. At the international scale of a water-based conflict or dispute between two or more countries, some principles of international law provide a solid foundation for negotiation and arbitration. However, it is clearly in the interests of individuals and societies that appropriate national and international institutions should jointly develop management plans for shared river basins and also derive workable protocols that can be used to prevent water-based conflicts in the region.

Introduction

In recent years there has been a rapid worldwide increase in public awareness that the world's fresh water supplies are a scarce and limited resource that is extraordinarily vulnerable to human activities (Falkenmark, 1989; Biswas, 1993; Glieck, 1993; Homer-Dixon & Percival, 1996; Delli Priscoli, 1998). This awareness is coupled to the growing realization that it is becoming increasingly difficult and expensive to provide sufficient supplies of wholesome water to meet the growing needs of communities and countries. These tensions are accentuated by widespread population growth, as well as increased rates of urbanization and industrialization (van Wyk, 1998). As a result, there has been a dramatic increase in the level of competition for water between different water use sectors. Whilst it appears clear that the basic reasons for increasing water shortages are well understood by all participants, much of the debate is still coloured by strong national concerns over sovereignty and territorial integrity issues (Business Report, 1998). As a result, the potential for "water-based conflicts" to occur will continue to remain high and tensions will be increased, possibly to critical levels, when such countries experience extreme climatic events such as droughts (Hudson, 1996; Glieck, 1998).

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It is easily understandable that the potential for conflict over water is likely to be most acute in those regions where water is scarcest. Where conditions of water scarcity happen to coincide with economic, ideological or other differences between countries, we can anticipate that tensions can rapidly reach crisis levels. Indeed, many small- and large-scale conflicts have been based on, or accentuated by, situations related to access to water in the arid regions of the world (Falkenmark, 1994). However, there is also a rapidly growing public awareness that water interdependence is already, or soon will become, a fact of life in many countries. There is therefore a growing drive towards cooperative development of water resources in certain areas (Delli Priscoli, 1998). It has been estimated that some 40 % of the world's population live in approximately 200 shared river basins; five or more riparian countries share thirteen of the world's major river basins. Whilst these situations provide ideal incentives for riparian countries to jointly develop collaborative actions to safeguard water supplies, such situations can also become the sites for escalating tensions between riparian countries (Rosegrant, 1995; 1997; Wolf, 1996).

Southern Africa is largely an arid to semi-arid region where the basins of most of the larger perennial rivers are shared by between three and eight countries (SARDC, 1994). Supplies of fresh water are finite and the existing demands for water in some parts of the region are fast approaching the limits of exploitation that conventional technologies can provide (SADC-ELMS, 1996). Demands for additional supplies of fresh water will need to be met through the use of unconventional technologies, the exploitation of new or novel sources of fresh water, or through the long-distance transfer of ever-larger quantities of water from regions that have ample supplies (Conley, 1995; 1996). In the future, concerted attention will also have to be paid to reducing the demand for water and to increasing the efficiency with which water is used (Hudson, 1996).

Against this current background of rising demands for water, and the finite supplies that are available, it is important to remember that the national boundaries of all southern African countries seldom follow even a portion of the "natural" boundary of river catchments (Pallett, 1997; Fisch, 1999). This last element represents part of the legacy of earlier colonial administrations, where the national boundaries of most countries appear to have been delimited or drawn up in an apparently arbitrary fashion (von Moltke, 1977; Prescott, 1979; Hangula, 1993). Consequently, the extent to which the larger river systems are shared by more than one country has often resulted in intense rivalry between countries as each strives to derive maximum benefits from the available water resources. Typically, "downstream" countries are more vulnerable than their "upstream" neighbours in such situations and therefore derive the least benefit. This situation has been accentuated in those situations where the downstream countries may be economically "poorer" or politically and militarily "weaker" than their upstream neighbours (van Wyk, 1998).

Recent political developments in southern Africa have been accompanied by a wider, regional acceptance of the need for all countries to work together to develop and implement joint strategies and protocols for the protection and management of regional water resources (SADC-ELMS, 1996; Republic of South Africa, 1998). However, whilst these welcome developments must be supported and promoted throughout the region, there remain several small- and large-scale issues that either have already led to some form of conflict, or hold the poten-

tial to do so (Hangula, 1993). In these situations, it would appear that despite the best intentions of politicians and water resource managers, some form of "water-based conflict" is either inevitable or "unstoppable". It is therefore crucially important that water resource managers examine these situations closely to determine whether or not these conflicts are indeed inevitable and if they are amenable to some form of preventive intervention.

The concept of "Water Conflict"

It is perhaps not surprising that the English words "river" and "rival" are derived from the same Latin root, rivalis - he who uses the same stream (Biswas, 1993; Ohlsson, 1995a). This is also reflected the conscious realization that various degrees of disagreement or conflict between individuals, communities and countries have arisen from, or are related to, competition for access to water and the ways it is used (Ohlsson, 1995b). Such animosities are ancient in origin and continue to the present day. Historical examples from Biblical times relate how irrigation-based civilizations were vulnerable to invading armies; later, Crusader forces were defeated by Saladin who denied them access to water. In more recent conflicts, desalinization plants and irrigation water distribution systems were systematically targeted in the Gulf War (Delli Priscoli, 1998).

Much of the recent debate around existing water conflicts, and perceptions of possible future conflicts, has been phrased in highly dramatized terms of "water wars" or "water crises" and similar doomsday prophesies (Delli Priscoli, 1998). Unfortunately, a considerable proportion of the debate has centred on existing or impending problems whilst very little attention is paid to finding solutions to these problems. On a more positive note, however, the resulting increase in public consciousness of the importance of water issues is to be welcomed. Nevertheless, it is also true that many of the emotively worded appeals or pronouncements often cause public fear or a pervasive sense of pessimism; the undertones of the debate are disturbing. In many cases, critics create the perception that government departments and water resource managers have either "ignored the signs" (clearly visible to these knowledgeable and far-sighted individuals) or, worse, concealed them. Such critics sometimes also suggest that these officials have "only just woken up" and realized that there may be a water-related problem in their area of jurisdiction. Such indictments of past actions or motivations, based on current knowledge, do not encourage constructive dialogue nor do they promote or support a concerted search for effective solutions (Delli Priscoli, 1998).

As already mentioned, water-related conflicts of varying degrees of intensity and spatial scale have existed for millennia; many of the contributing reasons or causes for these conflicts continue today and, undoubtedly, will continue to exist in the future. How we deal with these situations, and we will have to deal with them, will depend largely on the ways in which we interact with our neighbours and the ways in which we, jointly, harness information and knowledge to derive appropriate, mutually-beneficial solutions. The responsibilities we face are enormous; a pervading sense of pessimism will not help us to achieve success. We simply cannot afford to sit back, wait, and do nothing, in the fatalistic anticipation that some improbable "better option" will show itself. The scale and urgency of many of the water-related problems we face today demand that we implement proactive approaches now; any further delay will exacerbate these problems.

Our combined consciousness or awareness of the social, economic, political and ecological causes and implications of these conflicts has improved gradually with time as more and more information has become available. Globally, we are now in an ideal position to share this knowledge and our understanding of these problems and search for effective, long-lasting solutions. It is important to remember that the English word "crisis", derived from the Greek

root krisis, refers more to decision, a time of opportunity and decisive action; rather than a disaster. The word crisis, therefore, should rather be seen in the form of a "wake up" call for decision and action (Delli Priscoli, 1998). It is this form of the concept that should be the basis for our understanding and management of "water crises" or "water conflicts".

In its simplest and broadest sense, the term "water conflict" has been used to describe any disagreement or dispute over or about water, where social, economic, legal, political or military intervention has been needed, or will be required, to resolve the problem. Clearly, this broad definition spans a wide continuum of possible circumstances and situations. The simplest example of these might involve the relatively low-intensity dispute over stock watering rights between two adjacent landowners. A structured process of problem solving could easily resolve such a situation. At the other extreme, a typical example could consist of a relatively high-intensity or high profile interaction between two countries, both of whom dispute the "rights" of the other to a particular proportion of the flow in a shared river basin. Here, failure to reach mutual agreement could result in military intervention and may even require the involvement of an independent arbitrator. In both of these types of examples, geographical variations on the theme could also complicate matters further.

We have seen some of the elements of the broad range of possible types of conflicts that can be associated with, or driven by, water. It is important to understand that water is in fact "incidental" in many of these conflicts and is not the primary cause, objective or "driver" of the conflict. This can perhaps best be explained by a series of three simple examples where the "level" or intensity of conflict over water or around water escalates from a situation where water is incidental to the conflict, up to a point where water is either the primary "weapon of war" or the primary target of the conflict.

The first example would include the situation where a watercourse forms the national boundary between two countries. If a conflict occurs over territorial sovereignty, and this happens to result in military action in and around the "border" waterway, this situation can be considered to be a water-related conflict but is not a "water war". In the second example, water supply infrastructure and hydraulic installations have often been considered as legitimate targets for aggressive action during conflict between two countries. Here, again, water is not the primary reason for the conflict though the damage to water infrastructure may be used as a means to inflict hardship on an opponent. For our final example, we can define a "water war" as one that is fought with the sole or primary purpose of gaining access to water, or where water forms the central weapon of offence in the arsenal of an aggressor. There is ample supporting evidence (e.g. Kirmani, 1990; Khroda, 1996; Wolf, 1996; Pallett, 1997; Turton, 1999; 2000) that, despite the dire predictions of many authors (e.g. Homer-Dixon & Percival, 1996; Hudson, 1996), "true" water wars appear to have occurred very rarely if at all. Therefore, for our purposes, the broader term "water conflict" is used to cover the wide range of water-related conflicts that have already been recorded; unfortunately, we also should be in no doubt that many of these "lesser" conflicts will continue to occur in future.

Importantly, the term "water conflict" is not meant to cover a situation of conflict or violence that, by chance, happens to occur at or near a water source. As Delli Priscoli (1998) has noted, several people happened to "have been killed around the water hole". In reality, however, there seems to be a general reluctance to do this since such incidents of inter-personal violence can rapidly escalate into a national or international issue. Somehow, a shared realization of the fundamental value and importance of water in such situations of conflict forces us to elevate ourselves from familiar inter-personal adversarial positions into a position where our stance is based more on our awareness of, or is related to, the life-giving properties and

values of water. In effect, this realization seems to be based on an awareness that everyone suffers when water is used to make war.

The enormous volume of information available to us at the present time provides us with a remarkable degree of understanding as to many of the primary causes of water conflicts. Similarly, we are now far more aware of the range of options and actions that are available to prevent conflicts from happening, or to resolve them peaceably once they have been initiated. To achieve this goal of preventing or resolving water conflicts in southern Africa, it is important that we first examine our understanding of the basic causes of water conflict.

Some causes of Water Conflict

Water has long been recognized as critical for human health and well-being; no social or economic development can take place without adequate supplies of wholesome fresh water (Falkenmark, 1989; Delli Priscoli, 1996). In the arid and semi-arid regions of southern Africa, fresh water supplies are widely seen as the one resource that has the greatest potential to retard or halt national development programmes (Falkenmark, 1989; SARDC, 1994; Conley, 1995; Mutembwa, 1996; Pallett, 1997; Heyns et al., 1998).

Water is a classical case of a "fugitive" resource that moves naturally from one area to another and is transformed rapidly from one state to another. In addition, whilst water is widely seen to be a "renewable resource", reality dictates that there is only a finite quantity of water available in the sub-continent (Conley, 1995; 1996; Heyns et al., 1998).

Water is also extraordinarily vulnerable to human activities. Both ground water and surface waters are easily polluted when effluent is discharged; sometimes the adverse effects of such incidents can persist for decades. In turn, this can adversely affect both the integrity of the receiving (aquatic) system and the degree to which other water users might make use of the water. Against this background, it is almost impossible to define the ownership of water and water is now universally recognized as a "common good" that should not be "privately owned". This principle forms the basis of newly promulgated national water resource management approaches in South Africa that focuses on all aspects of the water cycle within the geographical bounds of a river basin or catchment area (Asmal, 1998; Republic of South Africa, 1998).

This realization that water is a critically important resource is not new; indeed, our progressively increasing awareness of the strategic importance of water has fuelled most of the water resource development activities that took place during the last century. This has also driven attempts to "trap" or impound water, so as to provide assured supplies during seasons when water is not easily available, or to transfer water from areas of ample supply to areas where water is in short supply (Ashton & Manley, 1999). However, the current reality of southern Africa is one of expanding populations, with its accompanying escalation in urbanization and industrialization, as well as rapidly increasing demands for water to redress past iniquities. Given this set of circumstances, we cannot continue as we have done in the past, to continue a seemingly inexorable pattern of exploiting the finite quantities of fresh water that are available in the region. Instead, we need to re-examine the ways in which we derive value from our use of water and then to implement those policies and practices that will ensure that our use of water resources is equitable and sustainable. This philosophy is directly analogous to equating effective water resource management with good governance (Asmal, 1998).

In its widest sense, water is a critical component of the national prosperity of a country. This is because water is inextricably woven into irrigation and food production processes as

well as into the provision of energy and, occasionally, to transportation systems (van Wyk, 1998). Access to adequate water supplies is usually seen as a "life or death" issue; any threat to disrupt or prevent access to essential water supplies becomes an emotionally charged and volatile topic of intense debate (Pretoria News, 1998; 1999a; 1999b). In extreme cases, the confrontation between competing parties can escalate to overt violence (in the case of individuals or communities), or to military confrontation and, more rarely, to armed conflict, in the case of countries (Falkenmark, 1994; Homer-Dixon & Percival, 1996).

At a strategic level, five key geographical and geo-political characteristics or features influence the ease with which water can become a source of strategic rivalry or confrontation between neighbouring states. The first four of these have previously been stated by Glieck (1998); the fifth is added here as an important determinant in Africa:

- the degree of water scarcity that already exists in the region;
- the extent to which a water supply is shared by one or more states or regions;
- the relative power relationships that exist between water-sharing states;
- the availability of alternative water sources and their accessibility; and
- the degree or extent to which a particular country's international boundaries are aligned with, or located along, shared river systems.

The outcome of this situation is then framed within the context of the strategic goals and objectives that each country has set for itself. In particular, two closely inter-related aspects are important here:

- first, the degree of attention or effort that each country is willing to focus on actions designed to maintain its territorial integrity or national sovereignty, and the circumstances and costs that it is prepared to bear to achieve this aim; and
- secondly, the political, social and economic lengths to which each country is prepared to go to achieve a state of national "resource security" in terms of achieving national self-sufficiency of water, food and energy supplies, rather than developing a more pragmatic, regional, and shared perspective with its neighbours.

We are all keenly aware that a river knows no boundaries; whatever happens to a river at one point will be transported, transformed and expressed along its entire length until it reaches the ocean. Where human activities divert or interrupt the flow of water, or cause degradation in water quality, the consequences are always attenuated, translated and transmitted downstream. Because very few rivers, other than relatively small systems, are contained within the borders of a single country or state, access to wholesome supplies of water increasingly becomes a source of potential conflict whenever a river crosses an international boundary. This issue becomes particularly acute in southern Africa where water resources are unevenly distributed and where a single river system may traverse or form several international borders (Pallett, 1996; Business Report, 1998; Heyns et al., 1998). The potential for conflict in such situations is brought sharply into focus in the case of a country that obtains the major proportion of its fresh water supplies from outside its national borders. Botswana, for example, obtains 94 % of its fresh water from neighbouring states; this undoubtedly contributes to Botswana's sense of vulnerability (SARDC, 1994).

This type of situation is further compounded by large seasonal variations in flow and by periodic droughts and floods. In some cases, the uneven spatial distribution of water supplies has also promoted international trade in water; Lesotho is a case in point, earning valuable foreign exchange from the water it sells to South Africa. However, in this context of "water trading", it is important to realize that there appears to be no shared understanding or agreement as to the value of water; it is usually treated as a "migrant" resource with a variable

value (van Wyk, 1998). This absence of an agreed system for valuing water also contributes to potential conflicts between neighbouring states. The value of water may also vary with its availability; for example, during floods, the unit value of abundant water supplies is considerably less than an equivalent unit of water that is available during a drought.

An additional complicating factor arises when a river system forms the boundary between neighbouring states. Seasonal changes in flows can alter the shape and position of a river channel within a river valley; this can result in year-to-year changes in the "apparent" geographical position of a boundary. Where specific human activities are associated with the "original" river channel (for example: traditional grazing rights on islands or the dredging of riverine mineral deposits), any alteration in the position of the river and its associated international boundary can lead to conflict.

To this "international" dimension of the potential causes of water conflict we can also add a wide variety of more local, inter- and intra-community conflicts over water that can occur within the boundaries of a single community or country. Perhaps the most important or frequently encountered of these smaller-scale conflicts relates to water quality problems that result from upstream activities, followed in importance by problems of access to water during critical periods. In addition, members of the public have expressed a growing need to be involved in decisions around water-related issues that affect their lives and livelihoods (van Wyk, 1998; Pretoria News, 1999a). Failure to provide opportunities for appropriate levels of public participation has led to several instances where the general public have openly expressed their dissatisfaction and, in extreme cases, rejected proposals for water infrastructure projects. Such cases can also be considered as "water-related" conflicts.

In order to fully appreciate the complexities that characterize actual and potential water conflicts in southern Africa, as opposed to those that may or may not occur elsewhere in the world, it is essential that we review some of the main geographical and geo-political realities of the region. This will provide us with an overview of the major driving forces that shape national and regional water resource management policies, as well as the social, economic and political responses that are directed towards specific water conflict situations.

Geographical and Geo-Political realities

We have already noted that water is unevenly distributed across southern Africa; this is expressed in both spatial and temporal (seasonal and inter-annual) terms. The primary driving forces for this are the steep East-West and North-South gradients in rainfall and evaporation (Falkenmark, 1989; Conley, 1995). This unequal distribution of rainfall and associated runoff, in turn, is reflected in a striking absence of perennial rivers and lakes in some parts of the subcontinent (Figure 1a). Namibia and Botswana are particularly poorly endowed with perennial rivers. Both of these countries have to rely almost entirely on the unpredictable supplies of water contained in many small, episodic and ephemeral rivers that flow only after rainfalls, or on perennial rivers that rise outside their borders (Pallett, 1986; Heyns et al., 1998).

The areas where water-related conflicts have already occurred in Africa, or where local tensions are high and these could lead to future conflicts, is shown in Figure 1b. There is a remarkable correspondence between these sites of actual or potential water conflict and the absence or scarcity of perennial rivers or lakes in Africa. In this discussion, our attention will be focussed on southern Africa.

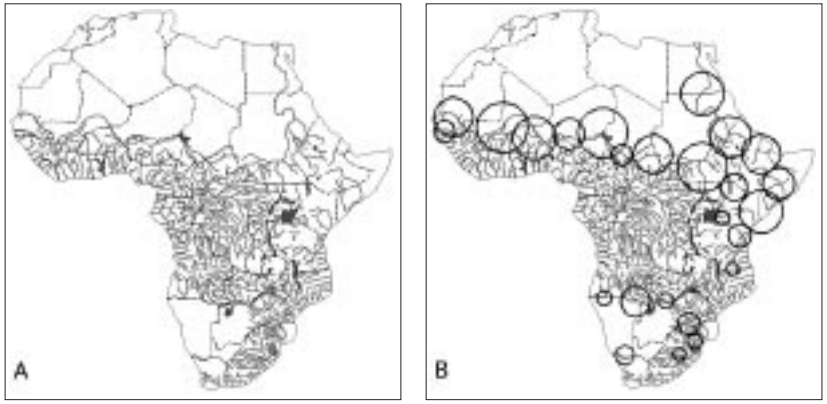

Figure 1: Diagrammatic maps comparing (A) the distribution of larger perennial rivers and lakes in Africa, with (B) the locations of actual or potential water-related conflicts. It is noticeable that rivers form the international boundaries between several African countries.

The so-called colonial "scramble for Africa" that took place during the last half of the nineteenth Century and early twentieth Century (Packenham, 1991) added yet another dimension to the potential causes of water-related conflicts. In particular, the failures of boundary surveyors to define clearly the exact locations of international borders located along river systems have resulted in considerable confusion (Hangula, 1993; Fisch, 1999). This situation was further aggravated by the terms and conditions of border treaties and agreements drawn up by Colonial powers as a means of partitioning the African continent and resolving or satisfying their competing territorial claims. In particular, the Berlin Treaty drawn up on 1 July 1890 redefined some of the geo-political boundaries between German colonies in southern and eastern Africa and their neighbouring Portuguese, English and South African counterparts, has left a legacy of problems for successive administrations (Hangula, 1993).

With the exception of the Sedudu/Kasikili Island dispute which has recently been settled in the International Court of Justice (ICJ, 1999), this confused situation continues to the present day in the case of Namibia's north-eastern Caprivi border with Botswana along the Chobe River, and the adjacent section of its border with Zambia along the Zambezi River (See Figure 3: Hangula, 1993; Fisch, 1999). On attaining independence in 1990, Namibia adopted the principles laid down in Article iii, paragraph 3, of the Charter of the Organization for African Unity (OAU), signed by Heads of States and Governments in 1964, wherein all (OAU) Member States pledged themselves to recognize and respect the national boundaries defined by earlier colonial administrations (Hangula, 1993). Despite this ratification, border disputes continue to persist in the Caprivi region of Namibia (Hangula, 1993; Fisch, 1999). The recent judgement handed down by the International Court of Justice finds that Sedudu/Kasikili Island forms part of the sovereign territory of Botswana (ICJ, 1999).

A related issue, also involving Namibia, concerns the relocated, "new" position of the international boundary between South Africa and Namibia along the lower Orange River. Here, the original agreement drawn up by Britain and Germany during the nineteenth century, confirmed that the entire lower reaches of the Orange River belonged to South Africa. Subsequently, and in conformance with generally accepted international practice for borders located along rivers, South Africa agreed to "relocate" this border to the Thalweg (the centre

of the deepest portion of the river channel). Whilst this move resolved Namibia's problems of access to the Orange River, the action resulted in several unanticipated consequences in terms of disputes around alluvial mining rights, grazing rights and offshore fishing rights. These contentious issues, though not strictly "water conflicts", have arisen as a result of water conflict and remain unresolved to date. Some of their implications are described briefly in the next section of this paper.

The guiding legal principles that underlie the choice of the Thalweg as the position of an international boundary that is located along the length of a river are firmly accepted in international law (ILC, 1994; ILA, 1996). Nevertheless, it is important to recognize the fact that rivers are dynamic, "living" systems that are continually changing the shape and location of their channels over time. Thus, it is inevitable that the precise geographic position of the Thalweg in a river will also change with time. This important feature of rivers carries with it the seeds of potential future conflicts between countries where their mutual border is defined solely by the position of the Thalweg. A closely related issue is one where the Thalweg has not been included in the definition of the border and, instead, the border is merely described as "the centre of the main river channel". In such situations, the potential for conflict between countries is greatly enhanced by each natural change that the river in question undergoes.

Some Southern African examples of Water-Related Conflicts

Against the background descriptions and information provided above, it is appropriate that we review a few southern African examples of actual water-related conflicts that have occurred, or potential water conflicts that could soon occur. The few details available for each of the three examples given below have been gleaned from very scanty published information and from personal experience in each area. Whilst the information available for each example is clearly incomplete, it does provide us with sufficient insight into the scale and complexities of the respective problems. Specific solutions to each of these three problems will only be attained if all the parties concerned demonstrate a great deal of tact and diplomacy, as well as a high level of mutual understanding and patience.

Water abstraction from the Okavango River (Angola, Namibia and Botswana)

The Namibian Department of Water Affairs has faced considerable public pressure to relieve the water shortages caused by recent droughts in Namibia. One potential option involved abstraction of some 17 Mm3 of water per year from the Okavango River at Rundu, and its transfer via a 260 km long pipeline to the head of the Eastern National Water Carrier (ENWC) at the town of Grootfontein (Heyns, 1995; Heyns et al., 1998). The general location of the proposed pipeline and its position relative to the catchment of the Okavango River and Okavango Delta are shown in Figure 2. Three countries comprise the catchment of the Okavango Delta: Angola, Namibia and Botswana. Zimbabwe is part of the subsidiary Nata River system that flows into the Makgadikgadi Pans and is not considered to form part of the Okavango Delta catchment; consequently, Zimbabwe should not be involved in discussions concerning actions or activities that may affect the Okavango Delta (Figure 2).

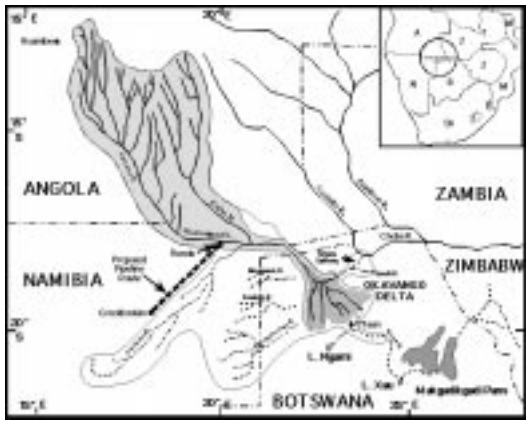

Figure 2: Sketch map of the Okavango River catchment, showing the locations of principal rivers and neighbouring countries in relation to the Okavango Delta. The proposed route of the water abstraction pipeline in Namibia is also shown. The shaded portion of the catchment represents the zone that provides surface runoff; the area indicated by the unshaded portion of the catchment appears not to have provided surface runoff in living memory. The subsidiary, seasonal Nata River system flowing into the Makgadikgadi Pans from Zimbabwe is located to the east of the Okavango Delta. (Redrawn from Ashton & Manley, 1999).

Along the Okavango River, the international border between Namibia and Angola is located over the deepest portion of the river channel (the Thalweg). Thus, both Namibia and Angola consider that they have a "Riparian Right" to abstract water from this section of the Okavango River, if required to meet local or national needs. However, the proposed water abstraction scheme has raised concern in both Namibia and Botswana that the proposed abstraction scheme could have adverse consequences for the Okavango Delta in Botswana. As a result, it was important to all the countries concerned that the potential environmental impacts of the proposed water abstraction scheme should be assessed (Ashton, 1999).

Detailed hydrological evaluations of the proposed water abstraction scheme have shown that the proposed abstraction represents a reduction of approximately 0.32 % in the mean annual flow of the Okavango River at Rundu. The abstraction represents 0.17 % of the mean annual flow at Mukwe, downstream of the Cuito River confluence. Both of these quantities are very small when compared with the average annual volume of water that flows down the Okavango River each year (10,000 Mm3 per year; Ashton & Manley, 1999). The adverse effects of the proposed water abstraction scheme would be insignificant along the Okavango River in Namibia, whilst outflows from the lower end of the Okavango Delta to the Thamalakane River in Botswana would be reduced by some 1.44 Mm3/year (11 %). Additional studies have shown that these effects could be reduced by some 10-13 % if water abstraction was confined to a six-moth period during the falling limb of the hydrograph instead of continuous (year-round) withdrawal (Ashton & Manley, 1999).

Hydrological simulations have shown that the maximum likely loss of inundated area in the Okavango Delta would amount to approximately 7 km2 out of a total area of some 8,000 km2. This potential loss in inundated area would be concentrated in the lower reaches of the seasonal swamps and seasonally inundated grasslands, specifically in the lower reaches of the Boro, Gomoti, Santantadibe and Thaoge channels. However, these effects would be expressed as a shoreline effect, with the loss in area spread out along the shoreline and islands and would not be restricted to a specific area. This anticipated loss in inundated area is unlikely to have measurable impacts on environmental components in any specific area (Ashton & Manley, 1999).

In both Namibia and Botswana, the initial public perceptions of the proposed water transfer project were strongly negative (Ashton, 1999). The proposed water abstraction was seen as having the potential to adversely affect the tourism industry along the Okavango River in Namibia and in the Okavango Delta in Botswana, with a possible loss of income for local residents. However, the environmental assessment study found no "fatal flaws" that would prevent the water abstraction scheme from proceeding. Whilst the anticipated effects are more likely to be seen in the Okavango Delta in Botswana, rather than along the Okavango River in Namibia, the anticipated ecological implications of the scheme were small in spatial extent and would not be perceptible against the natural year-to-year variability in inundation of the Okavango Delta or outflows to the Thamalakane River (Ashton & Manley, 1999).

The overall outcome of the "technical" evaluations of the anticipated scale and severity of possible impacts indicated clearly that the impacts would be very small and, in most areas, would not be measurable by conventional measurement techniques. However, it was also clear to the study team that the public perceptions were shaped by personal opinions and there was a relatively widespread rejection of the technical findings, (or a refusal to "believe the facts"), that were presented to the public. Therefore, if a decision is finally taken to proceed with the proposed water abstraction scheme, the public are likely to attribute to the project any and all adverse situations or circumstances that may arise, whether these may be caused by the project or by some other set of circumstances such as global climate change. Clearly, if this project, or any other water abstraction project, does indeed proceed, the governments of each of the basin countries (Angola, Namibia and Botswana) will have to openly demonstrate their support for the project.

Disputed ownership of Sedudu/Kasikili Island in the Chobe River (Namibia and Botswana)

The ownership of Sedudu/Kasikili Island in the Chobe River has been the subject of a formal dispute between the governments of Namibia and Botswana since 1996, when both governments agreed to submit their claims for sovereignty of the island to the International Court of Justice (ICJ) in The Hague (ICJ, 1999). Prior to this formalization of the dispute, the "ownership" of Sedudu/Kasikili Island had been disputed by local residents in Namibia and Botswana, as well as preceding colonial governments, since the Berlin Treaty of 1 July 1890 (Hangula, 1993; Fisch, 1999). A brief outline of the grounds for the dispute has been drawn from the official press communiqué that announced the International Court of Justice's decision to recognize the territorial claims of Botswana (ICJ, 1999). The sketch map shows the geographical position of Sedudu/Kasikili Island and the locations of other islands whose ownership is also disputed (Figure 3), and some features of the local terrain and the positions of river channels surrounding Sedudu/Kasikili Island.

The island known as "Sedudu" in Botswana and "Kasikili" in Namibia, is approximately 3.5 km2 in area and is located in the Chobe River. The Chobe River divides around the island, flowing to the north and south, and the island is flooded to varying depths for between three and four months each year, (usually beginning in March), following seasonal rains (ICJ, 1999).

On 29 May 1996, both Namibia and Botswana jointly submitted their cases for territorial sovereignty of Sedudu/Kasikili Island to the ICJ, asking the Court for a ruling based on the Anglo-German Berlin Treaty of 1890 and the principles of International Law (ICJ, 1999).

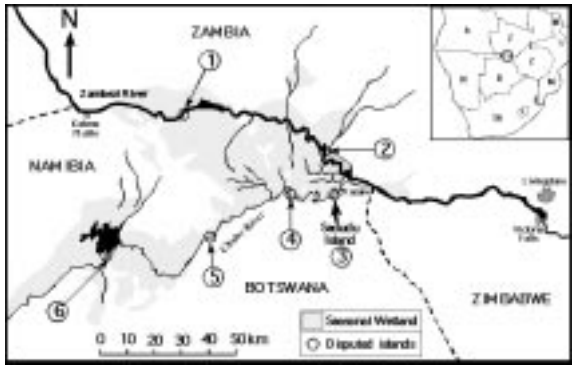

Figure 3: Sketch map of the Eastern Caprivi region of Namibia with the neighbouring territories of Zambia, Zimbabwe and Botswana, showing the general area of Sedudu/Kasikili Island in relation to the extensive wetland areas. Numbered arrows indicate the locations of the six islands whose ownership is disputed: 1 = Mantungu; 2 = Impalila; 3 = Sedudu/Kasikili; 4 = Kavula; 5 = Lumbo; 6 = Muntungobuswa.

The historical origins of the dispute are contained in the Berlin Treaty of 1890, when the eastern boundaries of the Caprivi Strip along the Chobe River were defined in very vague terms as "the middle of the main channel" of the Chobe River, so as to separate the spheres of influence of Germany and Great Britain. In the opinion of the ICJ, therefore, the dispute centred on the precise location of the "main channel". Botswana contended that this is the channel running to the north of the island, whilst Namibia contended that the channel to the south of the island was the main channel. Since the terms of the Berlin Treaty did not define the location of the channel, the Court proceeded to determine which of the two channels could properly be considered to be the "main channel" (ICJ, 1999).

In order to achieve this, the ICJ considered both the dimensions (depth and width) of the two channels and the relative volumes of water flowing within these two channels, as well as the bed profile configuration and the navigability of each channel. The Court considered submissions made by both parties as well as information obtained from in situ surveys during different periods of seasonal flow. Against the background of the object and purpose of the Berlin Treaty, as well as the subsequent practices of the parties to the Treaty, the Court found that neither of the two countries had reached any prior agreement as to the interpretation of the Treaty nor the application of its provisions (ICJ, 1999).

In reaching its verdict, the Court also considered Namibian claims that local Namibian residents from the Caprivi area had periodically occupied Sedudu/Kasikili Island, since the beginning of the twentieth century, depending on seasonal circumstances as well as river flows and inundation levels. The Court considered that this occupation could not be seen to reflect the functional act of a state authority, even though Namibia regarded this "occupation" as the basis for claims for "historical occupation" of the island. The Court also found that this so-called "occupation" of Sedudu/Kasikili Island by Namibian residents was with the full knowledge and acceptance of the Botswana authorities and its predecessors (ICJ, 1999).

The final Court ruling was given in favour of Botswana, with the ICJ indicating that the northern channel around Sedudu/Kasikili Island would henceforth be considered as the "main" channel of the Chobe River. Accordingly, the formal boundary between Namibia and Botswana would henceforth be located in the northern channel of the Chobe River. Botswana and Namibia have agreed that craft from both countries will be allowed unimpeded navigation in both the northern and southern channels around Sedudu/Kasikili Island (ICJ, 1999).

The ICJ ruling is very welcome after a relatively long period of protracted debate and intermittent threats of military action, including formal military occupation of the island by the

Botswana Defence Force. The Sedudu/Kasikili Island dispute provides an excellent example of a water-based conflict situation that reached a high level of tension, preventing resolution of the problem by the disputing parties, thus requiring an independent third party (the ICJ) to be called in to arbitrate the dispute. However, it is important for us to note that, like all other rivers, the Chobe River is a dynamic system where the shape and position of its channels will change over time. Natural processes of sediment deposition and erosion will continue to occur, each depending on the flow patterns in the river. Therefore, it is inevitable that the Chobe River will continue gradually to alter the position and configuration of its main channel in the future. Future changes in the position or shape of the main channel could possibly become a source of future dispute between the two countries.

In this example, the primary dispute between the two countries is one of territorial sovereignty rather than about access to water or to water-dependent resources. However, water is the physical driving force for changes to the aquatic system that forms the territorial boundary. Unless these two countries jointly develop a formal protocol to address this type of situation, similar cases of "water-related conflict" can be expected to occur in future.

There are still five islands in the Caprivi sector whose territorial sovereignty or "ownership" is contested; three of these islands are in the Chobe River and two are in the Zambezi River (Figure 3). Without wishing to pre-empt any options that may be considered by the countries concerned, we can anticipate that the legal principles upon which any decision will be based are likely to follow the same principles and logic used to resolve the dispute over Sedudu/Kasikili Island.

Are Water Conflicts inevitable ?

In the preceding discussion we have seen the degree of influence exerted by current geographical and geo-political realities, together with prevailing social and economic trends, in providing conditions that promote or accentuate water-based conflicts in southern Africa. We have also seen how natural patterns of change in aquatic systems can lead to conflict or can accentuate existing conflict situations. We should now seek answers to the question: "Are all or some of these potential water conflicts inevitable ?"

Given the evidence presented earlier, the simplest direct answer is an unequivocal "Yes"; however, this answer is conditional on several factors that will be expanded on in the next section of this paper. Simply put, and without being pessimistic, water conflicts are inevitable if we continue to do nothing to prevent them from occurring. Whilst this response may appear to be rather simplistic, it is guided and framed by the key insight that the finite fresh water resources that are available in the sub-continent cannot continue indefinitely to support the escalating demands that we make of them. Competition for the available water supplies will continue to increase to a point where radical interventions are required. In addition, water conflicts that are linked to the positions of international borders will still occur in those places where the countries concerned have not yet reached joint agreements.

Whilst water is very unlikely to be the direct casus belli of a war in southern Africa (van Wyk, 1998; Turton, 2000), it is very likely that water will become a contributing factor to regional instability as demands for water approach the limits of the available supplies. Inevitably, water conflicts will occur first in those areas where water is in shortest supply; these will then tend to spread further afield as more and more of the scarce water resources are used directly or transferred further afield to meet rising demands.

In all likelihood, any adverse effects associated with possible global climate changes, such as decreased rainfalls or increased temperatures, will exacerbate the situation. In this context,

it is important to understand that these remarks refer principally to the "minor", usually smaller-scale, forms of water-based conflicts where few individuals or relatively small spatial areas are involved. The case of more "extreme" forms of conflict, such as inter-personal disputes resulting in the death of individuals, or where military intervention escalates to the point where war is declared between two competing countries, is unlikely to occur as a direct or indirect result of water. In such circumstances, if war is declared, water is likely to remain a contributing or subsidiary issue rather than the main cause or "driving force" for war. Nevertheless, each country in southern Africa remains concerned about issues of territorial sovereignty and resource security. This is reflected in the recent return of the state in the control of water, as opposed to ownership by individuals (Asmal, 1998; Republic of South Africa, 1998). However, whilst this trend may reflect the growing strength of individual national governments, the same cannot be said for regional institutional structures. For example, SADC as an institution was unable to resolve the Sedudu/Kasikili Island dispute between Namibia and Botswana, despite the specific provisions for dispute resolution contained in the SADC Protocol on Shared River Systems (SADC, 1995; van Wyk, 1998).

In the light of these observations, we now need to consider some of the potential preventive approaches that are available to us so that we can properly formulate and implement suitable policies, strategies and actions to avoid the prospect of water-based conflicts and their consequences in southern Africa.

Possible preventive measures

We are all aware of the old adage that "prevention is better than cure". This commonsense statement provides us with a perfect outline of the goals and objectives that should direct our actions when we seek to deal with the complex issues of water-related conflicts. However, despite its apparent simplicity, it seems that this ideal often eludes us in practice. A large part of the reason for this lies in the diverse, and often contradictory, ways in which we attach value to water, and the ways in which we strive to derive both individual and collective benefit from our use of water. Too often our objectives have a short-term focus aimed at meeting objectives and solving problems today, rather than a far longer-term focus on the sustainable and equitable use of our water resources.

Clearly, if our demands for water outstrip our ability to manage water as a focus for cooperation and the achievement of common goals, we will run the risk of entering an ever-tightening spiral of poverty, whose social, economic and environmental consequences will threaten the fabric of society. In contrast, if we are able to attain an equitable balance between the demands we make for the services and goods that we derive from the use of water, and our ability to exercise our custodianship of water, we will be able to achieve a far more harmonious and sustainable situation. The second of the two visions outlined above is clearly one that should have a far greater appeal to wider society. However, in order for us to achieve this, all our policies and actions concerning water must be guided by the values of sustainability, equity, mutual cooperation, and the attainment of optimal benefit for society (Asmal, 1998).

Within this philosophical framework based on the concepts of sustainability, we can now briefly outline four of the most appropriate approaches for preventing water conflicts and, in those situations where conflicts have already occurred, approaches that can help to resolve these conflicts before they escalate to unmanageable levels.

Water resource management on a whole-catchment basis

Modern approaches to water resource management recognize that water resources can only be managed effectively and efficiently when the entire river basin or catchment forms the basic management unit. Furthermore, because surface water and ground water are inextricably interlinked, they must be considered and managed together as a single resource. These principles form the foundation for integrated catchment management (ICM), and are rapidly gaining wider acceptance throughout the world (Ashton & MacKay, 1996).

Most southern African countries have recognized the fundamental importance of catchment management and have already drawn up policies, implemented the required legislation, and initiated series of actions designed to achieve this objective (Asmal, 1998). Whilst it will still take some time for the full benefits of these activities to be realized, a promising start has been made. The special cases of water resource management in river basins that are shared by more than one country, and the issue of water transfers between river basins either within the same country or between neighbouring countries, still require additional attention.

The thorny issue of river basins shared by more than one country has been central to many of the water-related conflicts that have occurred in southern Africa. Part of the problem relates to the existence of different political, economic, and social structures within each country; another component of the problem relates to differences in the legal and legislative systems of different countries. Importantly, a critical component of the problem also relates to the relative economic and political "strengths" of each state. Nevertheless, it is inevitable that all the countries that share a single river basin will have to decide jointly on appropriate management goals and an equitable basis for allocating water to meet the needs of each riparian state. Clearly, it will then be the responsibility of the individual riparian states to communicate the conditions of such an agreement to all their citizens and water resource managers. If this can be achieved at an early stage, then the joint agreement will provide considerable assistance in preventing or avoiding water-related conflicts. Failure to achieve this will prolong any existing conflicts and create conditions that favour or promote the "rights" to water of one country over another.

In its ideal form, catchment management provides both a guiding philosophy and a practical framework for action that promotes cooperative decision-making and responsible management of water resources. A basic tenet of catchment management is the principle that all the water users within a catchment must take responsibility for determining the short-, medium- and long-term objectives of water resource management, whilst ensuring that water allocation is both equitable and fair (Asmal, 1998).

Water transfers and linkages within a catchment and, where necessary, between neighbouring catchments, are thus guided by the decisions made by all stakeholders (Basson et al., 1997). Clearly, this represents an ideal that may not yet be attainable because of a variety of problems. Perhaps the most important of these are: ineffective or non-existent water legislation, inappropriate institutional structures, a lack of suitable information and thus an absence of empowerment amongst stakeholders, and a lack of understanding of available participatory approaches for obtaining consensus and resolving disputes. Each of these aspects holds opportunities that can help us to prevent or resolve water conflicts; they are described briefly below.

Legal and legislative principles

Each southern African country has a set of legislative frameworks and laws that guide and control the development and management of society. Many of these policies and laws have

been inherited from previous colonial administrations where a form of centralized command and control of key resources such as water was of great importance. For the purposes of our discussion, the most important items of legislation in each country are the laws relating to the protection, development, control, use, and management of water resources. Many of these southern African "water laws" have been modified from their original (colonial) form and now share several common features. Particularly important are those aspects of these laws that recognize water as a common good, denote each state as having a custodial responsibility for water, and replace previous situations of "ownership" of water by individuals with a common "right to the fair and equitable use of water".

Whilst some of the principles contained in these legal systems represent a dramatic departure from previous water law, they now provide a far more equitable basis for water allocation and management (e.g. Asmal, 1998; Republic of South Africa, 1998). Therefore, when the laws are applied effectively by designated officials and agents of the respective governments, the national water legislation within each southern African country provides individuals and communities with an appropriate legal framework within which to seek suitable options that will prevent water-related conflicts, or can be used to resolve disputes over water.

At the international level, however, matters are somewhat less straightforward. International water law is organized around a core comprising four main doctrines that attempt to define and delineate the rights of river basin states to use water from a shared river system (Pallett, 1997; van Wyk, 1998). These principles and laws have evolved at different times and reflect responses to the suites of different claims that have arisen from riparian states. Each of the four doctrines reflect different historical and judicial approaches to solving the problems experienced by riparian states (ILA, 1966; ILC, 1994; van Wyk, 1998) and also reflect an important change in emphasis from rights to ownership of water, to one which strives to ensure that the interests of all parties are met equitably. The four main doctrines of international water law are outlined briefly, below.

- *The doctrine of absolute territorial sovereignty*
  Also known as the Harmon Doctrine, this consideration regards that portion of the water that flows through the sovereign territory of a riparian state as being subject to the exclusive sovereignty of that riparian state.
- *The doctrine of absolute territorial integrity*
  The principles of this doctrine instruct riparian states not to interfere with any portion of the natural flow of a river that passes through their territory, if such interference is likely to impact adversely on the flows of water to a "downstream" country and to interfere with any prior use that the "downstream" country may have made of such flows.
- *The doctrine of limited territorial sovereignty*
  The principles of this doctrine assert that the water of an international river cannot be exclusive appropriated by one riparian country; rather, that all riparian states must be allowed a reasonable and equitable level of utilization of the waters of an international river.
- *The doctrine of community interest*
  The principles of this doctrine attempt to remedy drawbacks that have occurred with the doctrine of limited territorial sovereignty, through expanding the issue of community interest and improving the definition of equitable utilization. This doctrine represents a more balanced approach that seeks to contribute to the joint development of riparian countries within a shared basin through equitable division and sharing of benefits, whilst also improving and facilitating the management of water within that basin.

An unfortunate characteristic of international water law is that it lacks the compulsory jurisdiction and enforcement that normally characterize domestic legal systems. Rather, it relies on its acceptance by the affected states and the opinion of the world community. The non-navigational use of river systems, (e.g. for domestic and industrial consumption), has focused considerable attention on the need for co-operative sharing of water resources throughout the SADC countries (Pallett, 1997). This has been further emphasized during recent meetings of the SADC Ministers (Heyns, 1995).

Instruments of international law also advocate that all states sharing an international river basin should jointly form a river basin management authority or organization which can equally represent the interests of each state (International Law Commission, 1994). This approach has been adopted with great success elsewhere in southern Africa (Pallett, 1997) and is the basis for the OKACOM agreement between Angola, Botswana and Namibia (OKACOM, 1994).

Development of appropriate institutional structures

At an international level, extensive co-operation exists between southern African states that share international river basins. This has usually taken the form of river basin commissions or Joint Permanent Technical Commissions, where the interests and concerns of each state are presented and debated before decisions are taken. However, whilst these formal commissions and committees are to be welcomed, full regional co-operation and co-ordination are still inadequate (van Wyk, 1998).

In 1995, all but three of the SADC Heads of State signed the SADC Protocol on Shared Watercourse Systems (Heyns, 1995). One more country has ratified the protocol, leaving only Mozambique and Zambia. This has been an important development, and signified widespread heightened awareness of the critical importance of water resources to the entire southern African region. The SADC Protocol was followed shortly afterwards by a meeting of the SADC Ministers responsible for Water Affairs in November 1995, where a new SADC Water Sector was established. All of these developments are to be welcomed and it is anticipated that SADC as an institution will eventually become a strong regional force for the prevention of water conflicts.

At a national level, catchment management approaches require the formation of institutional structures that promote empowerment of participants and allow meaningful participation by all stakeholders. Whilst many of these structures are still in their infancy and have not yet begun to function properly, we can anticipate that they will provide an essential process for defusing conflict situations and preventing water conflicts.

Development of participatory, consensus-seeking approaches

A central component of conflict prevention is a need for the prior development of suitable participatory processes that are designed to seek consensus and agreement. In the case of water conflicts, it is important for institutions and countries to have a mutually agreed framework of criteria and agreements that can provide the basis for decisions. This also requires wide agreement on the sharing of information and data, rather than each participant retaining (hoarding) the information it considers to be important (Turton, 1999). In turn, this openness will help all participants to understand the sets of rules and constraints within which they need to work, and will also facilitate the joint development of alternative options or solutions to a particular problem or concern. This ability to generate new options is one of the most important keys to successful negotiations (Delli Priscoli, 1998).

We are all aware of how important it is for participants in a dispute to reach consensus or agreement wherever possible. However, sometimes this is not possible since the differences between the parties concerned may remain too far apart to be bridged by a single solution or a combination of solutions. Whilst this type of situation may be driven by economic or ideological standpoints, rather than differences of opinion over water, the end result is the same: failure to reach joint agreement. In such situations, conflicts can be prevented if an agreed process for independent arbitration to cover this eventuality has already been selected. Possible solutions in the case of disputes between two or more countries include the International Court of Justice at The Hague, as in the case of the Sedudu/Kasikili Island dispute (ICJ, 1999).

Inevitably, individual countries that share the same river basin will have to continue to coexist and continue to use their shared water resources in the future (Ashton & MacKay, 1996). It is therefore extremely important for these countries to ensure that suitable institutional structures and administrative processes are in place. This will help them to maintain cordial relations with one another and not to have to rely on the rather dissatisfying option of an independent third party or arbitrator to resolve their water conflicts whenever these may occur.

Participatory decision-making processes that seek to reach consensus are equally important at the level of individuals and communities. Here, it is also important to ensure that all participants fully understand their roles and responsibilities, and that they are sufficiently empowered through the provision of information to exercise their responsibilities. Ultimately, each person or community has to "own" and implement the solution that has been derived from their joint deliberations and interactions. This is only possible when each individual also "owns" the process used to derive these solutions.

Concluding remarks

In this overview, we have examined some of the factors that cause or promote water conflicts and we have reviewed a few examples of existing water-related conflicts in southern Africa. Based on the available evidence, we have seen that water conflicts in southern Africa are inevitable unless we can take appropriate preventive actions. The opinion behind this assertion is fuelled by the continual increase in demands for water that a finite resource base cannot support indefinitely.

Some of the preventive measures mentioned above have been briefly outlined. These centre primarily on processes of joint decision-making, within suitable institutional and legislative frameworks. It is important to note that the possible options for conflict prevention are generic in nature, but these will have to be customized to make them site-specific, to suit the individual needs of the communities and countries involved.

The issue of the scale of actual or potential conflict is important, as well as the specific circumstances that have given rise to the problem. For example, a river boundary that coincides with, or forms, the international boundary between two countries, has a high potential to become a cause of conflict whenever the river changes its position. Similarly, it is clear that "downstream" countries and communities will always be more vulnerable than "upstream" countries. In turn, the degree of vulnerability felt by a "downstream" individual, community or country would be determined by perceptions of the relative economic, social and military strengths of the different parties.

All of the larger-scale southern African examples of water conflict share the characteristic that water may have contributed to the conflict, (for example through the erosive action of a

river changing the position of its channel), though it has not been the primary focus for the conflict. Some of the examples also comprise situations where access to other resources (e.g. oil, gas, minerals, grazing land) is compromised by the proximity of these resources to a national boundary whose precise position is disputed. The relatively smaller-scale situations of water-related conflict consist mainly of intra-community and inter-community disputes over access to water, or to services associated with water. These disputes occur usually within a small geographical area and seldom escalate to involve communities from neighbouring countries. Whilst these small-scale conflicts are very real to those involved, and often result in the death of individuals or their livestock, they are not considered to be true water wars in the widely accepted sense of a military conflict between two or more countries. Their smaller scale makes them more amenable to resolution by peaceful, negotiated means, and the resulting solutions tend to persist because each individual is involved in the resolution process.

We can also conclude that "true" water wars comprise only those extreme cases of water conflicts whose primary focus is to secure access to water or where water is the primary offensive weapon. Despite the dire predictions of many authors, the available evidence suggests very strongly that it is highly unlikely that "true" water wars will ever occur in southern Africa. However, this is no reason for complacency on our part. We all share the responsibility of ensuring that water wars never occur in southern Africa, or elsewhere. We need now to jointly identify those so-called "hot spots" where water conflicts are imminent or could arise in future, and then to develop joint strategies to defuse these situations. Military confrontation between Namibia and Botswana has already occurred in the case of Sedudu/Kasikili Island; we must ensure that this situation is not repeated.

This responsibility requires each of us to promote the principles of equity and sustainability in all our dealings with water users and water resource managers throughout the southern African region. Similarly, we should seek new ways to influence the relevant water management institutions and authorities to focus their efforts on those longer-term policies, plans and actions that will prevent water conflicts, rather than retaining only a short-term focus and then trying to resolve conflicts after they have occurred. Failure to achieve this is likely to result in an increased number of water-related disputes with the strong likelihood that their intensity may escalate progressively over time to intolerable levels of conflict between communities and, even worse, between countries.

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Good Governance and the Avoidance of Conflicts: The Lesotho Highlands Water Project Experience

*By R. T Mochebelele**

1.0 Introduction

Lesotho Highlands Water Project (LHWP) is one of the major water projects of its kind currently being implemented in the world. The LHWP is a project involving two countries: the Kingdom of Lesotho and the Republic of South Africa (RSA).

The LHWP harnesses the Senqu/Orange River water in the Lesotho Highlands, and through a series of water transfer and delivery tunnels delivers it to the Vaal River system for the water thirsty Gauteng industrial heartland of South Africa.

The LHWP proved to be a more economic option for the water resources development for South Africa, and has provided Lesotho with a unique opportunity for the economic development of the highlands and generation of its own power. Objectives for the implementation of this project between the countries summarise benefits for both countries:

- To harness surplus water from the highlands of Lesotho and transfer to Gauteng for revenue.
- To generate hydroelectric power for Lesotho.
- To realise economic development for the two countries.

One other advantage of the project, especially with Gauteng as the receiver of water is that 50% of the labour force working in the Republic of South Africa from Lesotho is actually working in Gauteng.

The LHWP topography, with its deep gorges, has resulted in a smaller number of people being displaced by the project and less environmental impacts than in dams of similar size. Katse Dam, at the height of 186m (the highest in Africa), impounds a reservoir surface area of only 35.8 km2. Another advantageous aspect of the LHWP is the head difference it provides to the Gauteng region, resulting in higher gravity flow of the water to the Vaal River system.

The LHWP was planned to be developed in 5 phases, and to deliver 70 cumecs of water. The two countries signed a Treaty on the project in 1986. The current commitment under the Treaty caters for the development of Phase 1 of the project. Phase 1 is being developed in two sub phases, Phases 1A and 1B.

Phase 1A is complete and operational whereas Phase 1B major works (dam and tunnels construction) commenced early in 1999.

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Phase 1A comprises Katse Dam on the Malibamats'o River, which is a tributary of the Senqu/Orange River in the upper catchment: 45 km long water transfer tunnel; the 'Muela tail pond and hydropower complex with 72 megawatts of power generation; and the 36 km long delivery tunnel. The main works construction activities are being supported by a range of infrastructure facilities, such as roads, power, and telecommunication etc.

Phase 1B comprises Mohale Dam on the Senqunyane River, another tributary of the Senqu River; and a weir on the Matsoku River, which is also a tributary of the Malibamats'o River and associated tunnels into Katse Reservoir. Likewise, as in the case of the Phase 1A, complementary development of the infrastructure has been done.

The Project has international dimensions in addition to its domestic one due to its far-reaching impact on the economy of Lesotho because of its size in comparison to the country's economy. The Project therefore has many stakeholders both outside and within Lesotho thus creating many fronts for possible conflicts which have to be managed. The potential major conflicts and how they were dealt with are as discussed below.

2 Potential Conflicts Between the Two Countries and How They Were Addressed

The two countries committed themselves to the project because its implementation provided both of them with sufficient and substantial tangible benefits for each Party. It therefore became necessary for the two Parties to put in place mechanisms for the prevention of disputes and to resolve any that arise. The issues that had to be addressed in order to avoid conflicts are as follows:

2.1 Institutional Arrangements

At the time of the Feasibility Study, South Africa was under sanctions and financial Institutions and donors only wanted to deal with South Africa at arms length and not directly. It therefore became necessary to come up with special organisational arrangements that would satisfy South Africa, which is responsible for all costs associated with the transfer and delivery of water, while recognising the developmental impact of the project in, and the sovereignty of, Lesotho.

The Parties agreed on the Lesotho Highlands Development Authority (LHDA) and the Trans Caledon Tunnel Authority (TCTA) as their implementing agencies in Lesotho and South Africa respectively. In addition a binational body, the Joint Permanent Technical Commission (JPTC) was established under the Treaty. The Commission has three delegates and their alternates from each Party and they are mandated to oversee the project on behalf of the two Governments. The Commission has monitoring and advisory powers over the activities of the LHDA and TCTA and does have approval powers over some of their activities.

The two Parties agreed on the review of the LHWP Governance Structure in 1995. The purpose was to make the Governance Structure more efficient by streamlining it and clarifying the roles and responsibilities of the organisations involved in the implementation of the LHWP. The Parties signed a new protocol to the Treaty in June1999 giving effect to the new Governance Structure. The JPTC changed its name to Lesotho Highlands Water Commission (LHWC) with added responsibility as an overseer of the project implementation on behalf of the two governments. The LHWC is the formal channel of the governments input to the project. The new Governance Structure further clarified the roles of the LHWC and the LHDA and TCTA. The LHWC is responsible for strategic policy issues while the implementing authorities are responsible for operational policies.

The Commission decisions are reached by consensus and mechanisms are in place for dealing with disagreements when they arise. The Commission constitutes the first level in the dispute resolution mechanism. The issues only get referred to the political level if the Commission fails to reach agreement after the third seating in which the issue is under discussion. Referral of disputes to the Commission can be by one or both implementing authorities and similarly by one or both Parties. The success of the institutional arrangements depends on transparency and good governance in the affairs of the project and the trust the Parties have in the activities of the Commission.

2.2 Financial Arrangements and Cost Responsibility

The Parties agreed up-front on the apportionment of costs. The Government of Lesotho is responsible for all costs associated with the generation of hydro electricity and ancillary development in Lesotho while South Africa is responsible for all costs associated with the transfer and delivery of water to South Africa. The costs associated with environmental impacts and resettlement of people are allocated depending on whether they arise from electricity generation or water transfer to Gauteng.

The Parties agreed to the involvement of the World Bank in the supervision of the studies and appraisal of the Project. The World Bank acted as a neutral advisory body and got the commitment of both Parties to project implementation. This was necessary in areas where the Parties disagreed on some issues. The Bank gave further comfort to the Parties, especially the smaller Party to the Agreement (Lesotho) vis-à-vis the larger Party in terms of resources and size.

2.3 Use of International Standards

At the time of Treaty signature, South Africa was experiencing international isolation and had their own technical standards which were often not in line with international standards. The Parties agreed in advance that they would implement the project in accordance with normal international standards. The World Bank also ensured the adherence to international standards if ever there was a disagreement on the standards to apply. This was to be an asset in coming to agreements on a number of issues which would otherwise not have been agreeable to South Africa, such as dealing with the welfare of the people impacted upon by the project and not only replacing assets lost but going further to ensure an improvement in the standard of living of the affected communities.

The agreement on international standards up-front was helpful in avoiding potential disputes during the implementation of the project. At the suggestion of the World Bank the project employs independent engineering and environmental panels of experts to advise in the design and construction of dams and tunnels and in the design and implementation of the environmental action plan for the mitigation of the negative impacts of the project.

2.4 Agreement on the Model for Water Tariffs

The discussions between Lesotho and South Africa date back to the early 1950s when the expected transfer from the Lesotho Highlands was 4 cubic metres per second from an Oxbow Scheme. The subsequent discussion centred on a Malibamatso Project which was to transfer 11 cubic metres per second in the early 1970s. Both of these projects were not carried to implementation due to failure of the two Parties to agree on the tariff for the water which Lesotho would charge South Africa.

During the Feasibility Study stage, the two countries agreed that the issue of tariffs should be determined in advance. The Parties agreed to study the LHWP and the Orange-Vaal Transfer Scheme (OVTS), the alternative project to LHWP in South Africa to the same level of technical detail

and costing. The difference in cost, called the net benefit, was agreed to be shared on a ratio of 56% to 44% between Lesotho and South Africa respectively. Lesotho's share of the benefit is called the "Royalty" and is paid in accordance with water deliveries to South Africa. As a means of avoiding conflicts or disagreements, a Royalty Manual was drawn up and signed as a Protocol to the Water Treaty. Among the important provisions of the Manual is that it cannot be changed and any mistakes that may be discovered at a later date shall not be a reason to change the model.

2.5 Provision for Avoidance and Resolution of Disputes

The Parties put in place mechanisms for the avoidance of conflicts and disputes by establishing the LHWC as a body to discuss and resolve issues, both technical and management related, on all activities associated with the project. The LHWC provides a forum for consultation and discussion and has succeeded over the last 15 years to resolve all potential disputes.

The Parties also recognised that the LHWC may sometimes not reach an agreement and thus provided for intervention at Government level to reach an amicable settlement. The Chief Executives of the implementing authorities have been entrusted with some discretionary powers to continue operations during the dispute-resolution process. These provisions ensure that disputes do not end-up hindering the implementation of the project.

3 Potential Conflicts Between the Project Authorities and The Affected Communities

The need to consult with the people to be affected by the Project was recognised at early stages of the project. During the implementation of Phase 1A of the project it became apparent that a structured consultation process was required to ensure a full and meaningful participation of the affected communities in the type of compensation they prefer and also where and how they are to be resettled.

Specific conflicts or disputes that have emerged during the project implementation have been on general compensation issues and employment issues in the project area. There were other disputes between the two governments, such as the Mapeleng incident where 70 households were relocated due to reservoir-triggered seismicity, and the original inadequate provision of funding for the rural development programmes.

LHDA, in conjunction with local authorities, set up a Conflict Resolution Mechanism at community level to handle disputes. In general, local authorities have participated in dispute-resolution at local level. The chiefs are empowered to deal with administrative issues at village level on a day-to-day basis. Where disputes arise, they also handle them. In most community-related disputes, agreements have been reached. So far, in one dispute, which arose due to construction of an access road to the construction site (where communities launched a claim about their cracking houses), an independent assessor is to be appointed. There was a labour dispute at 'Muela Hydropower which resulted in violence. The Government of Lesotho set up a Judicial Commission of Enquiry which produced a report whose recommendations are being implemented.

The LHDA has evolved in terms of human, financial and managerial resources to address administrative and on-site implementation of the project. The Environment and Social services have been decentralised to four project areas in order to foster early response and work with communities to address implementation problems, if there are any, with reduced reliance on Headquarters.

The LHDA, following the lessons learned from Phase 1A, sought a much closer consultation in Phase 1B and organisational structures were set-up to deal with inputs and queries from the communities to be resettled. Village liaison committees were set up as a link between

the project authorities and the communities. The consultation process was to be critical at a time when a decision had to be made about whether Phase 1B of the project should be implemented or not. The communities having assessed the compensation packages and the development programs agreed with them overwhelmingly and approved the project despite opposition from some of the international non-governmental organisations.

4 Potential Conflicts Between The Project Authorities and Non Governmental Organisation (NGO)

In the initial stages of implementation of the project, polarisation developed between some of the NGOs and the LHDA. The NGOs considered themselves as watch dogs and spokesmen for the communities impacted on by the project, while the LHDA considered that they should deal directly with the communities.

The project has learnt a lesson that the NGOs having worked within the communities, have an essential role to play in the delivery of services to the communities by the project and that both the NGOs and the LHDA have the same objective which is to ensure delivery to the communities. The LHDA and NGOs have therefore signed a Memorandum of Understanding in which each recognises the role played by the other and have agreed to cooperate in dealing with local people. The Memorandum provides for the NGOs to implement some of the developmental projects where they have capacity while introducing their independence as monitoring agents on the activities of the project authorities.

5 Potential Conflicts Between Lesotho and Riparian States

The implementation of the LHWP required that the downstream impacts of water transfer in the Lesotho Highlands be instituted. Studies were undertaken of the effect on the estuary of the Senqu/Orange River as it entered the Atlantic Ocean.

The Feasibility Studies on the Lesotho Highlands Water Project were carried out during 1984/85, at the time when Namibia was under occupation by South Africa, and this coincided with the time that there were United Nations sanctions against South Africa. The World Bank made it a condition of their financing that a no objection statement to the implementing of LHWP be obtained from SWA/Namibia as a riparian State. Lesotho therefore approached the UN Council for Namibia in New York and a go ahead for the project was given. The New State of Namibia was approached after it gained its independence and it agreed to the development of Phase 1 of the project, which is to transfer about 30 cms to Gauteng.

The four basin states of South Africa, Namibia, Botswana and Lesotho are presently discussing the formation of the Senqu/Orange River Commission. The Commission will facilitate the sharing of information among the basin states and advise the governments on the proposed water resources developments within the river basin.

6 Conclusion

The project has been under implementation since 1989 and Phase 1A has been completed while Phase 1B is under construction and is programmed for commissioning in 2003. During these 11 years three Protocols have been signed by the Parties amending certain provisions of the Treaty. All issues have been discussed and agreed and there has not been a need to utilise the provisions of arbitration provided in the Treaty. The conclusion is that the Treaty has served the two countries well resulting in no major disagreements after 11 years of successful project implementation.

Water Wars in Southern Africa: Challenging Conventional Wisdom

*By Anthony R. Turton**

INTRODUCTION:

Africa is dominated by transboundary waters, due largely to the scramble for Africa during Colonial times, when European powers arbitrarily drew borders onto the continent with little regard for natural, geographic or ethnic realities. The Charter of the Organization of African Unity (OAU) originally recognized all borders that existed at the time of its founding, thereby locking in one of the elements of potential political instability. Africa contains some 80 international river and lake basins. Twenty-one of these river basins have catchments greater than 100,000 square kilometers, some of which are shared by more than ten states. The major issue confronting management of these basins is access to, and control over, water resource use (Hirji & Grey, 1998:78).

Ismail Serageldin, then World Bank Vice President for Environmentally Sustainable Development, confidently declared at a meeting in Stockholm during August 1995 that "wars of the next century will be over water" (Homer-Dixon, 1996:362). This paper will argue that no justice was done to Africa when that statement was made. This statement has been repeated often in the media, thereby allowing a knowledge construct to develop, based on teleological arguments and unsubstantiated facts, ultimately undermining investor confidence. Who in their right mind will make direct foreign investment in Southern Africa if Northern-based conventional wisdom suggests that in the 21st Century, Africa will slide into a messy series of Water Wars in direct response to rising levels of water scarcity? This paper will try and shed some light on this subject.

WHAT IS A WATER WAR?

There is a fundamental epistemological problem regarding the notion of a water war. In order to obtain some degree of conceptual clarity on this issue, it is necessary to establish distinct definitions of a water war as a point of departure.

Firstly, the desire for access to water can be seen as being the direct cause of war. In this case, water scarcity is both a necessary and sufficient condition for going to war. For the purposes of this paper, this will be defined as a true water war.

Secondly, water, and especially hydraulic installations such as dams, pipelines and water treatment plants, can be seen as becoming targets of war. In this case, water scarcity is neither a necessary nor a sufficient condition for going to war. A war in this category is thus caused by something quite unrelated to water scarcity, but during the progress of such a war, the belligerents may select hydraulic installations as being legitimate targets. For the purposes of this paper, this is not regarded as being a true water war and can be called a conventional war with water as a tactical component.

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Thirdly, waterways that form parts of contested international boundaries, can become the focal point of war. In this case water scarcity is neither a necessary nor a sufficient condition for going to war, but because the war is apparently fought in and around waterways, it appears to be a water war. Under these conditions, the root causes of war are totally unrelated to water, but water issues may become politicized as a result of the larger belligerence and take on the appearance of a water-related conflict. For the purposes of this paper, this is not regarded as a true water war, and will be called a quasi water war instead, with the war merely being fought in a theatre that is dominated by an aquatic environment.

During the course of this paper, literature will be reviewed that will enable the reader to place the facts into either one of these three categories.

LINKAGES BETWEEN WATER AND CONFLICT

The three water war scenarios noted above presuppose violent conflict. Gleick (1998) notes that there are four major links between water and conflict, each with a different degree of violence or potential violence.

Firstly, water has been used as a military and political goal. This is most relevant to a Cold War/Realpolitik framework where water, like other natural resources, can be the defining factor in the wealth and power of a state (Gleick, 1998:108). In this regard, there are four variables that are important. These are (1) the degree of water scarcity; (2) the extent to which the supply is shared by two or more groups; (3) the relative power of those groups; and (4) the ease of access to alternative sources of water (Gleick, 1998:108).

Secondly, water has been used as an instrument or tool of conflict. There is a long history of this, with the earliest records dating back to an ancient Sumerian myth from 5 000 years ago, paralleling the biblical account of the great flood (Gleick, 1998:109). Two modern accounts of this exist (Gleick, 1998:109-110). In 1986 North Korea announced plans to build a major dam on the Han River, upstream of Seoul. This project was justified by providing for hydroelectricity, but it could also be used as a weapon to destroy Seoul should it be breached. During the Gulf War, the Allied coalition arrayed against Iraq considered the possibility of using the Ataturk Dam on the Euphrates River to shut off the flow of water to Iraq.

Thirdly, water and hydraulic installations have been used as targets of war (Gleick, 1998:110). There are many documented cases of this dating back to ancient Babylon. In modern times the "dam busters" under the command of "Bomber" Harris provide an excellent example. In contemporary Southern Africa, the damage to Gové Dam in Angola is also an example.

Fourthly, inequities in water distribution, use and development can result in tensions and conflict (Gleick, 1998:111), both within a country and between countries in an international river basin.

One need only consult any standard textbook on foreign policy or international politics that has been published in the post-Second World War era to become convinced that guaranteed control over, and access to, strategic raw materials is essential to national security. Yet on closer analysis, a conflict ordinarily described as a "resource war", has usually been triggered by other factors (Lipschutz, 1989:2).

CONVENTIONAL WISDOM ON WATER AND CONFLICT

In order to achieve a meaningful insight into the problem, it is necessary to understand what discourses on water and conflict exist. A recent overview of the literature reveals that at least five, and possibly more, different discourses can be found in one form or another. These discourses will be presented below, roughly in the chronological order in which they were developed. It must be noted that some discourses contain elements of others, and a clear-cut distinction is sometimes difficult to make. This is because elements of some earlier, relatively crude discourse, later found their way into the more sophisticated discourses that were developed as research into the topic allowed new concepts and models to be developed.

The Malthusian Discourse.

Malthusian-type discourse posits a linear relationship between population growth and water scarcity. Classic examples of this form of discourse include the now famous Club of Rome's "Limits to Growth" and The Ecologist Magazine's "Blueprint for Survival" (Eckersley, 1997: 11-12). Selby (1998) calls this discourse an ecological one, based on the notion of a finite carrying capacity of the planet. As estimated by Postel et al., (1996), humans now appropriate approximately a quarter of all evapotranspiration over land, and more than a half of the surface flows available. This is what Ohlsson & Lundqvist (2000) refer to as "the numbers game - a story of shrinking per capita-allotments". Arguably one of the important writers on this topic was Malin Falkenmark (1986) who first developed the so-called "water scarcity indicators" that were based on a central notion of a "water barrier". This led to the publishing of what has now become a classic index of water scarcity (Falkenmark, 1989) that is often used by other authors. Central to this thesis is the argument that as populations grow, so water scarcity increases, leading ultimately to a water war. It was this type of linear thinking, based on the teleological arguments inherent in the linkage of water scarcity to violent conflict, which led authors such as Starr (1991) to conclude that water wars were more or less inevitable in the 21st century.

The Virtual Water Discourse.

This grew partly in response to the crude Malthusian Discourse referred to above. Whereas the Malthusian Discourse predicted water wars with some confidence, the Virtual Water Discourse explained why there was an almost total lack of evidence of any water war in areas that are known to be highly water stressed (Allan, 1999:15-19). Developed by Tony Allan, the main concept is that of "Virtual Water". Allan noted that it takes approximately 1 000 tonnes of water (one cubic metre of water is the same as one tonne) to produce one tonne of wheat (Allan, 1996a). Therefore if a country is facing a debilitating water deficit, the government can balance the water budget by importing wheat instead of mobilizing additional water. Thus for every tonne of wheat that is imported into a country or region, it is the same as importing 1 000 tonnes of water in a "virtual" sense, with the added bonus of being ecologically benign and politically friendly. Allan (1996b) notes that "as much water enters the Middle East region as 'Virtual Water' in the form of subsidized grain purchases than flows down the Nile annually". It is this importation of water, embedded in grain and therefore available at highly subsidized rates, that has prevented the type of water war that was so confidently predicted by Starr (1991) from actually happening (Allan, 1996c).

The Structural Inequality Discourse.

Structural inequality results when unequal access to, and control over, water resources within a given country occurs over time. This is particularly relevant in societies where water deficit occurs, and where access to water can give a social grouping a major advantage in political and economic terms. This has led Thomas Homer-Dixon (1994a) to develop the concept of "resource capture" and "ecological marginalization". Selby (1998) calls this a political discourse and notes that people are seen as being the victims of the political economy. In this discourse, conflict is inherent within society as inequalities are contested and positions of hydropolitical privilege are entrenched and protected. Richard Sexton (1992) was focussing on similar issues when he expanded the concept of scarcity to include the economic use of water, thereby highlighting the adverse effects of deliberate policies designed to favour agricultural export (Warner, 2000). Turton (2000a) has shown that hydraulic pipelines become a significant instrument of political control under such conditions, as was the case in Apartheid South Africa, where structural scarcity was managed to the almost exclusive advantage of the white minority. Within this paradigm, hydraulic engineers are discursive elites, and their skills at the domination and control over nature leads inescapably to the domination of some people over others (Warner and Turton, 2000) as politicians manipulate natural resources to the advantage of their constituencies.

A component of this discourse is what can be defined as induced scarcity. A specific category of this induced scarcity is the depletion of the resource base as the result of pollution (Ohlsson & Lundqvist, 2000). Approximately all of the projected population increase that will occur over the next decades is expected to move to the already overloaded cities. Figures are staggering, being in the order of 80% of 2 billion people (Ohlsson & Lundqvist, 2000). Currently some 90% of all wastewater in developing countries is returned to river systems untreated. This is what Jan Lundqvist (1998) has called "hydrocide". The significance of this is that developing countries with vibrant economic growth and a strong modernization development policy, are caught in a serious dilemma. Strong and sustained economic growth is ecologically unsustainable, yet following environmentally friendly policies could result in political suicide and major economic hardship. Economic sustainability and ecological sustainability are thus two distinctly separate concepts (Turton 2000b). There are three ramifications of hydrocide (Ohlsson & Lundqvist, 2000). Firstly, increased levels of water pollution will affect morbidity and mortality in developing countries. Secondly, the loss of aquatic ecosystems and their resultant biomass production capacity will impact heavily on developing countries, more notably in marginalized areas. Thirdly, there will be an increased cost as the need to import uncontaminated water over longer distances, and the need to treat contaminated water, increases. This can lead to developing countries hitting a new form of trade barrier as the result of "green labeling" that is already being introduced in some industrialized states. What the hydrocide concept shows, is that water scarcity should not only be thought of in terms of volumes of water, but also in terms of the quality of water, with the latter arguably being a bigger threat to society as the result of a direct threat to ecological functioning.

This more sophisticated (but still relatively crude) discourse focuses on water scarcity, positing a more complex causal link to violent conflict. Elements of this were subsequently taken up into the more sophisticated environmental scarcity discourse presented below.

The Environmental Scarcity Discourse.

This is a relatively sophisticated discourse, having developed over a period of time and having been supported by a substantial body of research. It grew from the cruder Structural Inequality Discourse that was presented above. The key author in this regard is undoubtedly Thomas Homer-Dixon, who has published widely on the subject. This discourse has a strong environmental or ecological dimension to it, so a number of other authors can also be categorized under this broader heading. Homer-Dixon (1996) summarizes this discourse by building the following argument. Research has shown that there are three major sources of environmental scarcity (Homer-Dixon, 1996:360). Firstly, there is supply-sided scarcity. Depletion and pollution of resources reduce the total available volume. This can be thought of as reduc-

ing the size of the total pie available. Clearly upstream abstraction and polluted return flows fall under this category, leaving less water available for downstream riparians. Secondly, there is demand-induced scarcity. Changes in consumptive behavior and a rapidly growing population can cause demand to exceed supply. This can be thought of as resulting in a smaller piece of the pie. Thirdly, there is structural scarcity (or the severe imbalance in distribution of wealth and power), which results in some groups receiving disproportionally large slices of the resource pie, while leaving others with progressively smaller slices. This imbalance is reflected in institutions that act in a gate-keeping manner, making control over institutions the key to control over resource distribution. In reality, these three scarcities interact however.

One result of this interaction is resource capture, where powerful groups in society seize control over the resource base and use this to their exclusive advantage. Water in Apartheid South Africa is a classic example (Turton, 2000a), as is the Israeli control over groundwater aquifers in the occupied West Bank (Homer-Dixon, 1996:360). The result of this is ecological marginalization, as people who have had their resource base captured, are forced to move to increasingly precarious locations. Cases of this are legion.

Significantly, severe environmental scarcity can reduce local food production, aggravate the poverty of marginal groups, enrich a corrupt elite and eventually undermine the moral legitimacy of the state. South Africa is a classic example of this, where it has been shown that there are two distinct phases of this process (Turton & Ohlsson, 1999). The first phase, identified as coinciding roughly with the transition from water abundance into a condition of water scarcity, results in the birth of a hydrosocial contract (Warner & Turton, 2000) with resource capture as a critical component. This results in structural scarcity and ecological marginalization, allowing these elements to become the major driving forces of hydropolitical interaction, while also undermining the legitimacy of the state to the extent that water demand management cannot be introduced effectively (Turton, 2000a). The second phase, identified as coinciding roughly with the transition of water scarcity into a condition of water deficit, results in the birth of a new social conscience and the expansion of the hydropolitical elite base. In South Africa, this coincided with the transition to democracy and is evidenced by the strong desire to redistribute the balance of hydropolitical privilege in society in a more equitable manner (Warner & Turton, 2000).

Homer-Dixon (1996) notes that there is no doubt that some major wars in this century have been motivated by the desire to seize non-renewable resources such as fossil fuels. But there is no evidence that this has been the case for renewable resources such as cropland, forests, fisheries and water. There are two explanations for this (Homer-Dixon, 1996:362). Firstly, modern states cannot easily convert such resources into power. Secondly, countries that are highly dependent on renewable natural resources tend to be poor, lacking the capacity to convert the desire to increase their resource base into an actual attempt in the form of armed aggression. The incentives and means of launching resource wars are likely to be lower for renewables than for non-renewables, with the possible exception of water. Those who argue that water wars are possible, say that both rich and poor countries need adequate water supplies equally. Homer-Dixon (1996:362) concludes that wars between upstream and downstream riparian states are likely in an extremely narrow set of circumstances. Firstly, the downstream riparian must be highly dependent on the water for its national survival. Secondly, the upstream riparian must have the ability to restrict the flow of the river. Thirdly, there must be a history of antagonism between the two states. Fourthly, the downstream riparian must be militarily superior than the upstream riparian. There are only a few river basins where these conditions hold true, with the most notable example being the Nile. Nowhere in Southern Africa is this the case at present.

Homer-Dixon (1996:363) notes that while there is no real evidence that environmental scarcity is behind existing armed conflicts, one can expect that this will change in future as environmental pressures become acute. Relevant to this future scenario is what Homer-Dixon refers to as "pivotal states". These states are central to international stability in a regional context and include South Africa, Mexico, India, Pakistan and China. Existing conflict patterns in these states shows that infrastructure is overtaxed due to population migration factors. This migration element is complex however, with both environmental-push and population-pull factors at work. The essential element being the fact that marginalized communities are forced to migrate, settling on contested land and bringing these incoming communities into conflict with people who are already eking out a tenuous existence. Elements of this can be found in Southern Africa. Migrations away from the Kalahari towards the panhandle of the Okavango Delta (Turton 1999a) and migration towards Windhoek in Namibia are two examples. Shack dwellers in places like Alexandra are also an example, where incoming migrants are forced to live on the flood plain of the Jukskei River. Other examples can be found in the lower Incomati River Basin in Mozambique, where subsistence agriculture is under threat due to the increased use of water upstream.

The specific case of South Africa was studied in some detail as part of Homer-Dixon's project. Details of the findings are found in Percival and Homer-Dixon (1998) and can be briefly summarized as follows. Environmental scarcity threatens the delicate give-and-take relationship between state and society, with violence being a manifestation of troubled relations between these two main components. Structural scarcity was one of the main elements of the political economy of Apartheid, resulting in a high level of institutionalization to protect the unequal distribution of environmental resources that had been mobilized for the white minority via a systematic process of resource capture. There was thus a coincidence of both demand-induced scarcity in the former Bantustans, and supply-induced scarcity as the result of soil erosion, water depletion and fuelwood scarcity. Environmental scarcity reduced rural incomes and helped push many Black South Africans into urban slums. The local authorities in these urban areas were collaborators of the Apartheid State and were thus largely unresponsive to the needs of the expanding community, causing polarization of society and the weakening of the institutional base of the state. Group division then became the basis of politics in South Africa. Environmental scarcity increased the salience of group boundaries, allowing warlords to gain control, further fragmenting society. Inkatha came to dominate informal settlements during the early transition to democracy, by striking political deals with warlords and manipulating conservative group identities evident in recently mobile migrant commmunities (Percival & Homer-Dixon, 1998:293). The conclusion of this study was that while environmental scarcity heightened Black grievances, the role of environmental scarcity was complex, contributing fundamentally to the social instability that was evident in the pre-democratic South Africa.

Significantly, while environmental scarcity has been a determining factor in every case that has been studied by Homer-Dixon's (1996:360) team, environmental scarcity is never a determining factor on its own (Homer-Dixon, 1996:361). It is always found in conjunction with other factors that are usually the major causes of conflict. As such, environmental scarcity can aggravate existing conflict and make it more acute.

The Social Scarcity Discourse.

While the above discourses have focussed on natural resource scarcity as a source of conflict, the recent work by Leif Ohlsson (1998; 1999) has made a quantum leap in our understanding of the dynamics of resource scarcity. Ohlsson constructs his argument by showing that as water scarcity rises, there is an increased need for social adaptation to the conse-

quences of this scarcity. For example, as deserts have encroached, lifestyles have been forced to change and social patterns have had to shift. Ohlsson suggests that just as there can be either a scarcity or abundance of natural resources, there can be either a scarcity or abundance of social resources. To this end, Ohlsson notes the need to distinguish between a natural resource (what he calls a first-order resource) and a social resource (what he refers to as a second-order resource). Thus it is possible for a social entity that is being confronted by an increasing level of first-order resource scarcity (water) to adapt to these conditions, provided that a high level of second-order resources (social adaptive capacity) are available. This has enabled Turton & Ohlsson (1999) to develop a set of key concepts by using a matrix consisting of different combinations of a first and second-order resource. This explains why a country such as Israel, has managed to defy the debilitating effects of what Falkenmark (1986; 1989) originally defined as the "water barrier". To this end, water scarcity (a strictly first-order definition) is distinctly different from Water Poverty, which is a combination of both a first and second-order resource. "Water Poverty" is therefore defined as the existence of both a first and second-order resource scarcity simultaneously (Turton & Ohlsson, 1999). "Structurally Induced Relative Water Abundance" (SIRWA) is the condition that exists as a combination of both a first-order resource scarcity and a second-order resource abundance (Turton & Ohlsson, 1999). The latter condition is what best describes Israel, and what possibly describes South Africa, Botswana and maybe Namibia.

The key to the existence of a second-order resource is found in what Homer-Dixon (1994b) refers to as "ingenuity". In his original work on the subject, Homer-Dixon noted that what made developed states stable was the level of ingenuity that they could amass. Conversely, the reason why developing countries often failed, lies in the fact that they are faced with increasingly complex problems on the one hand, with a rapidly dwindling capital base with which to solve these problems on the other hand. Capital in this context can best be understood as being a combination of financial resources, natural resources, institutional resources and intellectual resources, all working together in some degree of harmony. In developed countries, this harmonious interaction allows problems to be solved, thereby enabling economic and technological progress to be made. In developing countries, the lack of harmony between, or in many cases, the total absence of key components of this overall resource base, results in the absence of ingenuity with the resultant economic and social decay that is evident in large parts of the developing world. Developing countries that are facing increasing levels of environmental scarcity, will thus have to develop an active strategy aimed at becoming more innovative, in order to maintain their wellbeing in the face of rising first-order natural resource scarcity.

In reality, the supply of ingenuity will be constrained by a number of factors (Homer-Dixon, 1996:365) including the brain drain from poor states, limited access to capital, incompetent bureaucracies, corrupt legal systems and weak states. In addition to this, markets in developing countries are inadequate, property rights are unclear, prices for water and other commodities do not adjust adequately to reflect the rising levels of scarcity, so responses from both the state and entrepreneurs are slow and inadequate (Homer-Dixon, 1996:365). This has led Homer-Dixon to conclude rather somberly that,

> *"In South Africa, scarcity-driven migrations into urban areas and the resulting conflicts over urban environmental resources (such as land and water) encourage communities to segment along lines of ethnicity or residential status. This segmentation shreds networks of trust and debilitates local institutions. Powerful warlords, linked to the Inkatha Freedom Party or the African National Congress, have taken advantage of these dislocations to manipulate group divisions within communities, often producing violence and further institutional breakdown. …*

> *Societies like these may face a widening 'ingenuity gap' as their requirement for ingenuity to deal with scarcity rises while their supply of ingenuity stagnates or drops. A persistent and serious ingenuity gap boosts dissatisfaction and undermines regime legitimacy and coercive power, increasing the likelihood of widespread and chronic civil violence. Violence further erodes the society's capacity to supply ingenuity, especially by causing human and financial capital to flee. Countries with a critical ingenuity gap therefore risk entering a downward and self-reinforcing spiral of crisis and decay. … Rather than speaking of limits, it is better to say that some societies are locked into a 'race' between a rising requirement for ingenuity and their capacity to supply it" (Homer-Dixon, 1996:365).*

Thus what Homer-Dixon (1996) is essentially saying is that in the coming decades, one can expect to see a bifurcation of the world into two types of society. Firstly, those societies that can adjust to population growth and natural resource scarcity, and thereby avoid turmoil through the successful development of what Turton & Ohlsson (1999) have defined as Structurally Induced Relative Water Abundance. Secondly, those societies that cannot mobilize the necessary ingenuity, and thereby falling prey to a black hole of acute conflict and unparalleled violence as a manifestation of what Turton & Ohlsson (1999) have defined as Water Poverty. This is represented schematically in Figure 1 as originally conceived by the author (Turton, 1999c).

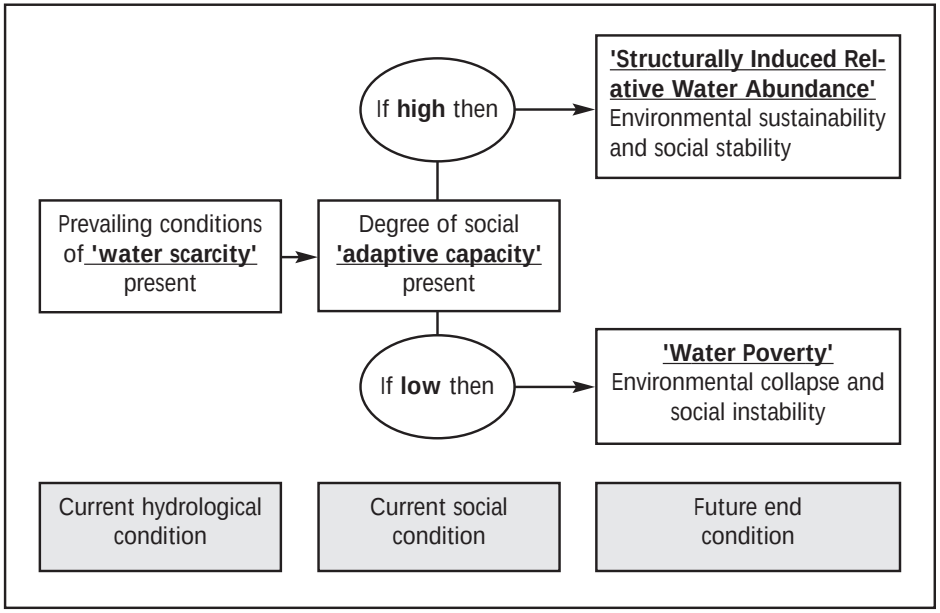


Figure 1. Schematic representation showing the hypothesized two end conditions that are likely to occur when combining both a first-order and second-order resource in the definition of key variables (Turton, 1999c).

A distinct component of this Social Scarcity Discourse is the Virtual Water Discourse noted above. In this regard, Ohlsson & Turton (1999) and Ohlsson & Lundqvist (2000) suggest that Virtual Water is a component of what has now become known as "The Triple Squeeze" or "The Turning of the Screw". As water scarcity increases, the result will be a series of bottle-

necks, primarily of a social nature. Each of these bottlenecks can be likened to a spiral, oscillating between an alternate scarcity of first-order resources (water) and second-order resources (social adaptive capacity). In this discourse, it is posited that not all states will be able to mobilize sufficient second-order resources with which to cope, in support of Homer-Dixon's ingenuity thesis.

At the first squeeze, water changes from being an open-access resource into a socially managed good. This has been identified as being the first transition (Turton & Ohlsson, 1999) and the birth of the hydro-social contract between the state and society (Warner & Turton, 2000). At this transition, water is changed from being a free good, sometimes referred to as a "gift from God" in certain cultures (Lichtenthäler & Turton, 1999), into an economic good with a price tag and all of the ensuing problems of relative scarcity and distribution. At this stage, human perceptions of water are still centered around the notion that it should be free even if it now costs something to mobilize, and that access to it may even have human rights implications (Ohlsson & Lundqvist, 2000). This is the birth of the hydraulic mission of society (Reisner, 1993), focussing on supply-sided solutions with the major management content being engineering in nature.

At the second squeeze, the new economic character of water gives rise to competition for this social good. Examples of this are competition between cities and rural areas for access to the resource base. Large cities, with their stronger economic base, can capture resources far more effectively than smaller rural communities. The city of Los Angeles is a classic example, with its progressive capturing of water from as far afield as the Colorado River (Reisner, 1993). Plans were even developed to make rivers flow backwards, in defiance of nature, in order that water from as far afield as Canada and Alaska could be appropriated by Los Angeles (Reisner, 1993). Johannesburg is an excellent example from South Africa, where major hydraulic works such as the Lesotho Highlands Water Project and the proposed Thukela Water Transfer Scheme perform much the same function in sustaining the industrial heartland of the country. One of the results of this second squeeze, is the emergence of a social conscience in the form of environmentalism as water scarcity moves into water deficit (Turton & Ohlsson, 1999; Warner & Turton, 2000). This in turn gives rise to early notions of water demand management, with the overall management function shifting from the pure engineering desire to appropriate more water, to embrace elements of end-use efficiency (Ohlsson & Turton, 1999) or intra-sectoral allocative efficiency (Turton, 1999b).

At the third squeeze, it becomes evident that engineering solutions are no longer viable on their own, and that the only way to effectively balance the water budget is to introduce a policy of intersectoral allocative efficiency - taking water away from agriculture where it has a low economic return and allocating it to industrial and domestic use where it creates far more jobs - and using Virtual Water as a component of this adaptive strategy (Turton & Ohlsson, 1999). This causes a fundamental restructuring of society as people move from rural areas to urban environments and away from agriculture to industry. This social restructuring requires considerable planning and control by government, needing a high level of what Ohlsson (1998; 1999) calls social adaptive capacity, or what Homer-Dixon (1994b; 1996) refers to as ingenuity.

WHY WATER WARS ARE UNLIKELY

There are hardly any serious scholars who are active in the hydropolitical field today that support the early water war arguments. There are three developments that have caused scholars to change their earlier views on the subject. These are as follows:

The Concept of Lateral Pressure.

The concept of lateral pressure is central to many analyses of water and conflict. Choucri & North (1975) and Ashley (1980) developed the theory of lateral pressure when they examined some of the factors leading to war between great powers. Gustafsson (1985:133-135) has summarized the work of these authors into the following brief notes. Lateral pressure refers to the process of foreign expansion of any activity. Included under this heading of "lateral pressure" are actions such as selling wheat, buying oil, investing capital, increasing the labour force or moving troops. Three specific aspects of this process must be distinguished (Gustafsson, 1985). Firstly, the disposition to extend activities beyond national borders. Secondly, the particular activities that result from the disposition to act. Thirdly, the impact that these activities have on people and the environment in other countries.

The origin of lateral pressure is explained by the increasing demand for resources, markets and living space due to a growing population, techno-economic activity and military aspirations. A direct relationship exists between the level of advancement of a society's technological base and the variety and quantity of natural resources needed to sustain it. In order for a natural resource-scarce social entity to actively try and sustain itself from outside its own borders, that social entity must have the means of doing so. In other words, demands and capabilities together generate lateral pressure (Gustafsson, 1985:133). However, in order for this lateral pressure to be manifest, it is necessary for a combination of these demands and capabilities to exceed a certain threshold. As such, lateral pressure refers to the unilateral process that originates from domestic growth. In the manifestation of lateral pressure, a society becomes involved in a bilateral process involving three general patterns (Gustafsson, 1985:133). Firstly, a stronger society's lateral pressure generates expanding activities thereby penetrating a weaker society. In this pattern, the weaker society adapts to the situation so no violent conflict ensues. Secondly, a society that is predisposed to lateral pressure cannot express it due to the obstacles posed by a stronger society. In this pattern, the weaker society will be held in check and no conflict will emerge. Thirdly, two or more expanding societies having roughly equivalent specialized capabilities collide when their aspirations for expansion are directed at the same geographic area. In this case the most likely result is violent conflict, with the degree of violence being a function of the degree of competition between the two parties.

Choucri & North (1975) found that a good indicator of lateral pressure is domestic growth as measured by population density and national income per capita. They also identified strong linkages between domestic growth and national expansion to military expenditure; and alliance formation and international interactions with an increasingly high propensity towards violent confrontation (Gustafsson, 1985:134). Large military expenditures and aggressive alliance formation often evoke violent reactions from rival powers and an arms race ensues, driven by an action-reaction response. At any moment in time, a given social entity may find itself embroiled in any one of a number of these bilateral relationships, often differing radically from each other.

Gustafsson (1985:135) notes that social units which generate lateral pressure can be found at three distinct levels - individual human beings, states and interstate systems (regimes) - with the latter two being most important due to their multilateral nature. At the multilateral level of analysis, Ashley (1980) applies classic balance of power theory, but Gustafsson (1985:134) suggests a more fruitful approach being the development of a theory of power transformation. In this regard, Gustafsson (1985:135) cites similarities in bilateral interactions with Organski's state typology. Gustafsson (1985) develops this argument as presented in Table 1.

Organski's Typology	Gustafsson's Typology
Weak and satisfied states.	These states are either satisfied with the existing order, or they lack the resources to change the status quo. The conflict potential is low in this group.
Weak and dissatisfied states.	These states are usually very dissatisfied with the existing international order, but they lack the resources needed to change it. The conflict potential is low in this group, but dissatisfaction will continue to cause disharmony.
Strong and dissatisfied states.	These states are dissatisfied with the existing order and actively strive to create a new international system. Conflict potential is high in this group.

Table 1. Schematic Rendition of Organski's State Typology and Gustafsson's Theory of Power Transformation (developed from Gustafsson, 1985:134).

Gustafsson (1985:135) concurs with Ashley (1980) that lateral pressure "represents a generic, timeless social process, potentially evidenced by all living systems at all levels, of which processes Marxists call 'imperialism' represent a specific, historically dependent form". Gustafsson (1985:135) notes however that the generality of the theory may also hide its weaknesses, and he supports the call by Choucri & North (1975) that research is needed to determine the ways in which economic factors influence the expansion of national activities and the resultant conflict of national interests.

Gustafsson (1985:141-142) concluded, after applying the concept of lateral pressure to the Middle East, that:

"The Euphrates River conflict is a good example of a resource conflict over fresh water with other economic as well as political factors involved. In these kinds of conflicts one cannot accurately say which factor is foremost at any given time; whether it is a dispute over fresh water resources which is spilling over to political conflicts, or vice versa; or whether some other economic factors and disputes are causing the sharpening of water conflict as well, or again vice versa."

Development of the Concept of Second-Order Resources.

The development of increasingly sophisticated discourses on water-related conflict have shown a distinct tendency. A direct linear linkage between water scarcity and conflict dominated the earlier discourse. This teleological argument is grossly oversimplified and results in a false conclusion. The reason for this lies in the emphasis on water as a first-order resource in the earlier discourses. Ohlsson (1998;1999) has enabled a quantum leap in our understanding of water-related conflict by highlighting the pivotal role that second-order resources play as conflict mitigators. This shift in focus away from water scarcity, towards the social mechanisms that are needed to compensate for increasing levels of water scarcity, has allowed for a more sophisticated understanding of the problem. Turton & Ohlsson (1999) developed a series of concepts by using a matrix of different combinations of first and second-order resources. Two of these concepts are crucial to the understanding of water-related conflict.

Because Water Poverty is defined as the existence of both a first-order resource (water) scarcity and second-order resource (social adaptive capacity) scarcity within a given social entity simultaneously (Turton & Ohlsson, 1999), the debilitating effects of water scarcity are compounded under such conditions by the absence of adaptive mechanisms within society, leading ultimately to social decay (Figure 1). Because this condition is likely to result in high levels of intra-state conflict, policymakers in semi-arid regions need to develop a set of policy instruments aimed at developing the social capacity needed to cope with increasing levels of water scarcity before the debilitating effects occur.

This leads logically onto the second important concept. Because Structurally Induced Relative Water Abundance (SIRWA) is defined as the existence of a first-order resource (water) scarcity and a second-order resource (social adaptive capacity) abundance within a given social entity simultaneously (Turton & Ohlsson, 1999), the potentially debilitating effects of water scarcity can be effectively countered when a high level of social adaptive capacity can be mobilized (Figure 1). Due to the fact that the earlier indices (such as Falkenmark's Water Scarcity Index) were focussed exclusively on first-order resource scarcity, they tended to sound the water war alarm bells (Ohlsson & Lundqvist, 2000). This also explains why a state such as Israel can survive "beyond the water barrier" (to use Falkenmark's terminology). The emphasis on the importance of second-order resources has now enabled Ohlsson (1999:250-260) to develop a far more sophisticated Social Water Stress/Scarcity Index (SWSI). With Ohlsson's (1999) SWSI, some of the anomalies that existed in Falkenmark's WSI are corrected. The development of subsequent indices has tended to highlight the role of ingenuity and other social resources such as adaptive capacity as the main concern, thereby focussing on conflict resolution instead.

Homer-Dixon's (1996) concept of ingenuity is nothing more than the empirical manifestation of Ohlsson's concept of social adaptive capacity. A social entity with a high level of second-order resources will thus be in a position to develop the necessary ingenuity needed to avoid falling into the black hole of first-order resource scarcity. Second-order resource scarcity thus seems to be the defining variable in the water war equation. Allan's concept of Virtual Water as a coping strategy also fits under this heading. Japan has long ceased to grow its own food, using its water in a far more efficient manner instead by diverting it to industrial and domestic use, thereby enabling it to generate sufficient foreign currency to buy its food on the open market. This policy needs a higher level of second-order resources to succeed however, as a state with a strongly nationalistic population may resist the dependency that a Virtual Water coping strategy brings, opting instead for national self-sufficiency in food and the resultant water deficit that this policy option inherently entails.

Larger Body of Empirical Research.

The development of more sophisticated concepts, models and theories has resulted in an expanding body of empirical research. One of the most notable examples of this is the work that was done by Wolf (1997) in which he concludes that,

" … over 3,600 water-related treaties have been negotiated, dealing with all manner of water management. … Our findings should not be taken to mean that there is no conflict over water - as we all know, there is lots - only that it does not happen at the international level. In fact, our findings suggest that the likelihood of violence increases as the scale decreases. […] rather than being causal, environmental degradation leads to internal political instability, which in turn can provide an environment conducive to acute conflict. This interpretation allows a less disingenuous argument which has the advantage of being backed up by data" (Wolf 1997 as cited by Ohlsson & Lundqvist, 2000).

Regarding the use of water as a weapon in war, in which the aquatic environment is modified on a scale sufficient to harm an enemy during conflict, Plant (1995:81) remains skeptical. He notes that such techniques are either undeveloped, incapable of being used or else of dubious utility. While Iran did try to divert river water to flood Iraqi defense positions during the 1980-1988 war; and while the USA did try to use cloud-seeding in Indochina between 1966-1972 in an attempt to stop the flow of logistical support along the Ho Chi Minh Trail; both of these met with failure (Plant, 1995:81). The present reality is that the water weapon is restricted to attacks on hydraulic installations.

In fact, research has shown that attacks on enemy hydraulic installations are common in times of war (Zemmali, 1995:73). For example, in 596 BC, Nebuchadnezzar captured Tyre after the aqueduct supplying water to the city was breached. In modern times, dykes and dams were not spared by American soldiers during both the Korean and Vietnam Wars. At the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts, the Vietnamese delegate recalled that 661 sections of dyke had been either damaged or destroyed during the war (Zemmali, 1995:74).

Kent (1999:109) notes that empirical research has shown that while water has been used as a weapon over time, evidence of water's "potential as a casus belli is less directly evident. The relationship between [water and war] … is part of a far more complex set of factors that reflect the ways that societies structure themselves and allocate their resources" (emphasis added). In fact, increasing evidence points to the fact that water is at best an indirect source of conflict, and global trends suggest that demands on water are increasing at the same time as conventional structures of governance undergo profound transitions. The emphasis thus clearly lies on social adaptive capacity or second-order resources.

This larger body of research has also enabled a better understanding of the concept of lateral pressure to develop. This has prompted Homer-Dixon (1999:12) to say that whilst the concept of lateral pressure has indeed helped to explain many past wars, more recent research on environmental scarcity and conflict has shown that a number of anomalies are evident within that concept. The most notable shortcoming being the failure to make a clear conceptual distinction between renewable and non-renewable resources. Work that has been conducted in a number of global settings by Homer-Dixon's team, has shown that while there is a large body of evidence showing that non-renewable resources such as fossil fuels have had a major contribution to war, "it is hard to find clear historical or contemporary examples of major wars motivated by scarcities of renewables" (Homer-Dixon, 1999:12). Two explanations are offered for this fact. Firstly, states cannot readily convert croplands, forests and seized waterways into increased state power. Secondly, countries with economies that are highly dependent on renewable resources tend to be poor, lacking in the capability of converting this lateral pressure into armed aggression.

Thus it can be seen that Kent's (1999:112) conclusion is reasonable and worthy of support when he said,

"If water throughout ancient as well as modern history has been used as a weapon, there is less evidence that water has been or will be a direct cause of war or violent conflict. Even the water of the Nile River, frequently regarded as an all-too-obvious casus belli, has never been a source of conflict. … Water stress is not a sufficient condition for conflict over resources" (Kent, 1999:112).

It thus seems safe to conclude that of the three sets of epistemological conditions noted at the start of this paper, water scarcity (or the desire to alleviate such scarcity) as both a necessary and sufficient condition for war, is not supported by any historic evidence. There are no such things as "water wars". An overwhelming degree of evidence exists in support of the other two epistemological categories however. In almost every war, hydraulic installations become targets, and in some cases waterways forming borders of disputed territories are the focus of war, but these are quasi water wars. In short, water scarcity, as a direct cause of war, is highly unlikely. The crucial element in this equation is the existence of social adaptive capacity, or second-order resources, as these are the actual determinants of the propensity for acute conflict.

WHAT CAN WE EXPECT INSTEAD?

Having noted that a true water war, where water scarcity is both a necessary and sufficient condition for violent conflict, is in fact highly unlikely and is certainly unsupported by any empirical evidence, we can focus our attention on what can be expected instead.

The work that has been done by Ohlsson & Lundqvist (2000) points to the existence of second-order conflicts instead, as water is diverted from agriculture to industry, and from rural areas to large cities. In this regard, the critical issue is about sustaining livelihoods, as distinctly separate from just procuring food. The challenge is enormous, creating sufficient new jobs in urban areas to compensate for the stagnating number of jobs that agriculture can sustain. This is the adaptive phase (Turton, 1999b) that is missing from almost all of the existing literature on water demand management, showing just how far we are from having an adequate scientific grasp of the problem at the conceptual level. It is during this adaptive phase that social resources will be taxed to their utmost, with the adequate supply of ingenuity being severely hampered by social conflict (Ohlsson & Lundqvist, 2000). Bringing the adaptive capacity of society into the equation thus means transcending the trap of absolute scarcity, at least for those social entities that are capable of mobilizing sufficient intellectual and social capital with which to generate effective coping strategies. Second-order resources are thus far more critical than first-order resources on their own.

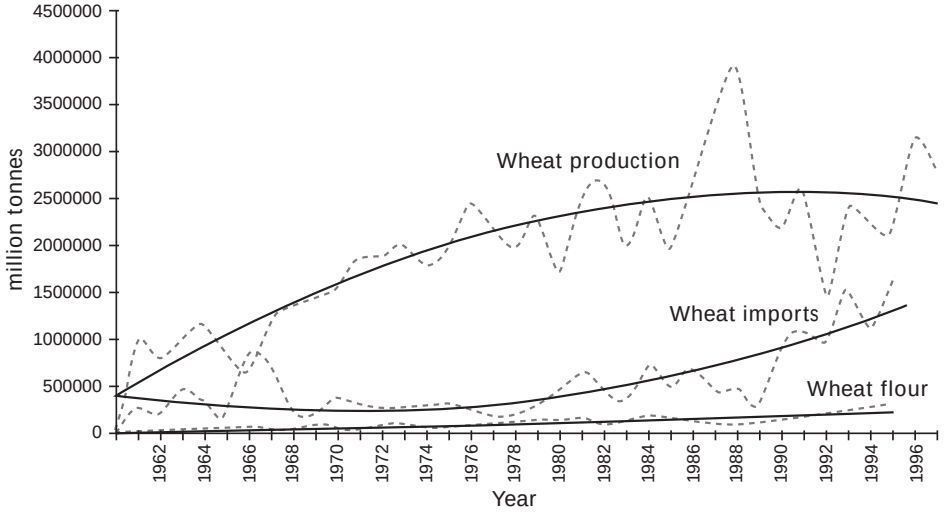
Evidence does exist that water scarcity can undermine a state's moral authority and capacity to govern, which in turn can tear a society apart (Kent 1999:110). This is the danger of Water Poverty, showing just how important it is to understand this concept better. The sensationalism of a water war scenario distracts the public's attention from the real results of water scarcity such as reduced food production, aggravated disease and poverty, large-scale human migrations and weakened states devoid of the capacity to govern effectively (Homer-Dixon, 1999:13). Water scarcity will thus not be the source of conflict to the same extent as the inability of governments to reconcile contending interests at the intra-state level is (Kent, 1999:111).

Some statistics on the impact of water scarcity on economic growth within Southern Africa are illuminating, and offer an insight into how first-order resources influence wider socioeconomic activities. World Bank data shows that during the droughts of the late 1980s and early 1990s, economic impacts were substantial. In Zimbabwe for example, the stock market declined by 62% (performing worst of 54 world stock markets), agricultural production fell by 40% (maize fell by a staggering 75%) and GDP declined by 11% during the 1991/92 drought (Hirji & Grey, 1989:83). Power generation fell by 15% due to the low levels of Kariba Dam and the Kafue River. A massive food relief program was needed to support 50% of the population, at a time that coincided with entry into a structural adjustment programme (Hirji & Grey, 1998:84). During the same drought, South African agricultural production fell by 27%, with a net negative effect of R 1.2 billion on the current account of the balance of pay-

ments, resulting in the direct loss of 49,000 jobs in the agricultural sector and a further 20,000 jobs in the formal sector (Hirji & Grey, 1998:83). In Namibia, the 1991-93 drought caused a 70% reduction in cereal production. Overall drought relief programs in Southern Africa for 1991-92 are estimated to have cost over US$ 2 billion, in a region where per capita incomes declined by an average of 1.1% annually in the decade 1982-92 (Hirji & Grey, 1998:84).

Against this rather gloomy background, it becomes instructive to note the extent to which Virtual Water trade has already become a viable coping strategy within Southern Africa (Turton, 1999c), even without it having been recognized as such by formal government policy. Figure 2 shows a distinct trend in Virtual Water trading patterns within SADC. It is an increase in this trade that is likely to become a crucial element in the prevention of water wars in Southern Africa.

Figure 2. 'Virtual Water' trading patterns for Southern Africa (after Jobson, 1999).



Sources: FAO Data, 1998
Note: Southern Africa Region: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe

These facts give support to the conceptual model that is being developed by Turton & Ohlsson (1999). This model shows that under conditions of Water Poverty, social decay and the resultant disintegration of states is highly likely. Such states will probably lack the ability to project their power aspirations beyond their own borders, so internal violence can be anticipated instead. Under such conditions, highly repressive regimes can pursue active strategies of resource capture in order to sustain their political support base. Such corrupt practices will further entrench inequality and result in chronic structural scarcity. One symptom of this social pathology will be environmental refugees, especially evident in time of drought.

Projecting this into a Southern African scenario, it is conceivable to anticipate a regional drought affecting a number of countries, some of which are better able to cope than others. With the onset of a major drought, and in partial response to increased levels of state repression needed to sustain the resource capture policies in these hypothetical states that are

founded on Water Poverty, one can anticipate a series of outward migrations of environmental or resource-scarcity refugees. This is likely to be the result of the coincidence of mass poverty, a history of civil war and the existence of the critical threshold of 0,07 ha/person beyond which subsistence agriculture becomes impossible to sustain. These refugees will target centres of perceived abundance. The latter will be suffering under the effects of the drought themselves, and will suddenly be confronted by the prospect of being inundated by masses of starving people. A domino effect is thus likely to occur, with a non-linear response beyond a given threshold. The receiving state will thus be confronted not only by its own drought-induced problems, but also by a series of exogenous factors such as migration. The image of mass starvation and violent political repression will further serve to alienate foreign investors, introducing yet another negative factor into the overall equation.

Thus for Turton & Ohlsson (1999), Water Poverty is the critical condition to avoid at the regional (SADC) level. Active measures should be initiated to assist with capacity building across international borders, in a joint attempt at creating Structurally Induced Relative Water Abundance. Where international water resources are concerned, knowledge is power (Hirji & Grey, 1989:89). Without knowledge, riparian states are extremely nervous about threats to their sovereignty, whether real or imagined, especially when another riparian state is deemed to have better information and decision support systems. Under such conditions, dependency can result from the absence of adaptive capacity, which in turn becomes a stumbling block to peace initiatives. If Water Poverty is the norm, then social decay and political disintegration can be anticipated at the sub-national level, resulting in an expanding black hole of internal conflict rather than an aggressive expansionist state. If Structurally Induced Relative Water Abundance can be achieved however, then the debilitating effects of Water Poverty will be effectively overcome and social stability can be expected. This will not be without disruption however, because the social effects of a migrating rural population will impact heavily on government, demanding a high level of resource allocation, both physically and intellectually. Furthermore, the social impact of an inter-sectoral allocative efficiency policy (Turton & Ohlsson, 1999) will exacerbate the problem during the latter stages of the water demand management phase.

Homer-Dixon's concept of ingenuity, and Ohlsson's concept of social adaptive capacity, are therefore crucial factors in the equation of water and war. If these are evident, then true water wars are highly unlikely to occur in the future, but they do not happen on their own. Governments need to play a leading role in nurturing and developing the second-order resources that are already found in society, and drought management has to be transformed from the existing crisis-induced response (Hirji & Grey, 1989:83), to a more strategic level, proactive approach involving adequate data sharing between states and the development of competent decision support platforms housed within functioning institutional settings. A healthy and active civil society is also important, as it can fill the gap between the individual and the state, assisting with the creation of capacity. It is therefore sobering to note that within Southern Africa, hardly any of these components exist at present in quantities sufficient to face the future with total confidence.

CONCLUSION

This paper has shown that epistemological clarity is needed in an analysis of water wars. As such, water as the cause of war is a very narrowly defined condition, with limited empirical evidence of its existence over time. Water as a weapon of, or target during war, is strongly supported by historic evidence. These are conventional wars with water as a tactical component. Waterways as borders or components of disputed territories are also supported by history, but these are only quasi water wars. There is thus no evidence of true water wars existing, and the

loose usage of terminology can lead an untrained person into mistaking a quasi water war for a genuine water war. Constructed knowledge, based on first-order indicators and readily propagated by the media, is thus counterproductive and can undermine investor confidence in the entire Southern African region. This does not mean that conflict over water scarcity is unlikely to occur however. On the contrary, while water wars are unlikely to occur, social decay and political instability can well be expected to rise as water scarcity reaches debilitating proportions. In this regard, a clear conceptual distinction needs to be made. On the one hand, Water Poverty is a highly debilitating condition where the absence of social capital will mean that the effects of water scarcity cannot be overcome. This condition will in all probability result in social instability, internal unrest, migration-induced conflict and coups d'etât. On the other hand, Structurally Induced Relative Water Abundance is a condition that is known to exist in certain societies that are confronted with water scarcity, but which have the social capital needed to make the necessary adaptations proactively. Rational government policy should thus be developed to address this condition, stimulating the ingenuity and institutional capacity needed to effectively manage water scarcity. Preliminary indications are that water scarce countries such as South Africa, Botswana and possibly Namibia have the necessary ingenuity with which to adapt, provided that a concerted effort is made by government to enable this. Water scarce countries like Mozambique, Zimbabwe and Malawi seem to be less well endowed as the result of economic stagnation, large population growth, the debilitating knock-on effects of civil war and in some cases the results of upstream riparian activities. In this regard, a helping hand should be extended to these countries, because drought and water scarcity respects no national borders, and the existence of islands of relative wealth and abundance, afloat a sea of poverty and resource scarcity, will inevitably result in endemic political tensions. The joint management of international river basins, including functioning institutions and adequate data sharing at the SADC level is therefore imperative if water is to be allowed to play its rightful role as an instrument of peace. The active development of multidisciplinary scientific capabilities is also important.

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Mitigration of Conflicts derived from Water use related problems - Zambia

*Cecil D. Nundwe and B. C. Mulendema**

ABSTRACT

'All I really ever needed to know about how to live and what to do and how I learned in kindergarten. Wisdom is not at the top of the graduate-school mountain, but there in the sand pile at Sunday school.

Share everything, play fair
Don't hit people
Put things where you found them
Clean up your own mess
Don't take things that are not yours
Say you're sorry when you hurt someone
Wash your hands before you eat
Warm cookies and cold milk are good for you
Live a balanced life
When you go out into the world
Watch out for traffic, hold hands and stick together

Everything you need to know is in there somewhere; the Golden Rule, love and basic sanitation. Ecology and politics and equity and sane living.'[1]

INTRODUCTION

John Kennedy is said to have said, *"Anybody who can solve the problems of water will be worthy to two Nobel prizes - One for Peace and One for Science."*[2]

Conflicts are usually a result of human differences, a failure to reach a compromise and are part of political dialogue. War is therefore simply a manifestation of this impasse and is a continuation of politics by other means[3]. Throughout history, wars have been fought for various reasons, such as propagating of religious beliefs and land acquisition etc, all a function of perceptions of resources, including human beings.

Why therefore should water be exempt from conflict? Depending on the circumstances water is an asset worth fighting for; this all nations must acknowledge. When there is injustice, or a perceived injustice, war may be the only rational option. It is not so much the resource (water) that is important but that its control and use represents our values for one another. Water must therefore be considered predominately as a representative medium. We should also consider that 'war is waged to obtain peace'.[4]

Zambia – International Water Resources

Zambia is part of two large international river basins, specifically the Zambezi River Basin, and the Congo River basin. The international rivers systems are:

* *Zambian Department of Water Affairs.*
The views expressed in the paper are speculative and strictly those of the authors and do not reflect the views of the Ministry of Energy & Water Development or the Zambezi River Authority.

1. The Zambezi River, which forms an international border from Sesheke to Feira with Namibia, Botswana, Zimbabwe.
2. The Luapula River, which forms a border between Northern Zambia and Congo.
3. The Luangwa River, which forms part of the border with Mozambique.

International lakes include:

4. Lake Mweru border on the northern border with Congo,
5. Lake Tanganyika along the northern border with Tanzania and,
6. Lake Kariba (man –made reservoir) along the border with Zimbabwe

With such an inventory of international waters, the aspect of sharing water resources and its accompanying challenges such as water conflicts between states is a very real one for Zambia. Some elements of the potential conflicts may be latent for various reasons, such as a peoples' current level of understanding international water issues, culture and poverty, but this in no way diminishes their propensity to result in open conflict or war in future.

Water-related conflicts demand an honest look at the realities and the differing values systems that prevail and the resulting interactions with regard to water.

APPROACH

The Authors suggest that conflicts can be resolved or reduced by the establishment of watercourse agreements to facilitate the regulation of the use of water between states. Under these Agreements, guiding principles, rules and procedures would be established and followed. Efforts to reach an Agreement on the use of the water of the Zambezi River can be traced back to the colonial period in Southern Africa. The Zambezi River Authority (ZRA) Act 1987[5] is an example of an agreement that has evolved from older colonial agreements on the use of water bordering present day Zambia and Zimbabwe. This agreement has facilitated the development of bilateral projects and management of operations of these schemes. It is our view that the existence of ZRA Agreement has kept possible water conflicts between Zambia and Zimbabwe in check. Bilateral talks facilitated by ZRA on Water resources developments proposals such as the Batoka hydro electric power scheme on the Zambezi River and the Bulawayo Matebeleland water transfer project are examples of how agreements can provide a more orderly arena for reaching agreement. Efforts are also underway to come to agreement on the entire Zambezi Watercourse under the SADC Protocol on Shared Watercourses.[6]

This paper offers some thoughts on the character some watercourse agreements should take in order to reduce conflicts that can eventually degenerate into war. Drawing from the Zambian experience in managing potential water related conflicts, the Authors propose an approach that focuses on an individual's right to water and an individual's right or duty to partake in the natural course of his society's development, at least with regard to water. This is based on the tenet that access to fresh water is a fundamental human right.

The Authors suggest that water, as it passes through its natural cycle and across international boundaries, provides an arena through which people/individuals can express their ends, attitude and character. The use and management of water resources like wealth is a last representative of moral values.[7] The necessity of acknowledging the presence of water resources management principles that should be adhered to as much as possible if conflict resulting from the use of water is to be curbed are highlighted.

The Authors also suggest as a solution the use of Water Right processes and procedures as a way of incorporating an individual's rights for management of water resources at national and well as international levels. For the purpose of this paper water rights are defined as 'a process of allocating water between individuals/enterprises by a state regulator for various competing uses'. In Zambia a Water Right is an Instrument of agreement between the state regulator and an individual/entity with regard to his Rights and his obligations for the use of water. This is similar to many other countries in SADC.

AREAS OF POTENTIAL CONFLICT

For the purpose of this presentation the discussion shall be limited to the Zambezi River common to Zambia and Zimbabwe and the related catchments. There have been discussions on the water resources of the Zambezi with regards to abstraction rights. Of the players on this portion of the Zambezi, the Zambezi River Authority (ZRA) is the principal institution whose mandate is outlined in the ZRA Act No. 17 of 1987.

As far as the development and management of this portion of the Zambezi River water resources is concerned, the ZRA Act is meant for the objective of obtaining economic social and industrial development to the greater possible benefit from the natural advantages offered by the Zambezi river to improve and intensify the utilisation of the waters for the production energy and for any other purpose beneficial to the two countries ensuring efficient and equitable use of the Zambezi River.

Several activities have been initiated in the area, the notable ones being:

1. The Kariba Hydro Electric Scheme
   The Kariba reservoir was developed for hydropower generation by Zambia and Zimbabwe. This scheme is currently maintained by ZRA.
2. The proposed Batoka Hydro electric Scheme
   This is a run of river scheme upstream of Lake Kariba, below the Victoria Falls, another power scheme on behalf of Zambia and Zimbabwe, to be managed by ZRA.
3. The proposed diversion of the Zambezi River to Bulawayo
   This pipeline would transfer water from the Zambezi River to some of Zimbabwe's parched southern provinces.
4. The proposed Zambezi – Sengwa
   This is a proposed water transfer project. It is anticipated to draw, on average, 1.5m^3/s for thermal cooling purposes and 2.5m^3/s for township consumption and en-route user needs.[8]
5. Water use activities in the catchment areas feeding the Zambezi River.
   Water permits or water rights are granted for various purposes within national boundaries by national water resources regulators.

This list highlights areas of potential conflict in the development of the water resources of the Zambezi River.

Project 1 was contracted without taking into cognisance indigenous peoples in the in the project area especially groups from where the water sources derive. In most respects the Kariba has committed the bulk of the raw water from tributaries such as the Kabompo River in the lower regions of Zambia. The communities in this region are not yet fully aware of the implication. Construction of projects like the Kariba have a far more reaching impact than just the commonly touted impacts such as the displacement of locals or environmental degradation. It has committed waters of peoples elsewhere such as the North Western Province of Zambia, without their knowledge and consent. When the time arrives when these communities decide to exploit their resources, they will find themselves caught up in a dispute.

Projects 2, 3 and 4 have been delayed due to divergent perceptions of the request for abstractions. For example, the 'bitter' experiences of the displaced Tonga ethnic group during the construction of Lake Kariba, and the failure to share the CAPCO (Central Power Corporation)[9] assets are often offered as arguments against future joint projects.

The activity under Item 5 brings to light the fact that national state regulators allocate water abstraction permits without check. With time the contribution to the Zambezi River reduces and will eventually have an impact on the Kariba hydropower scheme. More important than this is the question of equitable allocation of water between states and the fact that contribution to the lake is unchecked.

Current Perception of Water

'… the value of water varies among different groups, different places and at different times…the management of water resources has evolved to a stage where planning should centre upon the needs and rights of people rather than upon water per se...' [10]

As previously mentioned, conflict if any stems from our perceptions of the resources. Much of the management aspects of water resources are governed by the prevailing perceptions regarding the resource. Thus the idea that the root of water conflicts is our perception becomes more apparent. An understanding of the current general perceptions held with regards to water is gained by sifting through some of the regional water policy documents and are summarised below:

1. Water is a State – owned asset and the State is responsible for its development and management in the interest of the peoples within that state.
2. Water for primary use (basic domestic water supply) is a fundamental human right
3. Water changes character depending on its location
4. The rights of individual with regards to water are secondary to the rights of the State.
5. Fresh water is a finite resource.
6. Because water flows across international boundaries and therefore should be shared.

Upon further examination, it is the authors' opinion that:

1. Although States are considered the custodian of natural resources and that a State should develop its own resources primarily for its own purposes; the reality is that all natural resources are open to influence and use by other states and entities. This fact is manifested in commerce. In Zambia for example, many of the large commercial farming enterprises and copper mines are not wholly owned by Zambians, instead they are owned by non Zambian multinational corporations. Through the prevailing government policy of privatisation and foreign investment, they have a right to land, a right to water and every other resource related to their industry. Much of this business is governed by standards in international trade and conditions imposed external bodies, such as World Trade Organisation, International Monetary Fund and the World Bank. Therefore the notion of State ownership is compromised, as other states do participate in the exploitation of national natural resources. It would appear that socioeconomic benefits from enterprise and commonwealth should begin to take precedence to the idea of equitable allocation of water resources. In most respects, the state merely controls the use of the resources.
2. Water is a basic human rights when viewed within a country. However, when it comes to developing and managing the resource between states, sovereignty issues seem to take precedence over basic human rights. The application for abstraction is viewed as a State request rather than a request of a community of individuals.
3. Water's character does not change - it is our perception of water that changes with regard to its location. Water flowing at a station on the Kabompo River (tributary of the Zambezi) upstream is the same water flowing along a station on the Zambezi downstream
4. Use of water at any point affects the use of water at all other points of a watercourse. That is to say, how water is managed locally, nationally will affect how it is managed internationally. The two 'waters' should be governed by the same principles and the answer may lie in the water right/permit allocation approach. Also we must never think of resources as being abundant or as having no impact at any one time on a people. The impacts are dynamic in character in that they commit water and thus take away the potential use by another. They may also degrade the quality of water to an unusable state through pollution or cause damage to ecosystems. Furthermore the appropriate use of water by an entity fuels socio-economic development, including cultural growth generating an increased demand for water. Consequently the State that originally has the greatest demand for water will probably increase its demand with time as it develops. This nation's political strength therefore inevitably increases and consequently giver it even greater leverage to secure more water from weaker States, thus perpetuating the imbalance.
5. Water represents what you do and who you are and how you regard others. This is the underlying idea that should be adopted and propagated through our dealings with regard to shared watercourses and enterprise.

Suggested solution

It is our view that strict Central Government custodian-ship where Cabinets are responsible for decision-making on international water allocation and water development programs deprives an individual of his rights to fully appreciate and participate in water management issues. The current agreements do not provide answers to such crucial questions as:

- What remedies are available to an individual if he is harmed by the actions of entities in foreign territories or his/her Government's agreement with foreign entities?
- Is there any level of protection for the individual regardless of political borders as a result of harm (negative impact on individual) resulting from the use of an international watercourse?

Note here that the conflicts occur between the individual and the state or states.
The individual's rights and conflicts arising there-from are non-the-less as important as conflicts between states.

One way of getting around the problem would be to have national state water resources regulators responsible for the allocation of water amongst competing users and uses with their respective states through a water rights/permit process to take on some of the responsibilities for dealing with international water issues. Working on the premise that the concept of watercourse, or basin concept that has been adopted both nationally and internationally it becomes readily recognisable that there must be a relationship between national water resource regulators, and international agreements relating to the use of water. The water allocated within the states forms part of an international watercourse. Therefore has an impact on the whole system.

These processes, if properly designed, are amongst other things meant to protect the rights of the individual. Within the Framework of the SADC Protocol, national organs responsible for water resources are to continue to administer water rights whilst taking into account the requirements of other states. An agreement would have to be designed to link national water regulator to regulator sharing the common resource and their mandate expanded to deal with international water cases. It is noteworthy that State regulators are established by National Water Laws. Water Law in most respects formalises the most efficient methods of synchronising demand derived from competing water uses and users (domestic rural and

urban supplies, industrial, agricultural, livestock, wildlife, hydropower as well as the natural environment) with available water supply. Ideally, it provides a medium for adjusting technology to social conditions; one which would facilitate, not impede, the distribution of water where it is most needed.[11] The process of water resources planning, development and regulation is therefore formalised under any water law or laws related to water use, protection and development. By default, linking national regulators would aim to address the above issues in the interest of the States whilst providing for the protection of peoples' right to water.

Some Benefits

1. The main focus of allocation would be drawn away from Central government and taken on by state regulators who are governed by domestic law that ideally incorporates the participation of individuals and all segments of society within the state. Central Governments would not directly deal with securing water but, instead, government organs requiring water would themselves be subject to the regulatory process. This has the advantage of watering down the justification of military intervention on the water problem.
2. The balance of Government control in international water issues with the individuals' rights might also scale-down on the use of force.
3. People's individual rights would be upheld in a more practical way. Before allocating the water right for the construction of the Batoka scheme, individuals potentially affected can appeal to the water right issuing authority. And their concerns are addressed.
4. One-to-one contact between individuals in the region is provided i.e., Direct individual-to-individual contact on the use of Water, promoting discussion and appreciation of the problems at grass roots level. And building Capacity in terms of understanding water resources allocations issues from an international perspective.
5. Any individual/entity or any state party to this agreement would have the right to apply for water form any part of the watercourse.
6. The State from which the water is derived would maintain state control over its resources but would not have the right to deprive an individual unless it was in the interest of the wider public. A certain degree of sovereignty of would be maintained. Furthermore, current water rights processes incorporate the provisions for the review of water rights. All water rights would be subject to review from time to time to accommodate emerging and changing public interests and technologies.
7. It should be possible to categorise water uses and to prioritise these according to their importance in the region. For example, water for domestic supply and sanitation would have priority over energy throughout the states under the agreement. Therefore more water would be reallocated to this sector with time as populations grow.

Limitations

One limitation would perhaps be derived from the idea that state regulators might not be seen as bodies high enough in any government hierarchy to make decisions that would affect the entire course of nations.

The success of this approach would depend on the Public Interest that can be satisfied and this would to a large degree depend on the feasibility of agreeing on the socioeconomic benefits which could be realised to the satisfaction of both states when water is being allocated amongst competing users and uses. It our view, the benefits would have to be such that benefits accruing to a state issuing the water right would resemble that character of private sector investor within its national boundaries. The benefits would have to have an incremental character that would bear much of the opportunity costs of that Country's developments in the future. The question is, can our economic and financial experts come up with reasonable rules or models on how states can share benefits derived from water resources through time?

The States would have to "say what they mean and mean what they say" when talking about the fundamental rights of individuals. Our failure to acknowledge and observe water as a fundamental human right along with other water resources management principles will impede the successful execution of this approach. Below is a sketchy outline of governing principles we propose should be followed.

As all the waters in the main stem of the river are a result of contribution from the tributaries. This implies that any action on the tributaries will have a direct impact on the main stream. Therefore in the issuance of water rights we recommend that no water rights should be issued on the main river stem. Indeed all water rights should be allocated from the primary source, that is the catchment (tributaries). States would have to agree to this.

Guiding Principles

Ideally in order to guide the allocation of water or the management and use of water between states or within a country's own territory, it would be necessary to uncover as much as possible the 'Lighthouse' principles that govern the management of water resources. 'Lighthouse' principles are principles based on natural laws that operate regardless of our awareness of them or our obedience to them.'[12] Some of these 'principles' are captured in the Protocol.[13]

It our view that States need to accord more attention to some of these principles than is currently the case.

1. The availability of water resources for various purposes is finite and therefore should be treated as a scarce resource. This should be reflected in our dealing both nationally and internationally.
2. Newtonian laws of conservation of matter tell us that matter can neither be created no destroyed, it merely changes state, which implies that the amount of water on earth has been virtually the same since time immemorial.
3. Water has value and this value manifests itself in quantifiable and non quantifiable terms
4. Everybody has a right to a fair share of water; therefore there should be fairness in the use and management of water.
5. Water flows according to the hydrological cycle; it therefore demands that this cycle should be well understood and that this information provide key tools in sharing the resource.
6. Water is an integral part of natural environment and Society, and its use should be beneficial to all directly or indirectly.
7. People must be regarded as equal and of value and part of a unity with regard to water.
8. Everybody must contribute to the management of Water.[14]

Observations

Conflict over water will not be based on scarcity of water, but on the 'perceived scarcity' i.e., the different value systems prevailing in the affected states. With reference to some of the examples given above, the steps outlined above can help to mitigate conflicts.

Looking at the current situation on the Zambezi River, in particular under the ZRA Act, we can observe that the agreement does not explicitly link national regulators in the two countries. We observe that the energy sector takes precedence over other sectors in the agreement and thus looses the opportunity to embrace water resources management principles fully. Managing the area from an integrated water resources management perspective by embracing the basin concept therefore becomes difficult to achieve. The main clause of Article 18, which does not have a clear administrative procedure for its execution, suggests the architects

of the agreement were aware that upstream activities can impact parties to the agreement and the Kariba complex. However this aspect of the agreement appears overshadowed by management operations of the Kariba complex for hydropower.

It is gratifying to note that the ZRA has set up a program to further develop a process of managing water rights between the States on the Zambezi River. It is the view of the Authors that this very critical process should see itself coming into fruition as soon as possible with linkages to state regulators developed. ZRA should also consider losing its character as an agreement directed at energy utilities, to "obtain economic social and industrial development to the greatest possible benefit from the natural advantages offered by the Zambezi river to improve and intensify the utilisation of the waters for the production of energy and for any other purpose beneficial to the two countries ensuring efficient and equitable use of the Zambezi River", It would seem that now is the time to bring other sectors on to the playing field and the decision-making hierarchy, which is currently predominantly energy dominated. This will greatly support the management of conflicts between States, sectors and individuals.

Speculation on the Possibilities of Conflict Resolution on Some of Potential Cases

Working on the premise that conflicts are best resolved by satisfying both parties and assuming that ZRA or the two Governments agree to change the character of ZRA into a water resources regulator linked to national regulators and applying the ideas highlighted above, the following possibilities became more realisable:

The Bulawayo Matebeleland Water Transfer project might become possible if the Regulators, based on their analysis, considered the BMZ more critical than Hydropower generation. Here, one or both of the Energy utilities would suffer a slight reduction in energy generation. This would release millions of cubic meters of water for other projects such as BMZ. In the event that Zimbabwean water regulators have exhausted their allocation within their territory or if an entity such as the Bulawayo local Authority wishes to draw water from Zambian rivers, it should be possible for Zambian regulators to allocate water through a Water Rights process. However the question of both states having incremental benefits would be the determinant. The same applies for projects such as the proposed Batoka hydropower scheme.

Conclusion

Conflicts are a natural expression of human interaction, however they should not be permitted to progress without adequate redress. The development of dynamic agreements that protect peoples' present and future rights to water needs to be pursued with urgency. The profile of the water resources sector needs to be raised and recognised as the legitimate manager of the resource. In the case of the ZRA, there is a need to link it directly to the water allocation authorities in the contracting states.

We must remember that:

1. Access to fresh water is a basic human right for all.
2. Every drop of water counts, and should be accounted for.
3. Abstraction at any point in the basin has a consequential impact on the whole river system.
4. Every use of water must have a benefit.
5. People's rights should be our focal point.

Notes:

[1] *Fulghum R. 1986. 'All I ever really needed to know I learned in kindergarten'. Ballentine Books USA.*

[2] *Neil S. Grigg 1985 Water Resources Planning*

[3] *Derived from a 1995 Diary, Great Germans and their Cities. A quote from Carl Von Clausewitz (1780 –1831); "War is simply a continuation of Politics by other means."*

[4] *Hinsley FH., 1963. Power and the Pursuit of Peace – theory and Practice in the History of Relations between States'. University Press .UK*

[5] *The Zambezi River Authority Act of 1987 was enacted simultaneously in Zambia and Zimbabwe for the management of the Zambezi River bordering the two states, for purposes of energy generation and for any other purposes beneficial to both states*

[6] *The Protocol on Shared Watercourse Systems is a SADC agreement aimed at establishing an institutional and legal framework for the sharing of water between basin states in the SADC region.*

[7] *Emerson R.W. Complete Prose Works of Ralph Waldo Emerson; Essay on Wealth*

[8] *Mukono; September 1997. Water Abstractions From The Zambezi River And Lake Kariba. Proceedings of the Second Southern Africa Water and Waste Water Conference, Harare, Zimbabwe, September 1997*

[9] *Central Africa Power Corporation (CAPCO) is the predecessor of ZRA. When disbanded, it was agreed to share its asset on a 50-50 basis between Zambia and Zimbabwe. However, there is a dispute over the ownership of one asset; the Kariba North Bank Power Station*

[10] *Alternatives in Water Management. National Academy of Sciences National Research Council 1966 Washington D.C.*

[11] *FAO Publication 1975; Trends in Water Law*

[12] *Covey SR; 1989; Seven habits of highly effective People*

[13] *SADC Protocol on Shared Water Course Systems*

[14] *Some of the principles highlighted above are derived form principles listed by Covey in his book "the Seven Habits of Highly Effective People." 1989.*

The Domino Effect, a Downstream Perspective in Water Management in Southern Africa

*By Dra. Joanne Heyink Leestemaker,**

Abstract: *This presentation is on cumulative effects of inappropriate water management that impact on a downstream location. In Africa, the principle of Integrated Water Management at river basin level is recognised as the best option, the practice, however, is not yet implemented (Okidi, 1997:177). Between SADC countries alone, there were 23 agreements signed in the last century on international management of rivers. Although these treaties and the related literature agree on the urgent need to implement the intentions, in reality the alterations are lagging behind and meanwhile the downstream effects are becoming more visible. The case study illustrates how upstream water conflicts cause downstream trouble and that solutions are left to be found in places with little power or resources.*

We argue from a downstream perspective that the river basins in Southern Africa should be managed from the source to the mouth in order to optimise the development potential of the region and minimise the negative impacts for the human population and environment. Sector programs on energy, irrigated agriculture, industrial and urban development should be reviewed at that level. In doing so, conflicts can be avoided and co-operative solutions for water scarcity and abundance can be found by adjusting the water rights and prices, by using appropriated irrigation technology and changing cropping patterns and allowing water transfers between sectors and areas on a commercial basis.

Example: In December 1999 South Africa proposed, according to its National Water Act (no 36, 1998), an Authority for the management of the Komati River Basin. The Authority includes Swaziland but excludes Mozambique (DWAF, 1999). The Authority is therefore structured as if the river ends at the Ressano Garcia border whereas the Incomati flows 280 km further through Southern Mozambique before ending in the Maputo Bay.

As the downstream country, Mozambique is confronted with the consequences of upstream management practice of South Africa, Swaziland, Zimbabwe and Zambia. It suffers reduced flows during the dry period, increased flows during the wet period, artificial floods that upset the downstream environment and infrastructure, land-use induced sedimentation load in the wet season, salt intrusion as result of reduced flow and water quality reduction.

This is true for the all nine international river basins which Mozambique shares with other SADC countries; the Maputo and the Umbeluzi basin with Swaziland, the Incomati and Limpopo basin with South Africa, but even so for the Save and Pungue river basin with Zimbabwe. Only one out of the nine, the Zambezi River is intended to be managed at a basin level since 1987.

The combination of the downward orientation of a river -providing the cumulative effect- and the relatively backward status of the economy make Mozambique extra vulnerable for all impacts of uncoordinated upstream/downstream management. As domino stones, one after the

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other, the local water potentials fall as a consequence of upstream management practice. The cumulative quantitative and qualitative effect of water use for energy, irrigation, reforestation, industrial and urban development in the upstream countries cut off development downstream.

Whereas the downstream rivers in Mozambique are for the greater part in a 'natural state,' in contrast with the upstream situation where large dams and professional water managers control the flow in the river; very soon the downstream rivers will be in a degraded state. The water will not even be suitable or sufficient for domestic use. This is a crucial problem in Mozambique where, because of lack of infrastructure, thousands of people use the Incomati River as a direct source of domestic water (Kranendonk, 1980, own observation).

The total irrigated area in the downstream Incomati basin is less than 17.5000 ha, not even 1/6th of its suitable land, that must be farmed to feed the future population of the region. There are eight irrigation schemes of which two sugarcane plantations, Xinavene and Maragra. These are recently privatised and are being rehabilitated at the moment. The lack of sufficient reservoirs and dams leaves the Incomati water almost beyond human control on the Mozambique side. Floods in Mozambique overnight wash irrigation infrastructure, bridges and roads away, as we have seen this month. Almost every year Mozambican farmers have problems keeping their subsistence harvest, either because of the droughts or because of the floods. Capital investments in water management are not available and must be borrowed at unsustainable rates from the development banks. As long as this remains the case, an important input of development in the region, usable water, will remain scarce and unpredictable in Mozambique.

In contrast to the UN- Law of the Non-Navigational Uses of International Watercourses, the South African National Water Act and the recent SADC statement on Shared Rivers, South Africa does not always practise good neighbourly in the Incomati river basin. Building the Injaka dam in South Africa, and a weir at the border of Ressano Gracia/Komatipoort, are examples of uncoordinated development actions. These have resulted in a flow at the border that either does not reach the 2 m3/s minimum flow, which was agreed with South Africa in Pigs Peak in 1991 (Vaz, 1999), or is out of control and floods the lower basin as occurred in Jan/Feb/March 2000, at the very time of writing.

A major water transfer takes place from the Incomati to the Olifants basin for Eskom's cooling activities in the coal/energy production without compensation to any downstream users. The existing irrigation practise by South African farmers, that is subsidised through low water prices and high sugar prices, prevents innovative irrigation technology and shifting cropping patterns according to efficiency rules that could make the scarce water available for the best user. In the dry season, the reduced low flow in the Incomati results in salt intrusion at the river mouth, up to 70, 80 km inland.

These complaints could be easily dealt with in a basin-wide Incomati Authority, that would be able to find co-operative solutions in a politically neutral atmosphere. Part of the sugar could be produced in wetter areas of Mozambique, while South Africa could keep their scarce water for higher value crops. Mozambique's cheap labour force could stay home and work on their own plantations instead of migrating illegally to Swaziland and South Africa. Electricity might be sold or exchanged for water in the region. Such solutions on a river basin or regional scale offer a more productive way out, than Mozambique claiming compensation at the International Court of Justice in The Hague, with a full account of the environmental harm emanating from uncoordinated upstream activities.

The Incomati River Basin

The communities sharing the Incomati basin amount to a current population of 2.294.542 people and are estimated to grow towards three million people in the next ten years. The population in the basin as a whole is approaching absolute Water Stress according to the indicators of Falkenmark (Water Stress<1.700 m_/p/y). However, the communities have very different levels of population density, development and water use. Whereas in many river basins, the population density is low in the headwaters of a river, and higher in the lowlands, in the Incomati basin, it is just the other way around. In the first part of the last century, the colonial history turned the upstream area of the Incomati into a major sophisticated agricultural area for the white Afrikaners and their labour force. Here the population density is now about 65 persons per square kilometre. With 1561m_/p/y the South African part of the Incomati faces already Water Stress.

The black population in the lower Incomati (Mozambique) has historically been thinly spread cattle farmers, and only since 1955 did the Portuguese colonial government stimulate large-scale agriculture along the Incomati river by constructing infrastructure for eight irrigation schemes of which two are sugar plantations. The current population density is only around 17 persons per square kilometre. The water use is still only a fraction of the share of the upstream countries due to poorly developed and maintained infrastructure and agriculture. The water availability (2440 m3/p/y) is still sufficient according to Falkenmark indicators.

In the Swazi-part of the Incomati basin, large-scale sugar plantations are the main water users and the infrastructure to support the irrigation is up to date. The available water per person is relatively positive (3350 m_/p/y).

Table 1. Water density indicators for the three national entities in the Incomati Basin.

Adm. origin of the area	area (km2)(%),	population (%),	population density
Incomati Catchment (Mozambique)	14.900 (32.3%)	258.122 (11.2%)	17 p/km^2
Komati Catchment (Swaziland)	2.600 (5.6%)	151 900 (6.6%)	58.4 p/km_
N'Komati catchment (South Africa)[1]	28.700 (62.1%)	1 884 520 (82%)	65.6 p/km_
Total Incomati Basin	46.200 (100%)	2.294.542 (100%)	49.6 p/km^2

Irrigated Area (ha) MAR (*m_/a), pop, water availability m^{3}p/a [2]				
Incomati Catchment (Mozambique)	>20.000 (17%)	630	258.122	2440
Komati Catchment (Swaziland)	14.060 (12%)	509	151 900	3350
N'Komati catchment (South Africa)	83.382 (71%)	2.943	1 884 520	1561
Total in Incomati Basin	117.442 (100%)	4.082	2.294.542	1779

The population pressure in the upstream basin intensifies the Water Stress over the whole basin. To balance the inequality in economic development in the basin, people migrate to the upstream areas looking for employment opportunities that are not available in the downstream area. Most of these migrations are illegal, Mozambicans walk through the Kruger Park, finding a first entry into South African society in the densely populated area of Manyeleti. This further exacerbates the water stress throughout the region.

Restructuring of the Sugar Industry

Sugar is the main agro-industry in the Incomati basin. In South Africa, Swaziland and Mozambique, large-scale infrastructure has been set up to deliver the irrigation water. The farmer does not pay for this water and the infrastructure, including dams and reservoirs, has been constructed with government funds. The South African farmers can still sell their sugar on the national market at a constant price, higher than the World Market Prices.

The Incomati supplies water to 120.000 ha irrigated sugarcane plantations, six sugar mills and more than 40 dams. Sugar, especially at the upstream plantations in South Africa and Swaziland, absorbs the major part of the Incomati River, 41 to 73 percent of the MAR (Mean Annual Run Off).

Decolonisation and the civil war hampered development in the downstream area in Mozambique. Colonial sugar mills were established in Magude, Xinavane and Maragra. Only the Xinavane mill kept on producing during the difficult twenty-five years, but is now 'super-cansado' as the manager puts it. No new investments have arrived since the colonial time (1974). The infrastructure and the factory are worn out. After privatisation, South African and Mauritius management took over and can attract new investments.

Still, South Africa is committed by their new water law to sustain good relationships with the neighbouring countries, and in practice come to terms with their over-consumption of the water resources. The question is what are the best options for 'levelling the playing-field' between the South African, Swazi and Mozambican part of the Incomati to reach a sustainable tripartite situation? How could irrigated agriculture and the sugarcane industry be reorganised, what reallocations of water should take place, and how can water pricing and demand management help to solve the scarcity?

Sugar is a government-protected crop, sometimes protected at the direct cost of the local subsistence farmer. In the below-presented case of Xinavane, in South Mozambique, the local farmers suffer from both water excess and losses during the planting season. Flooding of their fields is initiated by a local sugar plantation, which in its turn has to cope with a low flow, caused by extractions in the Incomati River in South Africa. The case study illustrates how upstream water actions cause downstream trouble and that solutions should not left to be found at places like Mozambique with little power or resources.

When the Incomati becomes a threat…A case study.

Over one muddy dyke, then across the river by boat, another muddy dyke, then five kilometres of slippery stumbling and at last we arrive in a desolate 'street' of mud, a -by civil-war destroyed, ex-colonial- settlement in Southern Mozambique. This was…. This is the service centre for 20.000 people living, in the year 2000, on an island in the Incomati River called Iha Josina Machel. However, the biggest headache for the islanders is not the mud or the distance to the road or the empty shops, it is the three months of flooding, caused by the Incomati Sugar company, 8 kilometres upstream.

Wetlands

A flood as such causes no problems for the islanders. They have lived with the river all their lives and are well aware of the fertile loam that comes with floods. Their habitat is the wetland, life between land and river, which forms the basis of their existence on the island. Floods have come every year in January, February, and March. No, that is not the problem. The problem is with the new floods, in the Marilaphuvo and Xissavanine areas, caused by Incomati

Sugar company, which come in June, July and August: just as the maize is ripening on the field, and the first crops can be harvested.

Now there is no time left for planting, growing, weeding and harvesting crops on the fertile soils of the river valley. Water is everywhere almost the whole year around. "The river used to be our best friend," states Donna Cecilia Fulan, president of the Farmers Association, "but now the Incomati has become a threat…"

Delicate balance

The delicate balance between river and land, which once supported the lives of 20.000 Islanders has been affected. The lower part of the island suffers from a manmade flood during the dry winter months and the upper part of the island suffers form water shortage. This is caused by the intake of Incomati Sugar Company, and on a larger scale by the intake for irrigation across the border.

Since the Incomati river in South Africa has been dammed for agriculture there is little water left when the river comes to its last big bend in Mozambique, along the Xinavane Sugar Plantations, where 'Incomati Sugar' is located.

Low flow

For the last ten years, the water level has been very low during the dry months. Too low for the water intake of the Xinavane Sugar Plantation, where 4.000 to 6.000 ha of sugarcane needs irrigation from June onwards. It is also too low to maintain the minimum ecological flow in the river; the Incomati is full of reeds and plants.

As a solution to this problem, Incomati Sugar decided several years ago to improve its water intake by closing off a left branch of the river, that floods into lake Chuade, and from there flows back into the Incomati at a lower point. Every year, the Incomati Sugar workers close off a bit more of the river branch, by putting up a dyke of sand between the existing river dunes, using a drainage machine. During the floods in January and February, this dyke is eaten away by the force of the water. Meanwhile, the local subsistence farmers try to survive under the new conditions.

Hole in the dyke

Of course, the Islanders have not let the matter go by without protest; they have been discussing the problem within their associations, the president of each association discussed the problem in the union of associations, and the president of the union was sent to the Administrator of the Island. He had visited the Governor, who -in his turn- laid the problem on the table of ARA-Sul, the Regional Administration Unit for the Incomati River. The case has now been under discussion for at least four or five years. Last August, a tripartite meeting took place, between the farmers, Incomati Sugar and the government. Incomati Sugar promised to solve the problem, but no solution is yet in sight.

It is a fact that many Islanders find employment at the sugar plantations; it might be only for the men, and only for hard work during harvest time, but still the plantation offers the only chance to earn a salary, apart from migration to South Africa. And in order to produce its 10.000 tonnes of sugar, the plantation needs irrigation water. So, the Administrator, Inacio Muchanga and many others in the government, take the plantation's side, although they understand the Islanders' grievance.

The Islander themselves have been waiting so long for some support from outside that it

is hard to believe it will come. Either they make a hole in the dyke, or open other parts of the river system to release the water into other areas, avoiding flooding of their main fields, pushing the problem downstream. Last year, the Sugar Plantation was kind enough to help with the latter action and provide the islanders with the machinery needed to open up another area.

Linking land and water

This temporary solution will not settle the case. As the area has very fertile soils and enough water, the pressure on the land is increasing. In the near future, the area should become a major food producing area in the region. The land and water problems will have to be solved in order to reach that goal.

The large sugar companies were recently privatised and the new management have made substantial investments and brought in competent technical staff from South Africa and Mauritius in order to push up the production figures. In the near future, the Incomati Sugar company wants to start using the upper part of the island, which the company formerly used as pasturage in colonial times. That land is now occupied by farmers who fled the flooded area. The ground is very fertile, after years of cattle farming in the colonial period. The local farmers, although without official land titles, might claim the customary right to stay on the land, as they have been using it for more than ten years.

If the Incomati Sugar wants to obtain the official title and use of these pastoral grounds, they could opt to settle two problems in one go: free the land by resettling the farmers, back in the flooded area, after putting dykes around the area. That will solve a water issue, and avoid a land conflict.

The question is, who is going to organise and pay for this?

Upstream-downstream

As always, with river issues, the origin of the problem lies upstream, with the decreasing flow at the border, caused by increased abstraction of water for irrigation in South Africa. Downstream, this low flow triggers a solution, to dam part of the river in order to create sufficient intake for irrigation. Again, it is the farmers further downstream who bear the consequences.

A related problem is that those people downstream, the farmers, don't have strong connections with the people in power. Their say in the issue is limited, their influence even less. The governmental structures that should take into account the position of the small farmers are either not developed strongly enough or, in the case of ARA-Sul, do not represent the small farmers.

If you ask the local farmers, their solution would be to open the dyke in the river, so that everything will be as it was in the past. Or maybe, as second option, to work together and build dykes around their fields, in order to avoid the flooding in the dry season. The water could be regulated with sluices, and irrigate the fields during the wet season. Incomati Sugar should help in building these dykes.

The construction of a dam and a reservoir in the Incomati, just beyond the South African border, could be a solution on a larger scale. Better co-ordination between the South African and Mozambican officials could then regulate the flows and floods in a way that is less harmful for the environment and the farmers downstream. With the rains of 6th January and the release of water from South Africa on 13th January and the floods of 6th of February 2000, small-scale farmers lost their houses and virtually their entire subsistence crop.

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Notes:

[1] *Population of the N'Komati Basin in RSA: Komati Catchment 550300, Crocodile Catchment 497640, Sabie-Sand Catchment 794 900, Massintonto,840,Uanetze 840, Source Mozambique: 1997 census.*

[2] *Falkenmark's indicator for water use at national level:100p/1000.000m_ arid conditions, 600p/1000.000 m_ Water Stress and 1000p/1000.000 m_ Water Scarcity*

Hydropolitical Hotspots in Southern Africa: The Case of the Kunene River

*By Richard Meissner**

Introduction

During the 1980s and 1990s a lot was written and said about the impending water wars that can be expected in semi-arid and arid regions across the globe in the twenty-first century. The hype about this type of conflict has been instilled in the minds of hydropolisists and made popular by Boutros Boutros-Ghali's statement that: "The next war in the Middle East will not be over politics but over water." This led to an escalation of research projects regarding conflict over water resources in the Middle East. Thomas Naff and Ruth Matson (1984) and John Cooley (1984) did the first pioneering studies on the subject of water as a source of conflict and co-operation. Cooley (1984), a news correspondent by profession, looked specifically at the connection between water and conflict. Subsequent studies and articles followed. These studies focused explicitly on the Middle East, as a semi-arid and arid region and one of political importance to the international community.

The Middle East was not the only region being scrutinised by academics and water resource planners as a hotspot concerning future water wars. Southern Africa also came under the magnifying glass as a region where potential water wars could be a reality in the not so distant future. At a conference on Southern Africa into the next millennium in Johannesburg in 1998, Aziz Pahad, the South African Deputy Minister of Foreign Affairs, identified water security in Southern Africa as one of the principal issues and concerns in the region (Pahad, 1998:42). Pahad (1998:43) warned about water scarcities and the likelihood of conflict as a result of it. The phrase water war is on everybody's lips, it seems. But what is meant by a "water war"? Is it a violent conflict over scarce water resources or is it a situation where water is used as a weapon of war? Two variables are at work here: water as a direct cause of conflict and water being used as a weapon during a conflict. This ambiguity has the potential to cause confusion and the term "water war" should be clearly defined if we want to adequately address the issue of water wars in Southern Africa. A water war is a violent conflict that is directly caused by the incompatible sharing and/or allocation of water resources between states or non-state entities at both the national and international level.

This paper will look at the likelihood of water wars occurring in Southern Africa by analysing the hydro-politics of the Kunene River shared by Namibia and Angola, within the context of international relations between the two countries. If one wants to test the hypothesis of a water war happening between states in a semi-arid region, one should study the interaction of these actors as regards shared water resources. The paper will also present some solutions should a water conflict arise in the basin. This paper consists of three parts. The first section deals with political interaction among actors in an international river basin. In the second part the physical characteristics of the Kunene River will be outlined. The final part looks at the dynamics of water politics in the Kunene River basin. Water or hydro-politics is defined as the systematic examination of the interaction between, states, non-state actors and individuals within the national and international domain as regards the authoritative allocation and/or use of international and national water resources such as rivers, aquifers, lakes, glaciers and wetlands.

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International political interaction

In international politics three patterns of interaction between actors can be identified. Politics may firstly be characterised by competitive interactions. In such a situation the achievement of goals by one actor is incompatible with the attainment of goals by other actors. The action that can arise from this can vary from a breakdown in communications to outright military confrontation. Secondly, politics may be a reflection of co-operative contact, in which goal achievement is facilitated or promoted by the complementary actions of different political actors. This is usually reflected in collaboratory agreements between states and non-state entities. Finally, and most realistically, politics may follow a mix of both co-operative and competitive interactions, in which actors pursue multiple goals, some of which are incompatible and which thus give rise to contention, while others are compatible and are sought through complementary endeavours (Puchala, 1971:5). In a similar vein Soroos (1986:6) contends that "world politics is a rich and perplexing mixture of trends and counter-trends." What this means is that conflict and military confrontation can occur alongside co-operation and accommodation for any given period in time (Soroos, 1986:6). This is true not only for world politics but also for the interaction between states in a river basin. The three patterns of interaction that occur in a riparian context, identified and most importantly the third model, will always be discernible in the dynamics of any river basin.

By analysing the dynamics of the game of hydropolitics in a river basin one is able to measure the nature and degree of conflict and co-operation in a riparian context over a period of time. The nature and degree of conflict and co-operation over water varies constantly and is not the same at any given point in time. The sharing of the waters of the Orange River between South Africa and Lesotho, for example, saw a great deal of conflict before 1986. The degree of co-operation today is greater than before and may increase further in the immediate future (Meissner, 1999). There is a flip side to the coin as well. The overall international relations between the states sharing the waters of a river basin often offer an indication of the nature and degree of interaction over the riparian context itself. If state A does not maintain a very good relationship with state B, then it generally follows that their relationship will be found wanting when it comes to the sharing of water resources. Therefore it follows that in analysing the hydropolitics of a given river – in this case the Kunene River – one should also look at the nature of the relationship between bordering states as regards shared water resources.

As noted above, there are three types of interaction between states in the international political arena. There are also three schools of thought on the issue of water wars: there are those who say that water will one day lead to violent conflict, those who say that water only on occasion leads to conflict between states and those who say that water could lead to greater co-operation within and between states. Those who argue that a water war will in all likelihood occur in semi-arid and arid regions base their statements on the assumption that water scarcities, the improvement of living standards coupled with population growth and global climatic changes will contribute to tensions and violent conflict between states (Gleick, 1995:84). This is the main realist argument by observers writing on the subject of water wars. This is not universally accepted though. It is easy to exaggerate the importance of natural resources as an object of conflict. A dispute over natural resources seems so frequent that it can become tempting to regard competing demand for water as the single most important cause of conflict and war. This seems to be the case with water resources the world over. A dispute or military conflict which involves resources is not necessarily a struggle over resources (Brock, 1991:409-410). Water resource depletion is seldom, if ever, the only cause of major conflict within or among states (Holst, 1989:125). Interstate conflicts can be caused by a great variety of factors, including ethnic antagonism, ideology, border disputes, expansionist aspi-

rations by states, religion and so on. Therefore, water can be part of the conflict but not the overriding motive to start a war. Further there exists the possibility, or indeed the likelihood, of co-operation over water as a means to strengthen the overall international relations between nations sharing this resource (Brock, 1991:413) Gleick is in concert with this when he says that not all water disputes will lead to war, "indeed most lead to negotiations, discussions, and non-violent solutions". Analysing the water politics of the Kunene River will show that water has never led to violent conflict and the likelihood that it will is remote. The analysis of the hydropolitics will shed some light on the kind of interaction that has occurred historically in the Kunene basin and which continues to takes place.

Before tackling the dynamics of hydropolitics in the Kunene River basin, however, it is important that we first look at the physical characteristics of the river basin and the countries sharing it. This is important because many intervening variables like the geographic, climatological and hydrological characteristics of a riparian system and river basin can themselves have an influence on water resource scarcity – producing either an acute conflict or a co-operative relationship (Elhance, 1999:6). The physical characteristics of a river basin and the countries sharing it also explain the relationship between Homo sapiens and the way they utilise their environment. Every political community occupies a geographical area with a unique combination of location, size, shape, climate, and natural resources. These variables influence the behaviour of states. Human activity is affected by the uneven distribution of human and non-human resources in the system (Dougherty & Pfalzgraff, 1990:67). It is therefore necessary to study the physical characteristics of the Kunene River basin briefly to see why the actors in the basin behave in a certain way.

Physical characteristics of the Kunene River basin

The Kunene River rises in the central highlands of Angola near Nova Lisboa where the annual rainfall is in the region of 1 500 millimetres (mm). The river is 1 050 km long and has a catchment area of 110 000 km_ with an annual discharge of about 15 km3/yr. The last 340 km of the Kunene make up the border between Namibia and Angola before it flows into the Atlantic Ocean. The area where the Kunene has its source is very mountainous. After it crosses the border between Angola and Namibia the flow accelerates and for 30 km it runs through ravines and over rapids and waterfalls. It is estimated, from an engineering perspective, that the Kunene River has a surplus of water (Conley, 1995:7). These physical characteristics give rise to the Kunene River's hydroelectric potential (Best & de Blij, 1977:327).

Namibia, the downstream riparian in the Kunene River basin, is the driest country in Africa south of the Sahara. The mean annual rainfall is approximately 284 mm (Devereux & Naeraa, 1996:427-428) and the total surface water reserve stands at around 4.1 billion cubic metres per year (bcm/y). Of the total rainfall, 83% (between 2 600 mm and 3 700 mm) evaporates immediately after falling, while the other 17% gets carried away as surface run-off. Of this remaining 17%, 1% percolates into the ground to replenish groundwater and 14% is lost to evapotranspiration. Only 2% remains to be stored (Internet: Food and Agriculture Organisation, 1997b). The only perennial rivers are also international rivers on which Namibia is very dependent.

Angola, with its mostly tropical climate, on the other hand, has a more stable rainfall pattern than Namibia. Rainfall decreases from north to south and as one moves further away from the coastal areas. Angola is therefore more water-rich than Namibia. The total water source is in the order of 158 bcm/y. However, Angola is only using 0.3% (50 m_ per capita per year) of its available water resources. It is the lowest abstraction rate in the SADC region (Du Toit & Jacobs, 1995:30-31). The twenty-six-year-long civil war in the country is solely to

blame for this. Having expended all of its resources in the civil war, the government has not had the financial capabilities to develop the country's water sector. Also, much of the water infrastructure has been damaged during the conflict and repairs cannot be made. This is the milieu that forms the background to the hydropolitical game in the Kunene River basin.

The dynamics of water politics in the Kunene River basin

Because Namibia is not very richly endowed with water resources, both the states that had control over Namibia in the past and the present legitimate government came up with a number of coping strategies which followed adaptive behaviour. Adaptive behaviour is defined as a manifest response to water scarcity and can take any one of a number of forms, perhaps the best example being the undertaking of large water projects to alleviate water scarcity. A coping strategy can be defined as the output of the decision-making elite, usually in the form of some coherent policy or set of strategies such as water demand management, that seeks to manage the water scarcity in some form or another (Turton & Ohlsson, 1999:3). Adaptive behaviour and coping strategies have been part of the dynamics of water politics in the Kunene River in the previous century and at present and usually take the form of large-scale water projects to step up the supply of water and electricity in different areas of Namibia. For instance, at around the turn of the nineteenth century, the German colonists Brincker and Gessert first suggested damming the Kunene River to supply water to Deutsch Südwest-Afrika. Later, when South Africa held sway over Namibia, the development of the Kunene River was undertaken in order to facilitate the overall development of Namibia (Christie, 1976:31). Dirk Mudge, South African M.E.C. and acting administrator of Namibia in 1976, held the following view regarding the development of the Kunene River and what it holds for Namibia: "The Kunene scheme is very important, for one just cannot develop these territories without water and electricity . . . . We need a strong economy to provide jobs in the southern sector for people from the native homelands. One cannot have a strong economy without infrastructure" (Christie, 1976:40, personal interview with D. Mudge).

Because the Kunene River is an international river, it was necessary for the entities that controlled Namibia and Angola in the past, and for those who do so at present, to come up with some agreement regarding the sharing of the river's water. International agreements and co-operation regarding the waters of the Kunene River formed part of the coping strategies envisaged by Namibia and Angola. However, it was not always plain sailing to develop the Kunene River, for international political factors had (and still have) a profound impact on these projected plans.

From co-operation to conflict: 1926-1988

Co-operation regarding the issue of the joint management of the waters of the Kunene River can be traced as far back as 1926. On 1 July in that year the Union of South Africa and the Republic of Portugal signed an agreement to regulate the use of the waters of the Kunene River for the purposes of generating power, inundation and irrigation in the mandated territory of South West Africa (S.W.A.) (Agreement, 1990a) (Christie (1976:31). It was envisaged by Ernest Oppenheimer that one of his companies would build a dam on the Kunene River to supply the mining industry in S.W.A/Namibia. At this time Jan Smuts tried to redraw the Angolan border to include in the territory of South Africa the dam site at Calueque, but with no success. No substantial infrastructural developments were undertaken after the 1926 agreement. However, the Kunene Water Commission was established to investigate the possibility of damming the Kunene and diverting its water into Owamboland, with a survey undertaken in 1927 (Wellington, 1938:26). The reason why no development took place at that time, was that S.W.A. and Angola were in no great need of water. The ground was, however, prepared for future co-operation.

In 1962 the South African government established the Odendaal Commission to investigate a report concerning the socio-economic potential of S.W.A. and the measures to be taken to stimulate the rate of development in the country. The final report of the commission was published in 1964. One of the conclusions reached by the Odendaal Commission was that the waters of the Kunene River should be utilised for the generation of electric power. This kind of development could provide a substantial and economic contribution to the increased and accelerated development of South West Africa. A utility, the S.W.A. Water and Electric Corporation (SWAWEK), was set up to develop the power and water potential of the Kunene River (Olivier, 1977:125).

In the same year a second agreement was reached between South Africa and Portugal regarding rivers of mutual interest to both Angola and S.W.A. and involving the Kunene River scheme. In 1969 a third agreement was reached between South Africa and Portugal regarding supply-side management projects to be constructed on the Kunene River. This development included the following: a dam at Gove in Angola to regulate the flow of the Kunene River, a dam at Calueque upstream from the Ruacana Falls for further regulation of the river in conjunction with the requirements of the power station to be built at Ruacana, a hydro-electric power station at Ruacana with a capacity to generate 240 MW of electricity, and a pumping station at Calueque for irrigation purposes in Owamboland. A fourth dam at Matala in Angola was built outside the agreement with the view to generating 40 MW of electricity. In other words, four dams are at present in existence on the Kunene River (Conley, 1995:14). A Permanent Joint Technical Commission (PJTC), which is still functioning today, was established within the agreement to oversee the implementation of the different projects along the river (Olivier, 1977:128; Best & de Blij, 1977:380).

After the infrastructural projects neared completion, it was realised that the Kunene River had further untapped hydroelectric potential because of several cataracts and waterfalls along its course. After the completion of the Gove and Calueque Dams the Kunene River was more easily regulated and it was therefore technically viable to continue with the development of the power potential of the river downstream from the Ruacana hydropower plant. In the late 1970s SWAWEK estimated the future potential of the river to be 1 560 MW of electricity that could be generated at eight sites along the river (Olivier, 1977:128). This forms the backdrop to current developmental plans for another hydroelectric power station at the site of the Epupa waterfall.

Immediately after Angola gained independence on 11 November 1975 a civil war broke out with the participation of both internal and external forces. The war is still raging today (McGowan, 1999:233) between the government of Angola and UNITA (the National Union for the Total Independence of Angola). This has had a profound impact on the dynamics of water politics in the Kunene River. Not only was the fighting concentrated in the southern part of Angola and in particular in Angola's Cunene province, but the Ruacana hydro-power complex was also seen as an important strategic asset by the warring parties. This was highlighted in 1975 when the civil war was still in its early stages.

South Africa, under Prime Minister John Vorster, was very reluctant at first to become involved in the civil war in Angola.[1] The reason for this was that South Africa did not want to offend Portugal and international opinion by interfering directly in what was still a Portuguese affair (Barber & Barratt, 1990:191). However, after Cuba became engaged in the war, on the side of the Angolan government, South Africa got very alarmed. According to Barber & Barratt (1990:189), the Cuban factor had a critical impact on South Africa's decision to get involved in Angola. Throughout the conflict the Cuban issue was central to South Africa's pol-

icy on both Angola and Namibia. South Africa's first intervention in the Angolan conflict was in August 1975, when the South African Army went into Angola to protect the joint Kunene River project at Calueque. Clashes between the MPLA and UNITA and harassment of workers at the dam site by the MPLA and UNITA drew South African troops into Angola to occupy and defend the dam[2] (Barber & Barratt, 1990:191; Christie, 1976:31). The harassment of workers led to a halt of work on the Calueque dam and gave rise to the possibility that water to Owamboland would be cut (Steenkamp, 1990:37). The action by the South African Army highlights the strategic importance of the Ruacana-Calueque scheme for S.W.A/Namibia and South Africa's hold on the territory, at that time. The outbreak of war in Angola had a very negative effect on the co-operative endeavours between South Africa and Angola regarding the Kunene River project.

By 1979 S.W.A./Namibia considered extending its electricity supply-lines to South Africa. The reason for this was that the Ruacana hydro-electricity scheme was not running at full capacity because of the war raging in Angola. The direct cause was that the South African and Angolan governments could not agree on the operation of the project and work on the project was suspended. Angola refused to close the sluice gates of the Ruacana Dam and to complete the work on the Calueque Dam. As a result, the powerplant at Ruacana could only run at 120-160 MW capacity because of the suspension of the project (Financial Mail, 24 August 1979:739). The power grid between South Africa and Namibia was completed in the early 1980s after Ruacana proved incapable of producing electricity at full capacity (The Cape Times, 22 February 1980:1). This showed how dependent S.W.A./Namibia was on South Africa for electricity and also the importance of the Kunene River project for the country at that time. As the 1980s proceeded it was still not possible to tap the full potential of Ruacana and Calueque because of the antagonistic relationship between South Africa and Angola. The same thing happened with the Cabora Bassa hydro-electric scheme in Mozambique after the civil war broke out there (Business Day, 23 March 1987:6). It is obvious that the Angolan government used the Ruacana and Calueque dams as a lever to strengthen their position in the war against South Africa. Not completing the project meant that water to Owamboland and electricity to the rest of S.W.A/Namibia could not be delivered. This made South African operations in the war slightly difficult. However, because South Africa extended its power grid northwards into S.W.A./Namibia, it had a balancing effect on Angola's leverage.

The strategic importance of the Ruacana-Calueque scheme was again emphasised in June 1988 when Cuban and Angolan forces launched an attack on the Calueque dam, first by land and then by air. During the attack considerable damage was inflicted on the dam wall and the power supply to the dam was cut. The water pipeline to Owamboland was also destroyed. This was at a time when Owamboland was suffering a severe drought, and negotiations between South Africa, Cuba and Angola were held at different venues in London, Brazzaville, Cairo, Geneva and New York (Die Burger, 29 June 1988:1; Barber & Barratt, 1990:342.) in an attempt to end the conflict.

During the Brazzaville Round of talks, South Africa held negotiations with the Angolan delegation regarding the status of the Kunene River scheme. The importance of the project to the drought-stricken Owamboland was pointed out by South Africa. The Angolan side reacted positively to this notion and undertook not to cut water and power to Owamboland (Die Burger, 29 June 1988:1). However, the attack took place after Angola's assurance that the water and power would not be cut. The explanation for this could be the Cuban factor. The Cubans probably wanted to inflict as much damage as possible on the South African forces and convinced Angola to jointly attack the Ruacana-Calueque scheme. At the time a military expert, Mr. Helmoed-Rohmer Heitman, declared that the objective of the attack on the dam

was to put it totally out of commission. Heitman added that "what is happening is that the Cubans have added to the bill [of South Africa] for defending Namibia. Perhaps they think if they keep on adding to it, the cost will become so great that South Africa will pull out" (The Star, 30 June 1988:5). The assurance from Angola not to disrupt the scheme indicated that as talks to end hostilities progressed, so did steps to co-operate regarding the development of the Kunene River. It also showed the importance of the Ruacana-Calueque scheme, not only to Namibia but also to Angola. Bilateral co-operation in the Kunene River could start anew, after the withdrawal of South African and Cuban forces from Angola. However, the spectre of Angola's continuing civil war, and the external involvement of outside parties, added a new dimension to water resource co-operation in the Kunene River basin during the 1990s.

Outbreak of peace and renewed co-operation: 1989-2000

After peace broke out in Namibia and Angola in April 1989 with the implementation of the United Nations Resolution 435 and the election of the Namibian constituent assembly seven months later (Barber & Barratt, 1990:344), the two countries were very quickly out of the starting blocks to rejuvenate the Ruacana hydro-electric scheme. Delegations from Angola and Namibia met in Windhoek in May 1989 to reactivate the 1969 agreement between South Africa and Portugal. The purpose of the meeting was to discuss the setting up of a Joint Technical Committee (JTC) and to formulate plans to repair the Gove dam, which was damaged during the war (Business Day, 23 May 1989:3). A second meeting in Luanda in June 1989 set out to discuss the damage to the Gove dam and to discuss foreign assistance for the repair of the structure for it was difficult for Angola to raise the money internally because of the war (Die Burger, 24 May 1989:15; Die Republikein, 13 June 1989:3). In July 1989 the Administrator General of S.W.A./Namibia approved the Namibian component of the JTC. The JTC met for a third time that same month to start planning the reactivation of Ruacana (The Windhoek Advertiser, 12 July 1989:3).

After Namibia gained independence in 1990 the stage was set for greater co-operation between the two bordering countries regarding the Kunene River. The two governments could start with the socio-economic reconstruction of Angola and Namibia as they saw fit. The government of Namibia realised that the country needed electricity to power its numerous mining operations and to deliver employment to its people, and a number of coping strategies were therefore considered in order to achieve this. These coping strategies also required written agreements with Namibia's neighbours, however.

On 18 September 1990 Namibia signed two separate agreements with Angola concerning co-operation over the Kunene River and co-operation in general between the two countries. One of the agreements concerned reactivating the three previous agreements between South Africa and Portugal in 1926, 1964 and 1969 respectively. This agreement had a number of purposes:

- To conclude the uncompleted Ruacana-Calueque water scheme.
- To establish a Joint Operating Authority with the task of ensuring the maximum beneficial regulation at Gove that was needed for optimum power generation at Ruacana and to control the withdrawal of water along the middle reaches of the Kunene. Also to ensure the continuous operation and adequate maintenance of the water pumping works at Calueque and the diversion weir at Ruacana.
- To allow the Permanent Joint Technical Commission, established in the 1969 agreement, to evaluate the development of further schemes on the Kunene in order to accommodate the present and future needs for electricity in both countries (Agreement, 1990a:1-2).

The other agreement between Namibia and Angola created the Angolan–Namibian Joint Commission of Co-operation (Agreement, 1990b). The commission was to deal with joint co-operative endeavours on a number of issues, one of which was water. This commission was a response to the friendly relations that existed between Angola and the South West African People's Organisation (SWAPO) in the years prior to Namibia's independence (Agreement, 1990b:2). Thus five written agreements on shared water resources exist between Namibia and Angola, with one regarding general co-operation between the two countries. These agreements bode well for peaceful interaction in the water sphere.

These two agreements demonstrate not only the importance of international rivers to Namibia's socio-economic well being but also the relationship between the two countries. The linkage between these two agreements also highlights the fact that the overall relationship between countries sharing a river can be a decisive factor in determining the kind of interaction one can expect between them when it comes to the sharing of the river's resources. In this case, Namibia and Angola's friendly relationship meant that co-operation in the field of water resources would follow as a matter of course.

With these agreements in place Namibia and Angola could start with coping strategies in the water resource sector to develop their socio-economic outlook. However, the water politics in the Kunene River basin took a dramatic turn in the early part of the 1990s. First of all, the internal conflict in Angola took a turn for the worse after the breakdown of the Lusaka Accord that was signed between the belligerent parties. Secondly, a new kind of actor arrived on the scene that elevated the dynamics of water politics to a new level.

Continuing conflict in Angola and new kids on the block

This section looks at the effect of the continuing conflict in Angola in the 1990s and the involvement of non-state entities in future projects on the Kunene River. The only water project Namibia and Angola are pursuing at present is the Epupa hydroelectric scheme at the Epupa Waterfall. The two aspects identified in this portion of the paper – the war in Angola and involvement of non-state actors – have had a distinctive impact on the water politics of the Kunene River. These factors continue to influence the decisions of the two governments regarding the Epupa scheme, and they also (and this is especially true of the non-state entities) cast the interaction in the hydropolitical game of the Kunene in a different light.

Angola's ongoing civil war

The economic situation makes it difficult for Angola to find money to launch new water development projects, not only internally but also for international projects. Landmines make it very difficult for the agricultural sector to be developed to its fullest potential. Adaptive capacity is therefore at its lowest level and coping strategies cannot get off the ground – except perhaps if Angola goes into partnership with neighbouring countries. For instance, tap water supplied to towns is not potable and cholera is an ever-present threat. Visitors to Angola are warned not to drink the water. The water supply is in need of upgrading as water supply stoppages are an almost daily occurrence in Luanda. Only 32% of Angola's population have access to safe water and only 16% have adequate sanitation facilities (SADC, 1999:127). This is a grim outlook indeed. The war, which is still raging today, has not only had a negative effect on water resource development across the whole of Angola, but is also hampering the proposed Epupa scheme.

The decision as to whether or not to build a dam at the Epupa Falls site or the Baynes Mountain site lies with the Namibia–Angola Permanent Joint Technical Commission (PJTC). During

1998 and 1999 numerous meetings of the PJTC, to discuss the proposed projects on the Kunene, had to be postponed because of the security situation in Angola (Internet: The Namibian, 25 June 1998). The war was not the only factor delaying the decision on the Epupa Dam. The PJTC had to put off a decision in July 1998 on the project after it found that the feasibility study on the project was incomplete (Internet: The Namibian, 10 July 1998). In 1999 the PJTC decided that a meeting should be held in 2000 to make a decision on the Epupa project. The postponement of the decision created a lot frustration on the Namibian side, because if the Epupa Dam is further delayed the cost of the dam could rise and make it unprofitable. A number of projects like the Haib copper mine and Scorpion zinc mine could also be affected by this and thus the long-term economic outlook of Namibia (Internet: The Namibian, 23 August 1999). The war in Angola has therefore an indirect impact on Namibia's socio-economic prosperity. At the same time, Namibia and Angola have not seen eye-to-eye on the sites of the proposed dam. Angola favoured the Baynes Mountain and Namibia the Epupa Falls site. The Angolans' argument is that if a dam gets built at the Baynes site then it will mean that the Gove Dam, which was damaged in the civil war, could be renovated. This in turn would bring much-needed development to Angola's Huambo province. Namibia, however, would like to see a dam built at Epupa. The Baynes site, they argue, is too small, despite its environmental and social advantages. The Epupa site is regarded as a prestige site by Namibia (Internet: The Namibian, 13 July 1998). A dam at Epupa will also be larger than one at Baynes. The Epupa Dam will be the third-largest dam in Africa, and this holds the promise of much status and prestige for Namibia.

In September 1998 fierce fighting between UNITA and Angolan government police forces broke out at the Gove Dam for control of the installation (Internet: The Namibian, 11 September 1998). The battle at Gove Dam shows that taking control of a water installation is but one strategy belligerent parties use to gain advantage in an armed conflict. Whatever the purpose of the battle, it has certainly had a severe impact on a future dam at Epupa and Angola's arguments for a dam at Baynes.

There seems to be a linkage between the damaged Gove Dam, the postponement of the decision about building a dam at Epupa or Baynes and Namibia's sudden involvement in the Angolan conflict in December 1999. The Namibian President, Sam Nujoma, said that Namibia would back the Angolan government in its campaign against UNITA. The reason for this decision is the long-term friendly relationship between Namibia and the Angolan government (Internet: Mail & Guardian, 15 December 1999). It seems as though the co-operation between Namibia and Angola regarding the war against UNITA is payback for the support Angola gave to SWAPO in its struggle against South Africa and UNITA in the 1970s and 80s. It could also become a bargaining chip for Namibia in the upcoming decision on the site of the proposed dam on the Kunene. Also, the fighting reportedly occurred more to the west and away from the Kunene River in the region of the Okavango River. It could have been a strategy by Namibia to contain the fighting in that area and to keep it away from the Kunene basin with its strategic water installations. Should UNITA gain ground again and project the conflict towards the Kunene River basin, it could spell trouble for any proposed project on the river. Namibia's actions in Angola and the Democratic Republic of Congo (DRC) do not go unnoticed by the international community. If donor agencies perceive the financing of a dam on the Kunene as a severe risk, Namibia could find it very difficult to secure money for the project. Governments of such donor institutions could also influence them not to supply money to Namibia, because of Namibia's perceived negative image.

The war in Angola will, as long as it continues, have an impact on any international project on the Kunene River. Military confrontation is not the only type of interaction that influences the hydro-politics in the Kunene River, however. In the mid-1990s the dynamics of the

hydropolitical game in the Kunene River took on a new dimension with the appearance of a different kind of actor – the non-governmental organisation (NGO) or interest group.

The role and involvement of non-state actors

Giving an in-depth analysis of the role and involvement of non-state entities or their impact in the politics of the Kunene River is beyond the scope of this paper. However, a brief overview is possible. After various international and local non-governmental organisations became involved in the politics of the proposed Epupa Dam in the 1990s, a distinctive interaction between these non-state entities and other international non-governmental organisations (INGOs) and sovereign governments developed. In this section of the paper the types of interaction will be highlighted. The contact between the various actors must be seen in the light of resource use perception. Resource use perception is the perceived utilisation of a resource within a distinctive mindset. It is because of different resource use perceptions that the engineer and the ecologist or environmentalist do not see eye-to-eye on large-scale supply-side management projects. These differing perceptions bring to the fore the nature and degree of the interaction between NGOs and governments as regards the implementation of large-scale supply-side management projects.

For the purposes of this paper the term non-governmental organisation (NGO) will be used interchangeably with that of interest group. The growth and significance of NGOs, particularly with human rights and environmental agendas, is a very strong characteristic of the changing international dimension of water politics in the early part of the twenty-first century (Turton & Meissner, 2000). These non-state entities can launch organised and determined opposition to a dam project anywhere in the world and elevate the project from a national political issue to an international question. This is the case in respect of the proposed Epupa hydropower scheme. These non-state entities range from environmental, human rights and anthropological NGOs to grassroots interest groups in Namibia. Before discussing the engagement of these non-state actors it is necessary first to determine what an NGO or interest group is and what role or function they fulfil in society.

Interest groups or NGOs, like political parties, form the major link between the citizen and government in a society (Heywood, 1997:252). They are also a distinguishing feature of democratic regimes (Sadie, 1998:280). The linkage between interest groups or NGOs and government comes to the fore in the definition of an interest group. Interest groups form part of civil society, and can be defined as the wide range of voluntary associations that occupy the broad terrain between the individual and state. They are the primary means by which citizens can articulate their interests to both the state and to the society at large (Baldo & Sibthorpe, 1998:64). All in all these groups have but one purpose and that is to influence the political decision-making process (Ball, 1988:96), while remaining apart from it (Duverger, 1972:101). NGOs' business is the articulation of certain or sometimes special interests. In this case it is the Epupa Dam project or the impact it will have on affected communities and Namibia at large.

There is a mixture of conflict and co-operation in the interaction between interest groups and the actors directly and indirectly involved in the proposed projects. The tactics of these NGOs also vary greatly, with direct personal communication and indirect contact being used at the same time. Looking at their strategies and tactics will tell us more about the nature and degree of interaction between the actors.

In June 1996 the environmental lobby put a hold on the proposed R2 bn Epupa Dam. The construction of the proposed dam was delayed until an environmental impact assessment was

conducted, the results of which were published in 1997 (Financial Mail, 21 June 1996:73). A public hearing was held in the Namibian capital, Windhoek, in October 1996 where the Himba community voiced their opposition to the dam. The issues they raised to substantiate their objection were, inter alia, that the land they are living on and from would be lost as well as the graves of their ancestors and grazing land for their cattle. The Himba people were represented by their chief Hikunimue Kapika (Internet: International Rivers Network, 1996).

In March 1999 renewed criticism was levelled at the government concerning the Epupa Dam. This time the critique came from Kasita Mburura, Regional Councillor for the Epupa constituency. His arguments were that Epupa had good potential for tourism, mining and agriculture and that the government had not undertaken any developments such as schools, clinics, roads, water and other infrastructure. He also said that the "statements by deputy ministers about the building of the Epupa Dam are destroying the peace and harmony of my region" (Internet: The Namibian, 17 March 1999). In the same month the Minister of Mines and Energy, Jesaya Nyamu, indicated that a referendum, in the Kunene region, could be held on whether the controversial Epupa Dam should go ahead (Internet: The Namibian, 29 March 1999). If a referendum is held on the Epupa issue, it will be a move in the right direction and will reduce possible internal conflict in Namibia.

The strategies and tactics of the different national and international NGOs continued during the last part of 1999. In August the loose coalition of NGOs sent a letter to Getinet Giorgis of the African Development Bank (ADB), urging the ADB not to finance the Epupa Dam, if indeed they were considering doing so. The letter was signed by 42 organisations and 17 individuals (Internet: Letter to Getinet Giorgis, 1999). Of the 42 organisations more than half (23) were from South Africa[4], while five were from the UK and three from Namibia and Germany. This letter coincided with a briefing document sent to President Thabo Mbeki from the Environmental Monitoring Group (EMG), just before his visit to Namibia in August 1999. In the document the negative effects of the dam on the Himba community and the environment were highlighted. The briefing document echoed Mbeki's vision of an African Renaissance and emphasised the importance of the minority human rights of the Himba. The letter also stated that the proposed Epupa Dam was undermining the progressive development of Namibia and was contrary to South Africa's own self-interest in Southern Africa (Internet: International Rivers Network, 1999). This shows that the NGOs are doing everything in their power to stop the Epupa Dam. It also indicates the link between government and citizens, and the democratic processes that are involved in lobbying for a certain issue. The letter and the briefing document are further steps in the internationalisation of the Epupa debate and indicates the initiatives NGOs, with the limited resources available to them, can take to advance their stance on an issue.

The interest groups pulled out all the stops and used every forum possible to prevent Epupa from being constructed. In November 1999 the EAC and the LAC presented the case of the Himba before the World Commission on Dams (WCD) at a hearing in Cape Town. During the hearing the WCD heard about the negative effects the dam could have on the Himba community. Andrew Corbett, from the LAC, also told the hearing that numerous meetings of the EAC in Namibia had been broken up by armed police (Internet: Cape Times, 12 November 1999).

National and international NGOs can have a profound impact on supply-side management projects in developing countries like the Epupa Dam. At this stage the lobbying activities are well organised and peaceful and should not turn violent in the near future. Yet as long as the Epupa Dam is on the cards the interest groups will keep up their campaigns against it.

Conclusion

The interaction between the different actors in the Kunene River basin has since 1926 passed through phases of conflict and co-operation, although the waters of the Kunene River was not the direct causality in the periods of conflict. The chronological study conducted shows that a number of factors, most importantly ideological differences between the actors during the Cold War, contributed to the conflictual state of affairs in the period 1975-1989, with the waters of the Kunene playing a small role. The last stage of the relationship between the two neighbouring states is characterised by a larger degree of co-operation than in the past. The good and solid relationship between Namibia and Angola is the reason for this, and this factor will always bode well for water politics in the Kunene River basin. The only bone of contention is the dam sites for the proposed dam on the Kunene. In all likelihood, if the issue of the dam sites persists into the future, the issue will be resolved peacefully. The most likely methods will firstly be negotiations at ministerial level, between the two respective ministers concerned with the issue. Should these fail, talks will be held on a presidential level between Dos Santos and Nujoma. After this option has been exhausted, then Namibia and Angola will then move on to mediation and arbitration. However, it is envisaged that the issue will be resolved at presidential-level negotiations, if indeed it should even come to that.

The role and involvement of national and international NGOs are of such a nature that the issue of the Epupa Dam will continue to go against the grain of the non-state actors well into the future. One thing is certain and that is that the interest groups are in the Kunene River basin to stay, and will dog the Namibian government and influence other actors, like financial institutions, until the two countries either cancel the dam or go ahead with it irrespective of the anti-dam lobby. The interest groups in Namibia are using peaceful means to advance their opposition to Epupa. If the Namibian and Angolan governments press ahead with the construction of a dam the loose coalition will step up its campaigns against the governments, especially Namibia, because Namibia is seen as the driving force behind the new dam. If Namibia proves steadfast in its decision to build a dam, the most likely action that interest groups in Namibia will take is litigation. The international NGOs will go ahead with their letter-writing and influencing of statesmen and women and financial institutions in other countries to persuade Namibia not to go ahead with the dam. The prospect of a referendum on the issue holds the promise of a peaceful resolution. A Memorandum of Understanding (MOU) between the governments and the Namibian NGOs, like the one signed between the Lesotho Highlands Development Authority (LHDA) and the Lesotho NGOs regarding the Lesotho Highlands Water Project (LHWP), could also bring the issue to a peaceful conclusion. The only movement that could transform the interaction between the state-actors in the Kunene basin into a violent confrontation is UNITA, should it decide to attack the strategic installations on the Kunene River. This will not be water war, however, but payback for Namibia's support of Angola against UNITA.

Will there be a water war in the Kunene River basin? If the Sidudu/Kasikili Island dispute between Namibia and Botswana is taken as a yardstick for the way disagreements will be handled in Southern Africa, then it bodes well for the peaceful resolution of water disputes. Also, the relations between the countries in Southern Africa, and between Namibia and Angola in particular, are quite peaceful. These friendly relations are crucial to the prevention of conflict in the arena of hydropolitics. In conclusion, then, a water war, as defined in this paper, has not in the past occurred in the Kunene River basin and the likelihood that it may occur in the future is very remote.

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Notes:

[1] *It was the hawkish Defence Minister P.W. Botha that insisted that South Africa become more directly involved in the Angolan War at a cabinet meeting held in 1978. The cabinet was overwhelmingly in favour of South Africa's involvement and Vorster had to give in to the hawks (De Klerk, 1998:58-59).*

[2] *The Portuguese ambassador to South Africa protested against the action by South Africa on the Calueque Dam, but no assurances could be given by him as regards the safety of the workers and the pump station and the South Africans remained at Calueque (Steenkamp, 1990:39).*

[3] *These include, among others, the Southern African Rivers Association (SARA), Green Party of South Africa, Environmental Monitoring Group, Earthlife Africa and the CSIR: Environmentek.*

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