WATER AND HUMAN SECURITY

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Till taught by pain, men know not water's worth. Byron

INTRODUCTION[1]

As human populations and economies grow exponentially, the amount of freshwater in the world remains roughly the same as it has been throughout history. While the total quantity of water in the world is immense, the vast majority is either saltwater (97.5 percent) or locked up in ice caps (1.75 percent). The amount economically available for human use is only 0.007 percent of the total, or about 13,500 $km^{3.}$ This comes out to only about 2300 m^3 per person – a 37 percent drop since 1970 (United Nations 1997). Adding complexity to this increasing scarcity is the fact that almost half the globe's land surface lies within international watersheds (i.e., that land which contributes to the world's 261 transboundary waterways).

The scarcity of water in an arid and semi-arid environment leads to intense political pressures, often referred to as "water stress." Furthermore, water not only ignores political boundaries; it evades institutional classification and eludes legal generalizations. The 1997 Convention on the Non-Navigational Uses of International Watercourses Commission is vague and occasionally contradictory, and international agencies have historically been limited in coordination or strategy.

While water quantity has been the major issue of this century, water quality has been neglected to the point of catastrophe. The numbers are staggering:

- More than a billion people lack access to safe water supplies;
- Almost three billion do not have access to adequate sanitation;
- Five million people die each year from water-related diseases or inadequate sanitation;
- Twenty percent of the world's irrigated lands are salt-laden to the point of affecting production.

Water demands are increasing, groundwater levels are dropping, surface-water supplies are increasingly contaminated, and delivery and treatment infrastructures are aging. The World Bank estimates that it would take $600 billion to repair and improve the world's existing water delivery systems (CAFRW 1997).

When all of these characteristics are put together – water as a critical, non-substitutable resource, which flows and fluctuates across time and space, for which legal principles are vague and contradictory, and which is becoming relatively more scarce and degraded as world populations and standards of living grow – compelling arguments for considering the security implications of water resources management are found.

This paper investigates both the global water crisis – too little clean freshwater for too many people, and global water conflict – the political tensions that result.

WATER AND INTERNATIONAL CONFLICT

An increasingly prevalent viewpoint about water and security is best summed up by Ismail Serageldin, vice-president of the World Bank: "The wars of the next century will be about water" (quoted in the New York Times 10 August 1995). The view that water will lead to acute international conflict, one that is often tied to causal arguments of environmental security, unfortunately is gaining ground in both academic and popular literature. Some authors assume a natural link between water scarcity and acute conflict, suggesting that "competition for limited . . . freshwater . . . leads to severe political tensions and even to war" (Westing 1986). Others, often citing examples from the arid and hostile Middle East, assume that "history is replete with examples of violent conflict over water" (Butts 1997). Still others, combining this "natural" connection between water and conflict with assumed historic evidence, forecast: "The renewable resource most likely to stimulate interstate resource war is river water" (Homer-Dixon 1994).

There are two major problems with the literature that describes water both as a historic and, by extrapolation, as a future cause of acute international conflict:

1. There is little historic evidence that water has *ever* been the cause of international warfare; and

2. War over water seems neither strategically rational, hydrographically effective, nor economically viable.

WHAT IS THE EVIDENCE OF A LINK BETWEEN WATER AND INTERNATIONAL CONFLICT?

One component of the Transboundary Freshwater Dispute Database Project[2] at Oregon State University has been an assessment of historic cases of international water conflicts. In order to counter the prevailing anecdotal approach, researchers associated with the project utilized the most systematic collection of international conflict – Brecher and Wilkenfeld's (1997) International Crisis Behavior data set – and supplemented their investigation with available primary and secondary sources. This search revealed a total of seven cases in which armies were mobilized or shots were fired across international boundaries – in every case, the dispute did *not* degrade into warfare.[3] According to our findings, with one exception (now almost 4,500 years old),[4] *there has not been a war fought over water*.

It is, however, disingenuous to base a discussion about the future solely on history. Part of the basis for predictions of future "water wars," after all, is that we are reaching unprecedented demand on relatively decreasing clean water supplies. But there are other arguments against the possibility of "water wars."[5] They might include:

A Strategic Argument

If one were to launch a war over water, what would be the goal? Presumably, the aggressor would have to be both downstream and the regional hegemony – an upstream riparian nation would have no cause to launch an attack and a weaker nation would be foolhardy to do so. An upstream riparian nation, then, would have to initiate an action, which decreases either quantity or quality, knowing that doing so will antagonize a stronger down-stream neighbor.

The down-stream power would then have to decide whether to launch an attack – if the project were a dam, destroying it would result in a wall of water rushing back on down-stream territory. Were it a quality-related project, either industrial or waste treatment, destroying it would probably result in even worse quality than before. Furthermore, the hegemony would have to weigh not only an invasion, but an occupation and depopulation of the entire watershed in order to forestall any retribution – otherwise, it would be simple to pollute the water source of the invading power. It is unlikely that both countries would be democracies, since the political scientists tell us that democracies do not go to war against each other, and the international community would have to refuse to become involved (this, of course, is the least far-fetched aspect of the scenario). All of this effort would be expended for a resource that costs about one U.S. dollar per cubic meter to create from seawater.

A Shared Interest Argument

What is it about water that tends to induce cooperation even among riparian nations that are hostile over other issues? The treaties negotiated over international waterways offer some insight into this question. Each treaty shows sometimes exquisite sensitivity to the unique setting and needs of each basin, and many detail the shared interests a common waterway will bring. Along larger waterways, for instance, the better dam sites are usually upstream at the headwaters where valley walls are steeper and where, incidentally, the environmental impact of dams is not as great. The prime agricultural land is generally downstream, where the gradient drops off and alluvial deposits enrich the soil. A dam in the headwaters, then, not only provides hydropower and other benefits for the upstream riparian nation, it also can be managed to evenly control the flow for the benefit of downstream agriculture, or to enhance water transportation for the benefit of both riparian nations. Other examples of shared interests abound: the development of a river that acts as a boundary cannot take place without cooperation; farmers, environmentalists, and recreational users all share an interest in seeing a healthy stream-system; and all riparian nations share an interest in high quality water.

An Institutional Resiliency Argument

Another factor adding to the political stability of international watersheds is that once cooperative water regimes are established, they turn out to be tremendously resilient over time, even between otherwise hostile riparian nations, and even as conflict is waged over other issues. For example, the Mekong Committee has functioned since 1957, exchanging data throughout the Vietnam War. Secret "picnic table" talks have been held between Israel and Jordan, since the unsuccessful Johnston negotiations of 1953-55, even as these riparian nations were in a legal state of war until recently. And, the Indus River Commission not only survived through two wars between India and Pakistan, but treaty-related payments continued unabated throughout the hostilities.

Any of these arguments, in and of itself, might not convince one of the unlikelihood of "water wars." The combination of *all* of these factors, though – a historic lack of evidence combined with strategic, interest-based, and institutional irrationality of acute international hydro-conflicts – should help convince us to think of water as a vehicle for reducing tensions and encouraging cooperation even between otherwise hostile co-riparian nations. Undala Alam (1998) has aptly dubbed this concept of water as a resource that transcends traditional thinking about resource-related disputes, "water rationality."

IF NOT "WATER WARS," THEN WHAT ARE THE SECURITY ISSUES?

The concept of "environmental security" is not restricted to a presumed causal relationship between environmental

issues and international warfare. Much of the thinking on the issue has evolved to incorporate a broader sense of "human security" – a much more inclusive concept which stresses the intricate set of relationships between environment and society.[6]

Until now it is only the relationship between international armed conflict and water resources *as a scarce resource* that has been described. Internal disputes, such as those between interests of states/provinces, were excluded, as were those where water was a means, method, or victim of warfare. Also excluded were disputes where water is incidental to the main issue, such as those about fishing rights, access to ports, transportation, or river boundaries.

It is important to understand, therefore, that there *is* history of water-related violence. It is a history of incidents that are at the sub-national level, generally between tribes, water-use sectors, or states/provinces. Examples of internal water conflicts, in fact, are quite prevalent. They range 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 in the United States even commissioned a navy (made up of one ferryboat) and sent its state militia to stop a dam and diversion on the Colorado River in 1934.

While these "flashpoints" can and do occur at the sub-national level, the more common security issue is both more subtle and more pervasive. As water quality and/or quantity degrades over time within a local setting, the effect on the stability of a region can be unsettling. Since the degradation generally occurs slowly over time, it is difficult to say precisely where its impact begins and ends; yet the effects can be profound. Take, for example, the case of the Gaza Strip where, over the thirty years the region was under Israeli occupation, water quality steadily deteriorated, saltwater intrusion degraded local wells, and water-related diseases took a rising toll on the population. In 1987, the *intifada*, or Palestinian uprising, broke out in the Gaza Strip, and quickly spread throughout the West Bank. Was water quality the cause? It would be disingenuous to identify such direct causality. Was it an irritant which exacerbated an already tenuous situation? Undoubtedly.

Moreover, one need look no further than relations between India and Bangladesh to note that these internal instabilities can be both caused and exacerbated by international water disputes. At issue is a barrage that India built at Farakka, which diverts a portion of the Ganges flow away from its course into Bangladesh, and 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, impeded navigation, increased salinity, degraded fisheries, and danger to water supplies and public health. Migration out of affected areas has further compounded the problem. Ironically, many of those displaced in Bangladesh have found refuge in India.

So, while no "water wars" have occurred, there is ample evidence that the lack of clean freshwater has led 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.

Finally, there is the security issue of "simple" human suffering. Again, five million people die each year from water-related diseases or inadequate sanitation. More than half the people in the world lack adequate sanitation. Eighty percent of disease in the developing world is related to water. With a crisis this clearly defined over a resource this vital, the threats to security seem almost self-evident.

HOW ARE WE EQUIPPED INSTITUTIONALLY TO HANDLE WATER SECURITY?

Resolving the global water crisis, and ameliorating the attendant political stresses, increasingly will involve sophisticated mechanisms for cooperation. Current legal and institutional capacities are limited, but strides are being made slowly. Addressing both the water crisis and water conflict, global institutions both foster good relations among sovereign neighbors and improve capabilities for water resources management.

Legal Principles

Generalized legal principles for the management of transboundary waters are currently defined by the Convention on the Non-Navigational Uses of International Watercourses, ratified by the U.N. General Assembly in 1997. The Convention, which took 27 years to develop, reflects the difficulty of marrying legal and hydrologic intricacies: while the Convention provides many important principles, including responsibility for cooperation and joint management, it is also vague and occasionally contradictory. The Convention also provides few practical guidelines for water allocations – the heart of most water conflict. Neither these principles, nor those of the Convention's precursors – the 1966 Helsinki Rules or subsequent draft articles by international legal bodies – have been explicitly invoked in more than a handful of water negotiations or treaties.

Furthermore, international law only concerns itself with the rights and responsibilities between *nations*. Some political entities that might claim water rights, therefore, would not be represented, such as the Palestinians along the Jordan River or Kurds along the Euphrates River. In addition, cases are heard by the International Court of Justice (ICJ) only with the consent of the parties involved; and no practical enforcement mechanism exists to back up the Court's findings, except in the most extreme cases. A nation with pressing national interests can, therefore, disclaim entirely the court's jurisdiction or findings. Since its creation in 1945, the ICJ has decided only a single case regarding international waters.

International Institutions

Just as the flow of water totally ignores political boundaries, so too does its management strain the capabilities of institutions. No global institution currently exists for the management of transboundary water resources. Several UN agencies, including UNEP, UNDP, UNESCO, WHO, FAO, and UNIDO, incorporate water related issues in their charter, as does the World Bank. All of these agencies recently collaborated in production of the Comprehensive Assessment of the Freshwater Resources of the World (CAFRW). Many global water-related agencies have also recently cooperated in formation of the Global Water Partnership that aims to coordinate water policy worldwide. The World Water Council was also established recently as a self-described "think tank" for world water resources issues. However, none of these agencies incorporate mechanisms for the resolution of transboundary water resources disputes within their mandates.

Many of the most productive efforts at the international level are brought about by strong personalities within agencies and/or through ad hoc collaborations between agencies. The 1960 Indus Water Treaty owes much to David Black, then-president of the World Bank; the Mekong Committee was formed due primarily to an alliance between UNECAFE and the US Bureau of Reclamation; and the 1994 Danube River Protection Convention involved leadership from UNDP, the World Bank, and the Commission of European Communities. Occasionally, initiative is offered through economic and political alliances, as has been the case with the European Union's water quality guidelines, and the Southern African Development Community's protocol on Shared Watercourse Systems.

International Water Treaties

In the absence of detailed water law, adequate institutions, or warfare, the countries that incorporate the world's 261 international waterways have managed to muddle through. 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. Since 1814, states have negotiated a smaller body of treaties that deal with non-navigational issues of water management, flood control, hydropower projects, or allocations for consumptive or non-consumptive uses in international basins. The Transboundary Freshwater Dispute Database project includes an online collection of 145 of these treaties, which include only those dating from 1870 and later which deal with water per se, and exclude those that deal only with boundaries, navigation, or fishing rights.

Table 1. Treaty Statistics Summary Sheet

Signatories
Bilateral 124 out of a total 145 treaties, or 86%
Multilateral 21/145 (14%)

Principal Focus
Water Supply 53/145 (37%)
Hydropower 57/145 (39%)
Flood Control 13/145 (9%)
Industrial Uses 9/145 (6%)
Navigation 6/145 (4%)
Pollution 6/145 (4%)
Fishing 1/145 (<1%)

Monitoring
Provided 78/145 (54%)
No/Not Available 67/145 (46%)

Conflict Resolution
Council 43/145 (30%)
Other Governmental Unit 9/145 (6%)
United Nations/Third Party 14/145 (10%)
None/Not Available 79/145 (54%)

Enforcement
Council 26/145 (18%)
Force 2/145 (1%)
Economic 1/145 (<1%)
None/Not Available 116/145 (80%)

Unequal Power Relationship
Yes 52/145 (36%)
No/Unclear 93/145 (64%)

Information Sharing
Yes 93/145 (64%)
No/Not Available 52/145 (36%)

Water Allocation
Equal Portions 15/145 (10%)
Complex but Clear 39/145 (27%)
Unclear 14/145 (10%)
None/Not Available 77/145 (53%)

Non-Water Linkages
Money 44/145 (30%)
Land 6/145 (4%)
Political Concessions 2/145 (1%)
Other Linkages 10/145 (7%)
No Linkages 83/145 (57%)

Source: Hamner and Wolf (1998).

Despite their number and rich history, these 145 treaties reveal that the legal management of transboundary rivers is still in its conceptual infancy. 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 nations but one – that one nation must then accept the balance of the river flow, regardless of fluctuations. Finally, multilateral basins are, almost without exception, governed by bilateral treaties, precluding the integrated basin management long-advocated by water managers.

WHAT TECHNICAL/POLICY OPTIONS ARE AVAILABLE?

The solutions to this crisis are complex and expensive. They range from agricultural to technological to economic and public policies, but they all fall under the same three basic categories as for any resource shortage: increase supply, decrease demand, or improve the quality.

Table 1: Water management options to increase supply, decrease demand, or improve quality

UNILATERAL OPTIONS
DEMAND
• Urban/industrial demand management. • Rationing. • Public awareness. • Allow price of water to reflect true costs. • Efficient agriculture, including drip irrigation, greenhouse technology, and genetic engineering for drought and salinity resistance.
SUPPLY
• Wastewater reclamation. • Increase catchment and storage (including artificial groundwater recharge). • Cloud seeding. • Desalination. • Fossil aquifer development.
QUALITY
• Treat drinking water supplies at its most appropriate level. • Work towards universal sanitation. • Eradicate water-related disease through water treatment and/or vaccination programs.
COOPERATIVE OPTIONS
• Shared information and technology. • International water markets to increase distributive efficiency (where appropriate). • Inter-basin water transfers. • Joint regional planning and coordination.

Some of the current issues include:

Increasing Supply

New Natural Sources. No new rivers are likely to be discovered in the world, but more efficient management of existing sources and greater catchment of floodwaters, perhaps stored underground through artificial groundwater recharge, can add to supplies just as effectively.

New Sources Through Technology. Projects like iceberg towing and cloud-seeding, though appealing to the imagination, do not seem to be the most likely direction for future technology. The two more likely (although more mundane) means to increase water supply for the future are desalination and wastewater reclamation. High costs have precluded both – particularly desalination for most uses, although efforts are being made to lower these costs through

multiple use plants (getting desalted water as a byproduct in a plant designed primarily for energy generation), increased energy efficiency in plant design, and by augmenting conventional plant power with solar or other energy sources.

Decreasing Demand

Agricultural Sector. Agriculture is far and away the leading consumer of water resources, taking about 70 percent of withdrawals worldwide. Technological advances like drip-irrigation and micro-sprinklers are 20-50 percent more efficient than standard sprinklers and tremendously more so than the open-ditch flood method. Computerized control systems, working in conjunction with direct soil moisture measurements can add even more precision to crop irrigation. Other water savings have come through bioengineered crops that exist on a minimal amount of freshwater, on brackish water, or even on the direct application of saltwater.

Economic Water Efficiency. Water costs worldwide are highly subsidized, especially water earmarked for agriculture. Economic theory argues that only when the price paid for a commodity is a reasonable reflection of the true price can market forces work for efficient distribution of the commodity. Take away subsidies and allow the price to rise, it is argued, and market incentives are created for both greater efficiency on the farm and a natural shift of water resources from the agricultural sector to industry, where contribution to GNP per unit of water is often much higher. These arguments, though, tread through quite sensitive territory, have serious implications for equity, and often overlook other effects of urbanization.

Improving Quality

The strategies for improving quality have long been known: clean water both before and after it is used, and eradicate water-related diseases. The problem has too often been a "simple" lack of funds and/or coordination for this enormous task. The near eradication of dracunculiasis (guinea worm) in this decade provides a good example of a successful focused effort, coordinated between UN agencies and national and local governments, where attention was paid to all aspects of the disease and its transmission, from surveys and education to treatment and containment.[7]

WHAT ARE THE MAJOR LESSONS LEARNED WHICH HAVE POLICY IMPLICATIONS?

The most critical security lessons learned from the global experience in water security are as follows:

1. Water that crosses international boundaries can exacerbate relations between nations that share the basin. While the tension is not likely to lead to warfare, early coordination between riparian states can help ameliorate the issue entirely.

2. Once international institutions are in place, they are tremendously resilient over time, even between otherwise hostile riparians, and even as conflict is waged over other issues.

3. More likely than international "flashpoints" is a gradual decreasing of water quantity and/or quality, which over time can affect the internal stability of a nation or region, and act as an irritant between ethnic groups, water sectors, or states/provinces. The resulting instability can spill into the international arena.

4. The greatest human security threat of the global water crisis comes about not from the threat of warfare, or even from political instability, but rather from the simple fact that millions of people lack access to sufficient quantities of this critical resource at sufficient quality for their well being.

WHAT TYPES OF POLICY RECOMMENDATIONS CAN ONE MAKE?

Given these lessons, what can the international community do?

International Institutions:

Water dispute amelioration is as important, more effective, and less costly than conflict resolution. Watershed commissions should be developed for those basins that do not have them, and strengthened for those that do.

Three traits of international waters – the fact that conflict is invariably sub-acute, that dangerous flashpoints can be averted when institutions are established early, and that such institutions are tremendously resilient over time – inform this recommendation. Early intervention is also beneficial to the process of conflict resolution, helping to shift the mode of dispute from costly, impasse oriented dynamics to less costly, problem solving dynamics. In the heat of some flashpoints, such as the Nile, the Indus, and the Jordan, as armed conflict seemed imminent, tremendous energy was spent just getting the parties to talk to each other. In contrast, discussions in the Mekong Committee, the multilateral working group in the Middle East and on the Danube, have all moved beyond the causes of immediate disputes on to actual, practical projects that may be implemented in an integrative framework.

Funding and Aid Agencies:

Water-related aid needs to be coordinated and focused, relating quality, quantity, groundwater, surfacewater, and local socio-political settings in an integrated fashion. Funding should be commensurate with the responsibility these agencies have for alleviating the global water crisis.

Ameliorating the crux of water security – the crisis of human suffering – often rests with these agencies which, given the size of the crisis, are extraordinarily underfunded. One can contrast the resources spent on issues such as global change and arms control in efforts to protect against potential loss of life in the future, while millions die in the present due to a lack of access to clean

fresh water. Agencies such as USAID, CIDA, and JICA have the technical expertise and experience to help, yet are hindered by political and budget constraints. Funding agencies often are hamstrung by local politics. A powerful argument might be made for the fact that water-related disease costs the global economy US$125 billion per year, while ameliorating them would "only" cost US$7-50 billion (Gleick, 1998). Projects such as USAID's Project Forward, which integrates water management with conflict resolution training, offer models for the future.

Universities and Research Agencies:

Universities and research agencies can best contribute to the alleviation of the water crisis in three major ways: 1) acquire, analyze, and coordinate the primary data necessary for good empirical work; 2) identify indicators of future water disputes and/or insecurity in regions most at risk; and 3) train tomorrow's water managers in an integrated fashion.

The internet's initial mandate is still one of the best: to allow communication between researchers around the world to exchange information and enhance collaboration. The surfeit of primary data currently threatens an information overload in the developed world, while the most basic information can be lacking in the developing world. University programs such as the Institute of Earth, Oceans, and Space at the University of New Hampshire are working to ferret out useful global hydrological data, while encouraging greater collection and dissemination capabilities where they are lacking. Data availability not only allows for greater understanding of the physical world but, by adding parameters from the socio-political realm, indicators showing regions at risk in the future can be identified. Such projects are taking place for human security at the University of Victoria, and for indicators of water dispute at Oregon State University. Finally, universities are slowly recognizing that water is, by its nature, an exceptionally interdisciplinary resource and that the attendant disputes can only be resolved through active dialog among fields as diverse as science, law, economics, religion, and ethics. It is difficult enough to find university programs at the graduate level which adequately train students in water from a truly interdisciplinary perspective, allowing for exposure to both the science and policy of water resources (there are maybe four such programs in the entire United States) but there is *no* program which explicitly adds the international component.

Private Industry:

Private industry has historically taken the lead in large development projects. As the emphasis in world water shifts to a smaller scale, and from a focus on supply to one on demand management and improved quality, private industry has much to offer.

Private industry has three traits that can be harnessed to help ameliorate the world water crisis: their reach transcends national boundaries, their resources are generally greater than those of public institutions, and their strategic planning is generally unmatched. Historically, private companies such as Bechtel and Lyonnaise des Eaux have been involved primarily in large development projects, while the smaller scale projects have been left to aid agencies to develop. Recently, a shift in thinking has taken place in some corporate board rooms. Bank of America, for example, was not involved in the California-wide process of water planning until recently, when its president noticed that practically *all* of the bank's investments relied on a safe, stable supply of water. This was true whether the investments were in micro-chip manufacturing, mortgages, or the more traditional agriculture. When the bank became involved in the "Cal-Fed Plan," bringing with it its lawyers, planning expertise, and facilitators, not to mention its financial resources, progress was made in several areas which had till then been mired down in impasse.

Civil Society:

Inherent in our recognition that the most serious problems of water security are those at the local level, is the attendant recognition that civil society is among the best suited to address local issues.

One recurrent pattern in water resources development and management has been a series of projects or approaches which are in opposition to local values or customs. These projects can be as large as dams which displace hundreds of thousands of people and wipe out sites of cultural and religious heritage; as heedless as promoting water markets among religious groups for whom the idea is sacrilege; or as seemingly minor as cutting down a tree which is sacred to a village djinn. In recent years, as a consequence, the idea of including those affected by a project into the decisionmaking process has taken hold. Moreover, some aspects of civil society have both local roots and a global reach. Rotary International, for example, was awarded the 1997 Crystal Drop Award, the most prestigious institutional award of the International Water Resources Association, for its coordinated efforts in water supply and sanitation projects throughout the world.

CONCLUSIONS

The global water crisis has led to a large and growing literature warning of future "water wars," and pointing 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 – we have not, and probably will not, go to war over water. In modern times, only seven minor skirmishes have been waged over international waters. Conversely, over 3,600 treaties have been signed 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 tribes, water-use sectors, or states/provinces. What we seem to be finding,

in fact, is that geographic scale and intensity of conflict are *inversely* related.

While 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, one should not lose sight of the truly dire straits that have been brought about by the global water crisis. The critical problems that need addressing are neither of wars nor of politics, but rather of "simply" getting an adequate supply of clean freshwater to the people of the world.

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USEFUL WEB ADDRESSES

The International Water Resources Association (IWRA)

IWRA has strived to improve water management worldwide through dialogue, education, and research for over 25 years. Since its official formation in 1972, the organization has actively promoted the sustainable management of water resources around the globe. The world is a much smaller place today than when IWRA began its work due to advancing technologies and global social changes. The belief that sustainability requires interdisciplinary action and international cooperation is a driving force behind the association. IWRA seeks to improve water resource outcomes by improving our collective understanding of the physical, biological, chemical, institutional, and socioeconomic aspects of water. *<http://www.iwra.siu.edu/>*

The Pacific Institute

The Pacific Institute for Studies in Development, Environment, and Security is an independent, non-profit center created in 1987 to conduct research and policy analysis in the areas of environment, sustainable

development, and international security. Underlying all of the Institute's work is the recognition that the pressing problems of environmental degradation, regional and global poverty, and political tension and conflict are fundamentally interrelated, and that long-term solutions require an interdisciplinary perspective.
<http://www.pacinst.org/>

The Transboundary Freshwater Dispute Database

The Transboundary Freshwater Dispute Database, an ongoing research effort at Oregon State University, currently includes a computer compilation of 150 water-related treaties and 39 US inter-state compacts, catalogued by basin, countries or states involved, date signed, treaty topic, allocations measure, conflict resolution mechanisms, and non-water linkages. The Database also includes a digitized inventory of international watersheds, negotiating notes and background material on 14 case-studies of conflict resolution, news files on cases of acute water-related conflict, and assessments of indigenous/traditional methods of water conflict resolution.
<http://terra.geo.orst.edu/users/tfdd>

The Water Web

The WaterWeb consortium has been created to promote the sharing of information concerning water and the earth's environment. The organization seeks to create a global community, bringing together educational, governmental, nonprofit, and commercial entities interested in water research, conservation, and management. WaterWeb's goals are to advance water related issues, promote the use of quality information, and share information with water use stakeholders and decisionmakers. *<http://www.waterweb.org/>*

ENDNOTES

[1] A shorter version of this paper appeared as, Wolf, A. "Water and Human Security." AVISO: An Information Bulletin on Global Environmental Change and Human Security. Bulletin #3, June 1999.

[2] For more information on the Database Project, see A. Wolf. "The Transboundary Freshwater Dispute Database Project." *Water International.* December 1999 (forthcoming).

[3] For a list of conflicts see A. Wolf, 1999. "Water Wars" and Water Reality: Conflict and Cooperation along International Waterways. In S.L. Lonergan (Ed.), *Environmental Change, Adaptation and Human Security*, (forthcoming). Dordrecht: Kluwer Academic Publishers.

[4] The exception is the earliest documented interstate conflict known, 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.

[5] These arguments are described in more detail in A. Wolf, 1999. "Water Wars" and Water Reality: Conflict and Cooperation along International Waterways.

[6] For a more detailed discussion of these issues see, S. C. Lonergan (1997) Global Environmental Change and Human Security. In *Changes* 5. Ottawa: Canadian Global Change Program - The Royal Society of Canada.

[7] Gleick (1998) provides more detail on this and other water quality examples.