Water Management and Conflicts in Africa: The Role of Knowledge and Technology

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Introduction

Over the last two decades, a plethora of studies have investigated the actual and potential links between environmental change and violent conflict. In general, the idea of 'environmental sources of conflict' has been highly influential, especially in Western countries. The claim that, "the wars of the twenty-first century will be fought over water"[1] is so widely-spoken of to have become almost a cliche. Analysts point primarily to the volatile geo-political situation surrounding the Nile basin, or the strategic importance of the rivers of the Middle East, as evidence for this view.

However, others, especially in the southern countries, remain skeptical of the significance of environmental issues in the genesis of conflict. In terms of 'water wars', for example, they point to the fact that very few violent conflicts have been fought over or around[2] water sources; and these have all started due to other reasons.

One of the reasons for disagreement is conceptual misunderstandings over the definition of 'conflict'; another is the complex, changing, and multi-dimensional nature of conflict. The concept of conflict must be unpacked in order to be understood: is it violent non- violent? If violent, is it high- or low-intensity? Who are the actors involved? Broadly, at which level does it take place: local, national, or international? How do the many different forms of conflict in Africa today influence each other? Conflict is a complex phenomenon, a product of many diverse social, economic, political, and cultural processes. Many violent conflicts in Africa have gone on for many years, and the actors, motivations, resource flows and strategies have changed over time. Often, the causes and manifestations of conflict are purposefully obscured for the self-interest of those involved: for example, ideology is often utilized as a handy cloak to obscure more materialistic motivations.

The topic is huge, and this paper will only attempt to sketch out some key issues. It first makes reference to the debates (within academic and political contexts) over the existing and potential significance of water as a source of conflict in Africa. It then offers working definitions of conflict (at

[1] See. for instance. Ohlsson. Leit: 1995, *Hydropolitics,* Zed Books/ 'University Press. Dhaka. Bangladesh
[2] World Commission on Dams. *World Commission on Dams Challenges 'Water war' Rhetoric.* Pr\:s~ Relea~e.2000

local, national, and international levels) with relevance to Africa. Then, based on brief case studies the paper provides some examples of key issues in disputes at the interstate, national, and local level.

While acknowledging that water management can be a factor in conflict, the paper acknowledges that, through a variety of technological, policy and institutional innovations, water management in Africa also has the potential to act as a source of co- operation and mutual benefit between communities and nations. Perhaps the main point of the paper however, is that ideas of conflict over water should be broadly defined, to include debates over water allocation and pricing, for example. Such issues, though not directly leading to bloodshed, are as significant as violent conflicts in tern1S of their effects on livelihoods.

1. Overview

1.1 Discourse on 'Water Wars'

The idea of conflicts over water -particularly over international shared watercourses - appeals to common-sense understandings of conflict. About 60% of global river flow occurs in international river basins, which straddle national boundaries... The majority of all international river basins, some 62% of them, are found in Africa[3]. The threat of conflict is presumably higher now than ever, due to increased demand for water and reduced availability, due to environmental deterioration, reduced efficiency of aging infrastructure, and other factors.

A number of high-profile personalities have made statements over the possibility of conflict over water, including President Anwar Sadat who declared in the spring of 1979 that "The only matt~~ that could take Egypt to war again is water", implicitly directing his threats at Ethiopia.'.. In 1988, Boutros-Boutros Ghali (Egypt's Minister of State for Foreign Affairs at the time) said that, "... the national security of Egypt is...a question of water." Ismail Seragaldin of the World Bank also famously warned that, "the wars of the next century will be over water." Thomas Homer-Dixon, a well-known theorist in the field of 'environmental conflict', also argues that, "the renewable resource most likely to stimulate interstate resource war is river water"[iv].

However, the issue is not a new one. As long as four and half thousand years ago, a war was fought between two city-states in Mesopotamia (now Southern Iraq) over disputed water supplies.[v] Since then, much of the attention has remained focused on the Middle East- particularly the role of water resources in relationships between Israel and its neighbours. This is due both the levels of water scarcity in the region, as well as the history of violent interstate conflict in the region (it is interesting to note that water is managed in Israel by the Ministry of Defence). In addition, parts of South Asia are also seen as high-risk, due to high levels of population growth and population density, coupled with degradation of highland catchments, and the significance of lowland rice- production for food security.

[3] Powers, K. (2004)

Particular areas of Africa are also on seen as problematic; with much attention focusing on the Nile Basin, and Southern Africa. Specifically, of 17 basins identified by a major research project as being at risk of 'political stresses' over water resources, 8 are African, including the Lake Chad, Incomati, Kunene, Limpopo, Okavango, Senegal, and Zambezi basins[vi]. The Nile is already considered to be under political stress but of course, efforts are underway to address this through the Nile Basin Initiative.

Over the past decade, the idea of conflict over water has certainly captured the popular imagination. A Google search for online material on "conflicts over water", for example, provides links to 12,000 sites. It is significant though that for the much more media- friendly soundbite 'water wars " some 155,000 sites are found. This may be an indication of the way in which the issue has been treated - press coverage has been much more persuasive and frequent than in-depth, systematic research.

Similarly, many of the verbal warnings or public relations 'conflicts' over water, such as statements by Kenyan politicians advocating 'water for oil' swaps regarding use of the Nile by downstream riparians, do not have official sanction. Hence, much of the public face of conflict over water may be 'sabre rattling'. In an exhaustive study, 62% of all international conflictive or cooperative events over water were verbal statements or exchanges, of which two-thirds were not officially sanctioned[4]. According to this study, no water war has occurred since 2,500 BC. Of the 37 military events related to water were recorded, 30 were between Israel and its neighbours. Overall, the study found cooperative events to be twice as common as conflictual events. In general, the study found that shared water resources tended to act as an irritant in situations where states were already at odds; or as a positive factor when relations were good. It is important to - note that this study only looked at the international level. The lead author has acknowledged that within states, violence related to water resources has occurred and continues to occur .

However, as with most fields of research, and conflict studies in particular, there is a divergence of views. Other studies by eminent specialists, examining incidences of 'militarized interstate disputes' where at least one person died (though without a declaration of war necessarily being made) suggest that such disputes are associated with the existence of a shared river basin, and the size of that basin[5]. Poorer states, and states located in the water-scarce regions of the Middle East, North Africa, and sub-Saharan Africa experience more conflict than comparable basin-sharing countries elsewhere. In the words of the study paper, " Africa is indeed at the centre of the shared basin and conflict questions"[6].

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[4] Wolf et al (2003)
[5] Gleditsch et a) (2004)
[6] G)Gleditsch et a) (2004)

However, one interesting finding that to some extent goes against intuition and 'received wisdom' is that countries with endemic water scarcity and shared basins have long-term incentives to invest in water management measures and avoid conflict; incentives which other basin-sharing countries do not have. This is in line with the Wolf study described above, which points to the fact that we should look at issues of cooperation, as well as conflict over water, in order to understand the potentials as well as challenges that water resource pose in Africa.

1.2 Characteristics of Water as aResoruce

Water has unique characteristics and is crucial to every form of life and practically every human activity. It is important for agriculture, facilitates transport, disperses waste products, lubricates the wheels of industry, and often forms district or international borders.[7] For this reason, it 'eludes institutional classification " and requires extensive inter-sectoral coordination for proper holistic management[8]. This makes disputes or inefficiencies more likely.

Its key characteristic, from the point of view of management, is that it is a 'fugitive resource'. It is easily 'lost' due to evaporation or seepage into porous substances, and has to be contained. It flows as surface water, often crossing administrative (including international).boundaries, and it crosses such borders underground, in the form of large aquifers. Therefore any alteration of water sources, in terms of quality or quantity, will have ripple effects outside the immediate location of the changes. In the case of a river, "what happens at its source will reverberate all through its course until it reaches the ocean. Problems at the mouth may be unsolvable if you cannot control what happens at the source."[vii] In the case of underground reservoirs, pollution at one point can make the source unusable by anyone for decades, or longer.

If a river or lake is shared by a number of riparian communities, one can easily abstract more than its allotted share from its own territory: it may even be able to do so undetected, if the downstream user lacks an effective monitoring capacity. Underground reservoirs may cross international borders, meaning that over-pumping can effect neighbouring countries. Overpumping of oil reservoirs was Saddam Hussein's justification for going to war with Kuwait -could a similar scenario unfold in terms of water?

Uneven geographical distribution of water means that many areas of the African continent with a high water demand -due to agricultural and industrial development - are water-scarce. South Africa, for example, accounts for 80% of Southern Africa's total water use, but only 10% of the water resources

[7] Powers, K. (2004
[8] Wolf et al (2003)

in the southern African region are found in that country.[viii] North Africa is another case-in-point. Libya, for example, by draining underground aquifers at unsustainable rates, withdraws uses four times more than its annual renewable water supply[9].

The mobility and the resulting complexity of hydrological systems has resulted in a radical restructuring of water regulation institutions in most countries world-wide. In the past, the mismatch between administrative boundaries (e.g. districts) and the physical boundaries of water basins have resulted in some inter-agency conflicts and sustainability problems. Due to the way in which water resources are distributed geographically, some areas will abstract more water than is available within the district, by taking from other parts of the basin. The River Basin approach is intended to deal with this problem. However, because of mismatches between water supply and demand, transfers between river basins are becoming increasingly common. A well-known example of this is the water transfer scheme between Lesotho and South Africa, through which Lesotho gains foreign exchange in return for water transferred to its heavily industrialized neighbour.

In addition to uneven geographically distribution, water availability is also prone to great temporal variability, in terms of seasons during a single year, and in terms of multi-year cycles of drought and flood. The El Nino effect, as well as the longer-term effects of global climate change, are adding to this variability. Across much of Africa, climatic events are expected to become more extreme and also more frequent as a result. In the specific case of Kenya, expected impacts include: abnormal rains in arable areas, that will generate floods and threaten houses and other infrastructure; drier conditions in the arid parts of the country, thereby affecting food production, leading to increased malnutrition; increased occurrence of extreme climatic events such as droughts, heavy and prolonged rains and floods; and increased mean temperature.'[x]

One answer to the challenge of temporal fluctuations in water availability is storage -and Kenyan legislation, for example, requires every water permit holder to have capacity to store enough water to last for 90 days.[x] However, the expense involved means that this is only implemented by a few large commercial operators, and it is hardly enforced in practice.[xi] Currently, the capacity of African governments to store water is also limited.

It is also important to note that control of water opens doors to many potential land-uses. The location of water sources can influence pastoralists' choices of grazing areas, opening up new pasture areas and thus improving the animals' nutritional status. Because of the need for water sources in dry areas, water access rights are the key to control and utilization of arid and semi-arid areas, and can make African countries more food secure through irrigation technology. The systems of access to such water sources may therefore be the most complex of all natural resource tenure

[9] World Bank, (1994)

systems in such an area. Interventions should be carefully located geographically and in terms of socio-cultural 'ownership'. Development of water sources can lead to many second-order conflicts not directly around the water itself, but related to the effects of water development. For example, in dryland areas of Tanzania, the population of villages provided with anew borehole can increase by a factor of three within a few years[10]. This has obvious implications for land use.

Finally, it is clear that a key characteristic of water resources in Africa is their increasing 'scarcity' due to a variety of factors. In many ways, the Integrated Water Resources Management (IWRM) paradigm, which is dominant across the globe, is predicated upon the idea of scarcity, which has put emphasis on demand-management, and efficiency in both allocation and distribution. However, we should be cautious in definitions and assessments of scarcity. Due perhaps to a bias towards certain kinds of professions in the most involved in high-level decision-making in the water sector (various aspects of 'hard science'), water scarcity is usually diagnosed as a 'technical' issue, to be solved by improved water management through technological improvements, allocatory efficiency, and the like. However, even in areas of relative 'natural' water abundance, many people lack access to water. Indeed, the African countries where populations have the least access to water are not those with the least natural water availability, but generally those in the equatorial belt with higher levels of rainfall. It is clear therefore that amongst the primary causes of lack of water access, economic, institutional, political and social factors are just as significant as ('hard') technological factors.[11]

In addition, because of the importance of shared water resources and other regional links, water scarcity cannot be seen in a local or even national context, but rather as a regional issue. States, corporations, and other institutions have the power to manage water and transfer water from one basin to another. "Scarcity therefore is relative and mediated by power relationships, amongst other factors, within and between states". [12]

1.3 A Typology of Conflicts

One of the reasons for the divergence of views on the link between competition for water and conflict is the tendency towards misunderstanding regarding the definition of 'conflict'. ,

The first thing to note is that conflict need not involve violence. Instead, a useful definition of conflict is a situation where actors have 'incompatible goals'. This means that one actor, if it is to fulfill its goals, must act in a way that will prevent another actor from fulfilling their goals. Some theorists have defined goals to include status, power, and/or resources.[XII] According to this definition, conflict is

[10] WaterAid (undated) Social Conflict and Water; lessons from North-east Tanzania. Discussion Paper.
[11] This argument is rather compressed, but similar ideas are more fully developed in McGranahan and Satterthwaite (2004)
[12] Thompson, L. (2000)

manifested in purposeful behaviour by the protagonists, in order to capture more of the scarce resources, and/or to overcome the strategies of other protagonists.

However, in much of the literature on water and conflict, only violent conflict is considered. Even using this narrow definition, many different

This methodological problem has been noted by Peter Gleick, one of the foremost experts on the topic. He has been seen as a proponent of the idea that competition for water resources can indeed contribute to conflict, while people such as Aaron Wolf, coordinator of the Transboundary Freshwater Dispute Database, are associated with an argument that water resources tend to catalyze cooperation, rather than conflict. However, a close look reveals that Gleick takes a wider definition than Wolf, including the use of water as a tool of warfare (not necessarily a cause). Water resources may be managed or otherwise altered for tactical purposes during conflicts (which may have started for reasons completely unrelated to water). In this sense, water can be used as a weapon of war or as a means of putting extra pressure on parties during diplomatic disputes.

Gleick also assumes conflicts to be essentially multi-causal. This is an important point - large-scale violent conflicts are notoriously complex, and the causes, boundaries, and actors involved in conflicts are nearly always themselves disputed.

In trying to address issues which are of importance to Africa's people, we should be wary of taking a narrow definition of conflict. Much of the attention so far has a very state- centric character. Critics of mainstream 'environmental sources of conflicts' narratives have noted that such a focus tends to privilege certain kinds of knowledge and actors over others. Some of the ways in which issues have been conceptually framed may reflect a desire to increase the visibility of the topic, and also the funding available for research. A state-centric, 'realist' approach to conflict also neglects a wider, more 'bottom up' approach to security based on the idea of human security.

Case studies of water management at the national or local level also neglect some important aspects -particularly the external factors which represent the parameters of local knowledge, access to technology, and availability of water. In the words of one critic of mainstream approaches:

"the degree to which water use, water pollution, water scarcity, and water management are a reflection of global patterns of production, finance, security and knowledge are left unmentioned."[13]

[13] Thompson, L. (2000)

There may be many ways to analyze conflict. For example, disputes can be classified in terms of the different water uses involved. Thus in Africa, competition is common between water uses such as irrigation (commercial and small-scale), the hydro-electric sector, pastoralism, and industry .Contentious issues such as deforestation, overgrazing, pollution and other activities which can lead to water degradation can also be included in this list.

Alternatively, conflicts can be seen in terms of the geographical location of the disputed water uses. Most can be classified as 'downstream versus upstream' disputes, but the rural versus urban classification may also be relevant. In both cases, social, ethnic, and occupational differences between areas may increase the chances of a dispute become exacerbated.

Disputes can further be typified in terms of the actors involved. Thus disputes can occur between various combinations of social units including individuals, committees, villages, corporations, district authorities, and Ministries. Water conflicts may have a gender component -for example, when a man and wife disagree over the best use of water within the household, system. Conflicts over water rarely involve a clear-cut argument between two groups of disputants. Usually, "they involve a complex interaction between diverse clusters of competition". [14]

There is also an inter-generational aspect, which exists when environmentally unsustainable activities prevent future generations from using natural resources.

Additionally, it is possible to develop typologies of conflicts over water according to the nature of the root cause of the problem. In dryland areas such as East Africa, these may commonly include decreasing supplies of water, resulting in so-called 'simple scarcity' conflicts. " As water supplies decrease, communities are forced to move to seek new sources; resulting in tensions with other communities which may be termed 'group- identity conflicts'. [15]

Water scarcity and the related social stresses (migration of the community, coping mechanisms "such as increased spending on water from vendors, etc) can disrupt key social institutions. Indigenous councils of elders may no longer be able to meet, for "instance, or the loss of the most mobile members of society (stereotypically young men) may mean that traditional natural resource management regulations and other social regulations can no longer be enforced. Lack of water for agriculture or industry also affects government revenue, limiting the state's capacity to manage water resources. This leads to social instability, breakdown of mutual support mechanisms, and possible civil' strife. Of course, it may be difficult to identify cause and effect, as water management capacity exacerbates water scarcity, in a vicious circle.

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[14] de Bois, 1994

[15] This description approximates Prof. Homer-Dixon's conceptual framework.

All of these analytical lenses, or a combination, may be appropriate for different ends. For the purposes of this paper, which is meant to provide an overview of the issues, we can categorize conflict over water depending on the broad type of actors involved, following earlier research:

- Interstate conflict
- State-community conflicts
- Intercommunity conflicts (within a single state)
- Intercommunity conflicts (which straddle international borders)[16]

2. Case Studies

2.1 Interstate Conflicts - the Example of the Nile

As mentioned above, violent conflict between states directly over water (as the main cause) is rare. However, it is important to remember that disputes take other forms as well. Non-cooperation and undermining of water development activities are both forms of conflict which can retard development. In that regard, the example of the Nile is taken to illustrate some of the legal disputes which hamper development of water resources.

A number of international agreements over the Nile waters have been signed since the late 191 century. These include, for example, a 1891 protocol between the United Kingdom and Italy (the main colonial powers in the eastern Nile region at that time) which involved Italy undertaking not to construct any engineering works that would affect the flow of the Atbara river in the Nile. In 1902, Ethiopia and the UK signed a Treaty which provided that Ethiopia would refrain from constructing engineering works on the Blue Nile, Lake Tana, or the Sobat. Further agreements between the UK and the Congo (1906), the UK, France and Italy (1906), and the UK and Italy (1925) all included provisions designed expressly to protect what the UK and its strategic ally/client state, Egypt, saw as Egypt's 'natural and historical rights' to the flow of the Nile. These agreements, largely between colonial powers, are generally seen to have lost any legal basis with the end of colonial occupation of Africa. In the case of the 1902 Treaty, Ethiopia did not recognize the Treaty as binding once Haile Selassie's government came to power in the 1950s.xiii In any case, they do not affect Kenyan waters.

Today, the most talked-about document relating to utilization of the Nile Waters is the 1929 Nile Waters Agreement. This Agreement, which had been preceded by a number of hydrological studies and reports, consists of an 'exchange of notes' between Mohamed mahmoud Pasha, the President of Egyptian Councial of Ministers, and Lord Lloyd, the British High Commissioner in Cairo. The Agreement had the following key terms: -

- The Nile Waters were to be shared between Egypt and Sudan, with Egypt claiming rights to 48bn cubic m per year, and Sudan 4bn cubic m.
- The dry season flow, between the I 5th of January and the I 51h of July , was entirely reserved for Egypt-
- Egypt claimed the right to monitor the flow of Nile Water into and out of upstream riparian countries.

- Egypt claimed the right to veto any upstream engineering works that would affect the flow of the Nile.
- Egypt claimed the right to construct engineering works on the Nile without the consent of other riparian states. [xiv]

There was however some leeway over future re-negotiation, based on the political future of Sudan. Accordingly in 1959, after Sudan had gained its independence, Egypt entered into an Agreement for the Full Utilization of the Nile Waters, which is discussed below.

The,1929 Agreement was concluded without the involvement of any other riparian states.. During the colonial period, the East African Territories of Tanganyika, Uganda and Kenya expressed concern over the terms of the Agreement, and declared their interest and right to a share in the Nile Waters, based on detailed estimates of water requirements.[xv] Following independence, Tanzania rejected the Agreement as not binding upon itself as an independent sovereign state. This was in accordance with the Nyerere Doctrine on State succession which considers colonial-era treaties to be non-binding if incompatible with state interests. Tanzania sent a Note to this effect to the Governments of the UK, Sudan and Egypt in 1962, to which Egypt replied with a Note submitting that the Agreement remained valid, though there may be room for negotiation. Similarly, the Government of Uganda declared in a letter to the Secretary General of the UN in 1963 that all colonial-era Treaties would, after December 31 SI, 1963, would be considered 'terminated' unless modified by agreement with the Government.

However, this position has been complicated by the later policies of the Ugandan government, which has continued to seek consent of the Government of Egypt for all projects of the Nile (as per the terms of the Agreement), has continued to observe the 1949 Owen Falls Agreements, and signed a new agreement with Egypt, through an exchange of notes, in 1991, "affirming the so-called existing agreements".[xvi]

When Tanzania and Uganda were officially rejecting the Agreement, the Kenyan Government -at that time still a colonial machine -stayed silent. However, after independence, Kenya declared that it adopted the Nyerere Doctrine, and considered Treaties which were not modified by mutual consent within a 2-year period, and "which cannot be regarded as surviving according to the rules of customary international law" to be terminated.[xvii] .

A number of other international agreements on the Nile were entered into after 1929, the most relevant being the 1959 Agreement for the Full Utilization of the Nile Waters between Egypt and Sudan, which provided for the construction of the Aswan High dam, and modified the terms of use of Nile Waters. Under the 1959 Agreement, the two countries were to achieve "full utilization" of the waters: Egypt was to receive 55bn cubic m per year, while Sudan was to receive 18bn cubic m per year.

While some downstream powers consider the 1929 and 1959 Agreements to be binding legal documents, many lawyers, academics and politicians have argued otherwise. There are many reasons put forth to argue that they are null and void. Some of the key arguments include:

- The 1929 Agreement was between the UK and Egypt, and thus became void following the end of the UK's colonial control over East Africa.
- The 1959 Agreement was intended to replace the 1929 Agreement, which was then implicitly superceded.
- The statements of the Governments of Kenya, Tanzania and Uganda (notwithstanding any later bilateral agreements) rejecting colonial-era agreements are, arguably, upheld by international customary law.
- The 1959 Agreement between Egypt and Sudan did not involve any consultation with third parties such as riparian states, and cannot therefore be seen as binding upon them.

For reasons such as these, the East African Legislative Assembly chose not to refer to the Agreement in a set of resolutions on Lake Victoria and Nile Waters issues in June 2003, because they feel that the Agreement' does not exist' .

Despite these arguments, many Kenyan officials and politicians have identified the 1929 Agreement as a constraint to development of irrigation, hydroelectric power generation, and flood-control structures. In off-the-cuff remarks during a speech to the East African Legislative Assembly in June 2003, the Minister for Water Resources Management and Development, Ron. Martha Karua wondered if some people had not used the Agreement as an 'excuse' for lack of action. This may be true -for example, it is unclear whether a number of rivers in the Lake Victoria Basin in Kenya would be affected by the Treaty, as it is unlikely that flows of water to Egypt would be affected -certainly, non-consumptive hydropower projects would not have had an impact. Conspiracy theorists then wonder if it is an excuse for the lack of development in parts of Kenya which were seen as opposing KANU, which was in power until 2003. Others have pointed out that many references to the effects of the Agreement on Kenya have been made in ignorance of its historical and legal context.

Notwithstanding formal and informal discussions around the use of the Nile waters in Kenya, "Kenya continues to participate in the NBI and negotiate on the Nile Basin Cooperative Framework and related issues of access to Nile waters. This may be due to some of the wider geo-political and economic issues discussed below. I

The Nile Basin Initiative has been described as a 'closed shop', typified by high-level meetings between politicians with minimal civil society input. Indeed, the NBI has been described as 'secretive' by its critics.[xviii] This is partly due to the massively sensitive nature of the discussions, particularly as they pertain to the re-negotiation of the current water allocation regime (whether it is believed to be de jure or de facto). There have been efforts to bring civil society into the process, via a Nile Basin Discourse, but these have been controversial and there are currently funding problems with the institution. This situation demonstrates the need for transparency and information flows from donors and NGOs, not just state-driven processes. '. ~

It may be instructive to look at other processes of negotiation on international waters. LeMarquand suggests that the following issues, in order of importance, are most critical for governments during negotiations:

- Concern for national image
- Principles of international law
- Linkage to other bilateral or multilateral issues
- Reciprocity
- Sovereignty

The first issue is linked to the complex web of relationships within the Nile basin and the wider African political arena (see section on conflict below). National image presumably has both 'internal' and 'external' aspects -e.g. how do citizens feel about the national image; and how to foreign states perceive the nation? This may shed some light on the predilection for verbiage, rather than action, on water issues.

The second issue is somewhat complex. There is no real internal consensus on the legal frameworks or norms for negotiation over international waters. Efforts to arrive at consensus have so far been unsuccessful. For example, despite 20 years of effort in developing the Convention on the Law of the Non-navigational Uses of International Watercourses (1997), only 5 countries have ratified it. None of the Nile Basin countries have signed the Convention.[xix] The development of several influential legal frameworks has helped to build a general sense of common principles for the management of international watercourses, for example the Law of Non-Navigational Uses of Watercourses and the Helsinki Rules for International Watercourses both include the principle of equitable sharing and reasonable use of the resources. Though these are not binding on the riparian states of the Nile, the Rio Declaration and Agenda 21 of the Convention on Biological Diversity call upon states to apply generally accepted principles of international law in water management.[xx]

Both the Law of Non-Navigational Uses of Watercourses and the Helsinki Rules have, however, been criticized as lacking in clarity as the term "equitable" is open to many different interpretations.[xxi]

The financial implications of co-operation, and of the alternative {withdrawal from the NBI, either with or without" undertaking significant development activities on the Nile 'unilaterally') are great. Informal remarks by politicians indicate that Kenya may favour an approach of compensation, where mechanisms are developed for downstream countries to offer aid in return for continued water security. Ugandan politicians have also called for compensation of up to US$ 1.2 million, specifically from Egypt.[xxii]This situation would approximate the so-called 'potential pareto' improvement, by which one party benefits, and the' losers' are compensated to the full value of their losses.xxl11 Table 2 might shed useful light on the riparians' relative abilities to provide such compensation. Other politicians have called for East African states to 'sell' water to downstream states, though these ideas are not official policy.

According to the World Water Development Report, which lists 180 countries according to their water availability per person per year, Kenya is ranked 154th, Uganda 115th and Ethiopia 137th. The upstream countries of Egypt and Sudan are ranked 156th and 129th respectively.

Table 2: GDPper capita {US$), Riparian Countries of the Nile xxiv

Egypt	US $ 3221.67
Sudan	1594.69
Uganda	1094.47
Kenya	1014.98
Eritrea	906.34
Rwanda	839.94
Burundi	583.46
Ethiopia	598.58
Tanzania	482.26
Democratic Republic of Congo	N/A

It is also worth considering the ongoing NBI process, and especially the negotiations over the Cooperative Framework (project 03) within the wider geo-political context of the Nile Basin.

For example, while the potential for 'conflict over Nile waters' has been much discussed in recent years, and often over-exaggerated, several of the riparian countries have actually gone to war with each other over other issues (e.g. Eritrea and Ethiopia), while many of them have reportedly fought 'proxy' wars through support for rebel groups (allegedly Sudan and Uganda; Uganda and Rwanda; DRC and Rwanda; several other examples could be given). From this perspective, the NBI might offer a basis for communication and cooperation between these countries, where few others exist.

It has also been claimed that Egypt has maintained its control over the Nile through support for rebel factions in upstream countries and other destabilizing measures. Analysts argue that Egypt is only now altering its foreign policy in order to enhance regional co-operation. This may be linked to a desire to access increased funding from multilateral lending institutions and to boost income from regional trade in order to increase its capacity for efficient water use, including water recycling, as it attempts to increase its food production capacity to feed a rapidly expanding population. There are two major projects planned: the Toshka project will divert Nile waters upstream into Egypt's desert oases and increase the exploitation of groundwater sources in order to irrigate 200,000ha of land at a cost of $88.5 billion. The second project, the North Sinai Development project, plans to expand the area of irrigated land by 250,000ha by mixing water from the Nile with drainage water.[xxv]

Analysts argue that Egypt may also plan to remain influential in the Basin despite any change in water allocation regulations, due to its experience in dam construction, water management (especially for irrigation) and its economic power.

From abroad view of the situation, the wider geo-politics of the Nile is also linked to the Arab-Israeli conflict, and since September 11th to the 'War on Terror'. This is because of the religious aspects of some of the internal and proxy conflicts in the Basin (e.g. Sudan, Eritrea, Uganda, Ethiopia) and the interests of foreign powers -primarily the US -in maintaining influence in the region. The recent IGAD-facilitated Somali Peace Process, and the Sudan Peace Process, could be interpreted as a problem to some countries, which may prefer to have neighbours which are too disorganized to engage in major water development activities or to monitor, or oppose, water uses upstream.

Any process of high-level negotiation between the 10 riparian countries is bound to be sensitive. When those negotiations centre on the Nile, with its strategic importance as the source of actual and potential food security, hydropower, and other key aspects of national stability, the negotiations are bound to become more sensitive still.

As mentioned above, governments are likely to be assessing the merits of different negotiation positions according to a range of priorities. It may be, for example, that for some countries, the value of any improved access to Nile waters (e.g. for irrigation) might actually be less than the perceived benefits from the various NBI projects or any economic incentives being offered by downstream countries. Rational economic decision-making will presumably take a 'national' view of the situation, but will hopefully be guided by national policies for poverty eradication (including for example the Poverty Reduction Strategy Papers (PRSPs) as well as water management objectives.

In Tanzania, both violent and non-violent conflicts exist over water, and to some extent, these stem from a mismatch between customary (local) and 'modern' (state) conceptions of water rights.

Under Tanzanian law, all water in the country is vested in the government. In theory, "Tanzania citizens have equal right to access and use of the water resources".[xxvi] However, access depends on many factors. Indeed, the statutory laws are just one of a variety of systems which have de facto influence on water management. There is a situation of legal pluralism, where land and water resources are regulated according to a range of institutions and agreements, including customary laws, and religious injunctions. Despite the ubiquitous nature of customary water and irrigation rights, the statutory water management system has simply been superimposed on these existing norms, leading to conflicts. This is increasingly recognised by those involved, but when faced with potential conflicts over water, it is often the case that, "the authorities pretend that the only prevailing law is state law".[xxvii]

The first national water policy was formally adopted in 1991. It reintroduced charges for water services ("economic water users fees"). Government funding was also to be specifically limited to "basic needs facilities". In 1994 -1997 however, studies on the water sector funded by the World Bank recommended that these fees be increased so as to fully cover operation and maintenance costs, including the functioning of river basin offices, and monitoring of water abstraction and flow regimes. The emphasis of the 1991 policy on water resources development was also criticised, and instead, the Bank and the Government focused on water resources management. Fees for water were

designed not just. to provide revenue, but also to lead to demand management, through more economical)y 'rational' use of water. One of the justifications for this focus was the power rationing introduced in Dar es Salaam 1993, but later shown to be only partially the result of localised water 'scarcity'.[xxviii] This demonstrates that scientific knowledge, of course, develops over time, and science should not be considered sacrosanct: especially when scientific investigations are managed by those with vested interests.

In Tanzania, my abstraction from surface waters, other than minor water collection using buckets rather than pumps or fixed structures, requires a Water Right, as does groundwater extraction of 22,700 L per day or more. It costs a significant amount of money to apply for a Water Right: $40 as a fixed-rate registration fee, and an extra annual fee based on volume of water extracted. However, because of a general lack of technical capacity, volume~ are usually estimated, making the exercise highly subjective and prone to corruption. [XXIX] However, for uses under 3.7L/S, a flat-rate is applied of $35 per year. These charges are significant in a country where per capita GDP is only $560, and 85% of the rural population lives in poverty.[xxx]

There are a number of significant problems with the water rights system as currently designed and implemented. These problems are social and cultural as well as economic and technical in nature. Essentially, the imposition of water user fees, without any apparent associated benefit for the users, has led to perceptions that it represents a tax. It has therefore been extremely difficult for water office staff to collect taxes, and the exercise is not cost effective, resulting in a loss rather than a profit for the government.

In the Pangani River Basin, research conducted in 1994 indicated that of 2265 ';)'j abstractions, only 171 had Water Rights.[xxxi] Many Water Rights which were allocated during the pre-Independence period allowed for very high rates of abstraction, sometimes on a 24-hr basis. The allocations were made during a time when the population was much .lower than at present, and when industry and urban centres were less developed. Holders of rights included private and state-owned commercial irrigators, and the Tanzania Electricity Supply Company (T ANESCO).xxxii Some of these early rights are still valid today. Payment for the rights was nominal, and the results were merely to protect the uses . of the wealthy and the 'formal' sector at the expense of the peasant majority. There are many conflicts between colonial-era coffee and tea estates and local people.

In the Rufiji Basin, the majority of people still abstract water without any water right. A survey carried out three years ago found that 37% of the total abstractions were outside the water right system with many of the abstractions in distant villages where the basin board has little access. Unpermitted abstractions have not been inspected by Ministry of Water staff, in order to set maximum permitted levels of water use.

Furthermore, insufficient funding for the Ministries in charge of water means that staff cannot travel to inspect all permitted abstractions, both before and after required infrastructure is installed to help keep water flows within the set bounds. Water users may pay bribes, or pay for the transport of staff so

that they arrive at a time of high water volume, so that the appropriate amount for abstraction is over-estimated.[xxxiii]

The current Tanzanian water policy recommends that those abstracting without legal rights are given two years to apply, after which time abstractions will be treated as a criminal offence. If this approach is taken, an extensive public information campaign will, have to be mounted, and support services will have to be provided to communities. Many of the rights granted before Independence in Tanzania are still legal, and provide for very large abstractions: clearly these need to be re-assessed. However, "it is very difficult [for the state] to alter water rights, no matter how unfair they may be, as we need to pay compensation for lost access to water".[xxxiv]

The water availability situation is so critical that since 1994, Pangani Basin Water Board has had a policy of granting no new applications, except under special circumstances[xxxv].

Because of the mismatch between the changing water demand context to the unchanging water rights, the current draft of the Tanzania National Water Resources Management Policy recognises the need to implement a fixed water right duration. A 5-year duration (as used in Kenya) may discourage investment, as people will feel that their water use regime is insecure. South Africa's new policy, which is regarded by many as a 'model' of best practice, sets a 40-year maximum duration for Water Rights. Certainly, the process of reforming the current situation must be handled carefully. Commercial farms in Tanzania provide employment for many local people as well as vital foreign exchange earnings.

In the Tanzanian water sector at present there are "no guidelines for prevention of conflicts through consensus-building"[XXXVi]. Although the draft water policy suggests that the River-Basin Water Offices should be "the preliminary centre for conflict resolution" it is realistic to view its role as a mediator of macro-level conflicts. As regards micro-level conflicts, clear guidelines on conflict prevention and resolution should be developed at the regional/national level. Such guidelines should include transparency at all stages of the Water Rights allocation procedure, and should identify a mediating institution with independent status. This fits with the Ministry of Water's aim of separating its regulatory and operational functions.[xxxvii] However, each dispute occurs within a different context "and local political factors, and may require a tailor-made strategy for conflict resolution. Traditional dispute mechanisms should be identified and strengthened as appropriate.

In some ways, the mismatch between state and local community conceptions of rights to water are an example of an issue identified by Thompson (2000): "It is of course the clash of interests. ..that brings about the most visible conflicts, whether these occur intra-. or inter-state.. Thus most decisions on water security are. ..the result of the state's reallocation from certain allocative interests to others." Financial and regulatory mechanisms such as permits are of course one part of allocatory systems.

2.2 Intercommunity conflicts (within a single state): A Case Study from Arusha, Tanzania

Local conflicts over water are notoriously common. Indeed, one assessment of international donor funding suggested that by concentrating funds on local level water development, donors had in many cases contributed to conflict.[17] However, this should not prevent states, communities NGOs or donors from further efforts to provide water. Instead, more should be done to understand the local dynamics of conflict. In many cases, lack of coordination between institutions, poor stakeholder identification, and lack of full negotiation over water development is an issue. Power relations and access to information could be seen as cross-cutting themes in such problems.

One case from Tanzania shows how technological issues, stakeholder identification, and local politics are all significant. Until the late 1980's, the high level of fluoride in the springwater used by the villagers of Oldonyowas (Arusha Province) was unrecognized. However, water analysis revealed levels of around 20ppm, compared to the WHO recommended standard of 1.5ppm. In 1990/91 local people located a spring, some 15 km away. They requested assistance from MS, the Danish volunteer service, and received advice on how to proceed. In 1993/94 they paid Ministry of Water staff to test the new source, which contained only 3.5ppm of fluoride, and applied for a Water Right. The application process took 3 months and involved the usual process of official notice being published in the local newspapers, and the Ward Development Committee (which represents Oldonyosambu and other villages as well as Oldonyowas) met with the hydrologist before the go-ahead was given.

With the assistance of M.S. and the Ministry of Water, the villagers calculated the cost of a pipeline from the spring to the village: about $165,000 including labour and equipment costs. Villagers raised about $3,000 and worked in teams of 60 per day for two days per week during the course of a year The women of the village prepared food for the workers.

Soon after work had started, moronis[18] from Oldonyosambu destroyed the sections which had been completed. The Oldonyowas village council and traditional elders started talks with their counterparts in Oldonyosambu, which lasted for almost a year. Finally they got permission to continue from these village representatives, and work recommenced. After another year or so of construction work, the pipeline was completed. Then, three days before the scheduled opening day, moranis again destroyed the system. The moronis from Oldonyowas prepared themselves for some kind of battle with the opposing group, but were dissuaded from doing so by the village council and their traditional elders.

[17] Allan and Nicol (1998)

Further meetings were held between the traditional leaders and village council officials from each village, and a number of objections to the scheme were voiced by the Oldonyosambu group. These included the idea that the pipeline would severely reduce the water flow in the pipe used by the Maasai in the plains, which is contested: the water right was allocated after a hydrology study, which should have ensured the plains supply was maintained. However, some local people claim that water levels in the pipe used by the Maasai fell dramatically.

A counter-claim is that this pipeline is in urgent need of repair so that much water is lost before it reaches the watering-point. The lack of storage facilities on the plains also leads to a lot of water wastage.

Ministry of Water officials mentioned that the hydrologists didn't study a wide-enough range of water users when allocating the water, and may have devalued the interests of the pastoralists because of their geographically 'marginal' position. When hydrological studies are being done, it may be wise to involve legitimate local representatives from surrounding areas in order to avoid this cloud of misinformation that frequently surrounds such disputes. As MS state, "Part of the problem seems to be because of lack of sufficient information -and in some cases deliberate mis-information -on the effects of the changes in the distribution of water to the various users down the stream." [19]

The main issue however was that they apparently thought that money from the district Annual Development Levy (collected from every household in the village) had been used to fund the project. Indeed, the vandalism apparently occurred immediately following the release of some morani after their arrest for demonstrations against the Development Levy. The Oldonyowas village council think that some of the motivation for the destruction may have been political: their theory is that people were causing unrest in order to destabilize the powerbase of the local M.P. or other politicians.

Discussions were held to try to resolve the situation, and were sometimes chaired by the Regional Commissioner or the District Commissioner. As a result, the Oldonyosambu group agreed to let the Oldonyowas pipeline operate, if the Oldonyowas villagers undertook repairs to the Oldonyosambu pipe which leads to the plains, and constructed a storage tank for the use of the Maasai and their animals. It seems as if Oldonyowas may provide the other group with a storage tank and some pipes if the Oldonyosambu group contribute some money in return. However, in the end, MS invested in improving the pastoralist' s water systems. [20]

This example demonstrates a number of things. Most significantly, it shows that the Water Rights process is not seen as 'legitimate' by some people: the opponents to the scheme do not care that official permission has been granted to abstract water. Indeed, locals don't trust Ministry of Water

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[18] Young men of the 'warrior' age-set

[19] Tanzania Annual Report 1998, MS website, http://www.ms-dan.dk/uk/

statistics on the yields available from the disputed source.[21] If they had been better informed and involved in the process of Water Rights allocation, they might have respected the decision.

Secondly, this example demonstrated that the conflict resolution process has not been successfully institutionalised by the District Council, the Ministry of Water, or other Ministries. There may be need for an 'independent' authority with some measure of local legitimacy to mediate in the process. In this case, the churches helped to avoid bloodshed, showing the importance of local knowledge and relations in conflict resolution.

Thirdly, the end-uses of the development levy were not sufficiently detailed by the authorities. It was thus perceived to be a 'tax' over which contributors had no control, rather than an investment in local development activities. This indicates the importance of information dissemination and transparency, within a context of wider political competition which is ubiquitous.

3. Knowledge, Technology and Institutions

3.1 Legal and Normative Framework over water

One of the most fundamental disagreements over water, which is being fought not in the irrigation ditches or the river basins, but rather in the conference-halls of the world's capital cities, revolves around the concept of water as an economic good. A number of institutions argue that given the levels of inefficiency in water management -not just in terms of water leakage during conveyance, but in inefficient allocation of water between different users -the only solution is to give water its true economic value. They also argue that this will help to address the opportunity costs of water use, e.g. fees from water can be used to protect the environment or provide social goods and services. Indeed, the idea of water as an economic good is encapsulated in the Dublin Principles.

[20] batchelor

[21] E.L. Nassar, 1999

On the other hand, there are fears that putting a price on water may put it out of the reach of poor. Privatization of water delivery services has seen great price hikes in several countries around the world.

This discourse is playing out in various processes. For example, momentum has been building for a few years now regarding the possibility of an international convention on water. In 2003, the UN Committee on Economic, Social and Cultural Rights issued a 'General Comment' that the Convention on Economic, Social and Cultural Rights, includes the right to adequate amounts of clean water for personal and domestic use.[22] This binds governments to progressively provide water for their citizens.

The important issue is whether the right to water will mean the right to free water; or the right to 'affordable' water. It seems that, following debates within the UN and between large NGOs, consensus is forming that there should be a right to sufficient affordable water .[23] Of course, the question now is what is affordable. In East Africa, the urban poor (such as those living in informal settlements) generally pay 5 times more for water than . the rich, due to economies of scale and other reasons. Does this mean that they should continue to do so? The General Comment by the UN says that water should be recognized as asocial and cultural good, and not primarily as an economic good.

The Right to water is an important concept. The question is how useful a water Convention would be. Because of the immense global variation in distribution of water resources, access to water, and

modes of water allocation and distribution, it could turn out to be a blunt instrument. It would, of course, represent a compromise position between various perspectives, and hence would not be acceptable to all. Some major NGOs, such as the Council of Canadians/Blue Planet Project and Public Citizen (USA) have already come out against the initiative, arguing that "convention language would incorporate into the international legal framework the commodification of water and it would encode privatization"[24]

There is also speculation that if water comes to be defined as a commodity during other international processes, it would come under WTO rules which prevent governments from putting obstacles in place to trade in commodities.25 The approaches of the EU to the General Agreement on Trade in Services (GA TS) under WTO have also been criticized in this regard: " As part of the GA TS Request/ Offer process the EU has requested opening up of various sectors in 109 countries. The EU is seeking to liberalize water distribution services in 72 countries. It is scandalous that the EC is targeting the water distribution sector of some of the world's poorest nations, including 14 out of the 41 Least Developed Countries (LDC')."26 Though GA TS is meant to be optional, the realities of international trade, aid and politics means that countries may come under pressures to open up -which could conceivably lead to major international disputes.

[22] Details at http://www.righttowater.org.uk/
[23]See Freshwater Action (2004)
[24] See Source Weekly No.45-46, 22 November 2004
[25] Wolf et al (2003)
[26] See Wide (2003)

Kenya is one example of a country advancing down the path towards increased private involvement in the water sector, though its 'progress' down this route is not as far advanced. Hence, disputes over water privatization are still at an early stage and being played O1,lt largely in the media.[27]

Like most African countries, Kenya made provision of free water for all a post- independence policy priority. However, funding and political will has never been sufficient: the Ministry in charge of water has been constantly under-funded, never being allocated more than 2.5% of the GDP (of which about 90% was spent on salaries). There were many other problems. Lack of water use monitoring resulted in ad hoc decision- .making, over-allocation of water and conflicts between water users. The system was highly bureaucratic and centralised, with water permit applications taking up to six years to be processed. There were no performance measures for water utilities, and hence no sanctions for those under-performing. Different institutions had overlapping mandates, leading to 'turf wars' and duplication of activities.

In addition to these 'technical' issues, corruption and nepotism robbed the sector of large sums of money and compromised efficiency. As a result, only 65% of urban households, and 35% of rural

households, have access to safe water. This can be compared to South Africa, where in 1999 it was estimated that half of all water projects were not functioning.[28]

In response to these problems, the Water Act 2002 was designed to clarify and streamline the role of the Ministry of Water Resources Management and Development. The Ministry of Water Resources Development sees privatization as an important means to ensure regular water supplies for all. In fact, efforts at privatization are not entirely new. Several wealthy private estates around Nairobi and Mombasa have been supplied by private companies for many years. In less wealthy areas, unregistered private water kiosks or informal mobile suppliers have become important. In East Africa as a whole, these are the main source of water for about a quarter of unpiped households. In Kenya, about 95% of urban households rely on vendors at some time or another. Private supplies tend to cost more than public supplies -an average of 5 times more than public private supplies, per litre, across East Africa. This means that in general, the poor pay more for water than the rich.

There has been considerable controversy over the move towards privatization in Kenya, just as in other parts of the world.. Some critics of privatization have argued that due to capital costs, it is not viable to build multiple water supply networks in a single area, and hence the sector exhibits 'natural monopoly'. Privatisation therefore does not prevent monopoly, but merely shifts it from a public body to a private one. In order to safeguard consumer rights, control systems must be put in place to protect consumer's rights. The role of transnational corporations in water service provision has also been questioned -

[27] This example is chosen, rather than that of South Africa, because the author knows Kenya much better than other countries, However, some comparisons are drawn with other African countries.
28 Mcdonald, D. and Pape, J. (2002)

should their risks be underwritten by donors, for example? Why not exclude transnationals and build indigenous capacity'?

Most important perhaps are questions over the financial incentives for private organisations to provide affordable water to the poorest sector of society. This is especially important in regard to informal settlements, as experts estimate that by 2020 almost half of urban Africans -about 300 million people -will be living in slums. While many advocate cost recovery as the key to sustainability, others point to the penalties this imposes on the poor, while the rich may benefit from cheaper water due to better-established infrastructure in wealthy estates. Some conclude that the incomes of consumers in poor regions do not allow tariffs high enough to allow cost-recovery.

Opinion polls seem to indicate that the majority of urban-dwellers are suspicious of privatization, believing it will make water more expensive. Ministry officials confirm that due to hydrogeological and other factors, water tariffs will not be uniform throughout the country .In effect, changes in tariffs will end the subsidy of remote areas by better-served areas. Experiences from other countries suggest

that price increases could be extreme -in Nelspruit South Africa for example, after British firm Biwater was given a 30-year concession, prices increased 100% within two years, for many households.29

Even within government, there is controversy over the new policy directions. Rifts have appeared over which Ministry has responsibility for urban water supply, an important source of revenue for local councils until recently. The Minister has made statements that 'privatization', but not 'commercialization' is being considered, perhaps indicating the importance of price controls. Others have defined the terms 'privatization' itself as public-private partnerships, and leasing of government property, rather than privatization through sale of assets.

Potential obstacles to affordable water delivery to the poor also include land tenure insecurity (e.g. in informal 'shanty' settlements), corruption within local government (who might lose out from improved accountability), and difficulties of including all stakeholders, some of whom may cross traditional stakeholder categories (e.g. private users who also informally donate or sell water to neighbours).

3.2 Technological Adaptation

One of the arguments common to many studies on water and conflict is that the levels of water scarcity and associated risks of conflict can be mitigated if relevant institutions have sufficient capacity for 'adaptation' or 'innovation ,.30 This concept is often captured by the idea of 'social resources' available at the state level -a mixture of attributes based on the cohesion of social institutions, flow of knowledge, level of technological expertise, etc. Often, these attributes are seen as equivalent to the indicators used in UNDP's Human Development Index, for example. Knowledge and technology are important

[29] Mcdonald, D. and Pape, J. (2002)
[30] Homer-Dixon is a proponent of this view; see also Ohlsson (1999)
elements of social resources and innovation capacity, and must be defined to indicate the social context in which they are generated.

Knowledge should be defined not just as information but the ability to use that information effectively. Technology incorporates 'software' elements, related to management, as well as 'hardware' aspects. Indigenous technology, for example, may be primarily based on specific local ecological knowledge, rather than use of particular physical instruments. It should be noted that the common understandings of knowledge and technology for water resources management do not fully acknowledge the relevance of local capacities. According to one iconoclast, "academics, researchers and policy-makers are obsessed with management. ..[which] carries within it.. the idea that all environmental problems can be dealt with through rational debate and scientific and/or technical solutions. ..The predominance of science in understanding the environment. .. displays the power-relations which dominate it".[31]

While acknowledging the importance of a comprehensive and holistic definition of 'knowledge' and 'technology', it is useful in this paper to isolate different components, for the sake of clarity, while all the while considering the wider political and institutional contexts.

Exchange of information -and the transformation of information into knowledge, through joint projects and training exercises -is a useful first step in many international basin management efforts. The genesis of the Nile Basin Initiative, for example, as essentially a technical programme with access to information across the basin as a key element.

In terms of 'hardware', technology offers great opportunities in water management. It must be remembered, on the other hand, that it also offers challenges. One of the most revolutionary factors in modern water resource management (apart from the flush toilet, which is a disaster for water quality and use efficiency) is the small diesel pump. The use of small pumps by fanners has made water use much more difficult for authorities to monitor (compared to furrow irrigation, for example). The new technology has also had adverse effects on institutional capacities in some areas. In Egypt, the traditional water wheel (sakieh) has been almost completely replaced by the diesel pump. Pumps have two-three times the output of a sakieh, and are almost generally owned by individuals (who purchased them with money from labour in the Gulf States). With the end of the sakieh, has come the end of many water user associations', which existed because the operation of a sakieh was largely a communal affair.[32] This means that local agreements and compromises, and also local capacities to advocate for water rights, may be compromised. The key to managing water, and controlling the effects of diesel pumps, lies primarily not in better state enforcement (as who will be able to enforce water laws in the most remote parts of the country?) but rather, self -policing on the part of local people. Institutions are therefore key.

[31] Thompson (2000)

[32] Ayeb, H. (2004)

Industry is a major consumer of water in developed and industrializing countries (representing between a fifth and a quarter of total use). However, not all water used by industry is lost. Indeed, less than 10% of such water should actually be consumed -the rest is available for re-use.33 The catch is that re-use will depend on the existence and enforcement of anti-pollution measures, and incentives to encourage use of low-quality waters for appropriate purposes. This indicates the importance of 'software' aspects of technology -the ability to manage all the necessary elements, and incorporate institutional mechanisms to 3;chieve the goal.

Turning to information communication technologies (ICTs), they are vital tools for knowledge management. As in many fields, the sheer availability of information (data) means that the prime constraint to development may no longer be data availability, but rather the access to the appropriate

information by the right person at the right time. Knowledge management becomes a big issue, and use of the internet and digital technology becomes paramount. This is particularly the case in water resources management which, as mentioned above, is inherently multi-sectoral and thus requires - that concept and data flow between institutions. In Africa, internet accessibility is low. According to the World Bank, in Kenya, in 200 I, the number of internet users was 1.6% of total population. In Zambia, it was less than one percent.34 In many ways, internet access is a political question, related to regulation of the sector, and the willingness to provide community services for development purposes, rather than just individual services on a profit-making basis.

A Burkina Faso-based organisation currently focusing on knowledge management for water, Centre Regional pour I 'Eau Potable et I' Assainissement (CREP A) , recognises that given these constraints. "Despite their relevance, these tools have to be adapted for in an environment where computers and the Internet are not always accessible or appropriately used. In this context, knowledge management for the water and sanitation sector in West Africa cannot solely rely on ICT .,,[35]

Table 1. Active adult Internet users aged 14 and over, worldwide (in millions)

	2000	2001	2002	2003	2004
North America	97.6	114.4	130.8	147.7	160.6
Europe	70.1	107.8	152.7	206.5	254.9
Asia and the Pacific Rim	48.7	3.8	85.4	118.8	173.0
Latin America	9.9	15.3	22.1	31.0	40.8
Africa and the Middle East	3.5	5.3	7.2	9.0	10.9
Worldwide total	229.8	306.6	398.2	513.0	640.2

Source: Dennis, S. Computeruser.com.2000 retrieved March, 2004.

[33] Ohlsson, 1999
[34] Beniest et al (forthcoming)
[35] Source Weekly 2004 b. Special Features Edition, November 2004 See CREPA website, http://www.reseaucrepa.org/index.htm

During the debates over 'environmental security', question of the role of the military has been a recurrent theme. Military academies -especially in the US, but elsewhere as well, including South Africa -sponsored conferences and research into issues related to environmental change and security. Some welcomed this, seeing environmental issues (including water resources management) lifted to the realm of 'high politics' for the first time. Others were more skeptical. Following the end of the Cold War, they argued, security forces (at least in the developed world) had lost much of the justification for their huge budgets. In response, they had 'jumped on the bandwagon' and were now attempting

to enter into the environmental arena in a bid to maintain their relevance. The problem was that the military might not have lost its state-centric 'threat' orientated perspective, and hence might undermine the development of the human security paradigm.

Since 9/11, the debates have changed somewhat, as security forces have regained influence in high politics. However, the engagement of the military with the idea of water-related conflicts remains a relevant issue. Key concerns, of course, relate to the perceptions of different parties to the dispute - geopolitics did not disappear with the fall of the Berlin wall.

A number of key technologies have been developed through military programmes which may now offer some opportunities for the management of conflicts over water -if used appropriately. For example, remote sensing, including GIS and satellite imaging, can improve understandings of hydrology, human-hydrologic interactions, and environmental changes. They can generate information that can be used for common monitoring and to increase common acceptance of hydrological models. In using these technologies responsibly, scientists and governments should consider access to technology, information and also capacity-building as political as well as ethical issues. For example, African states should avoid being drawn into political disputes because of- or in return for-being given access to such technology.

Finally, from a conflict management viewpoint, power-relations are all-important in negotiations over potential or actual conflicts. Access to information and technology is a major factor in power-relations. In order to avoid conflicts at all levels, key institutions should work towards creating a 'level playing field'

7. Conclusion

This paper -which is still in draft form -has sketched out abroad range of relevant issues. A full conclusion will be added later, based on conference discussions. A few common threads can however be emphasized at present:

There is some convergence emerging in studies on water and conflict:

- While shared water resources are associated with a higher risk of some kind of international conflict, much of the popular discourse is influenced by 'sabre- rattling' and unsanctioned threats.
- It is likely that Africa is at higher risk of international conflict over water than other areas
- Shared water resources may also offer important opportunities for international cooperation
- At the local level, violent conflicts over water and water-related (i.e. second order) conflicts are fairly common.

In terms of local level violent conflicts, stakeholder identification, coordination, access to , information, and lack of acknowledgement of power relations and politics are all key issues. Local level conflicts are not entirely 'local' -they cannot be divorced from the national-level water allocation decisions and water pricing mechanisms, for example, which create parameters within which water resources are locally managed.

It is important to consider a conflict from a broad viewpoint, in order to consider not just physical violence, but the violence done against communities and individuals through inequitable access to water. It is therefore important to look at issues such as debates over water as an economic good, and particularly the role of the private sector. These will increasingly shape the contours of local resistance against water allocation, management and development.

Ideas of water scarcity, which tend to dominate IWRM should be interrogated in order to identify the political issues (inter- and intra-state) which may not be overtly addressed. Water access at the local level may not match 'natural' water availability. In addition to 'hard' technology, economic, political and social factors all limit water access and should be addressed by policy-makers.

[16] Dr. Kinfe Abraham, op. cit.
[17] Yacob Arsano, op. cit

Technologies of various kinds, and knowledge in its broadest sense, are important tools for effective water management and management of potential or actual conflicts. Water is inherently a multi-sectoral issue, making knowledge management key to success of projects. Access to technology and information are essentially political issues and should be treated as such, in order to redress imbalances. Hard technologies impact on software aspects -as in the example of diesel pumps undermining the social basis for water user associations cited above- as well as vice-versa.

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