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ENVIRONMENT, SCARCITY OF WATER AND VIOLENT CONFLICT: A STUDY IN THEIR LINKAGES

Abstract

The fresh water resources and the related environment of the world are under enormous stress. The growing population and industrial development based on extraction of fossil fuels have degraded water and other renewable resources. The demands on fresh water are escalating to the extent of making it environmentally scarce to millions. Though there has never been wars over water, intra-state conflicts or disputes between or among states are frequent and likely to increase with the environmental scarcity or degradation of water. After a long debate, discussion and analysis of environmental issues, it is widely acknowledged that environmental scarcity or degradation of renewable and non-renewable resources can play a major and definite role in local, regional and even international disputes. Not all water resources disputes will lead to violent conflict but in certain regions of the world water is becoming increasingly scarce and important for economic and agricultural production, and the probability of water related conflicts is also increasing.

INTRODUCTION

With the end of the Cold War and break up of the Soviet Union, the world has moved away from a focus on political and military conflict between two major superpowers to a growing concern over

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the connection between environmental degradation and scarcity of resources, on the one hand, and regional and international politics and disputes, on the other. This has questioned the very traditional and military thinking and put forth a strong argument for linking certain environmental problems with the prospects for political frictions and tensions or even war and peace. At the centre of the ongoing debate is the growing assertion that resource security and environmental degradation are important factors contributing to political instability or violent conflicts at local, regional and inter-state levels.

This kind of rethinking of security in terms of environment has emanated from a growing admission to the fact that a myriad of new and large scale environmental threats with political ramifications are beginning to dominate international discourse about environmental concerns. While many of the past, present and future causes of conflict and war may seem to have little or no direct connection with the environment or with resources, a strong argument can be built linking certain environmental problems with prospects for political frictions and tensions, or even war and peace. A related argument is that with the burgeoning of population growth, the environmental scarcity or degradation of resources is likely to proliferate large-scale violent conflicts within or among states. This growing perception that environmental scarcity and degradation of resources will increasingly create conditions leading to conflict, has marked the current debates.

The relationship between violent conflict both national and international and environmental degradation or scarcity of resources has become an increasingly relevant issue in the international realm. Scholarly works showing the linkage have spawned up. The earliest one to predict such conflicts is the Bruntland Report entitled, *Our Common Future* which stated:

Environmental stress is both a cause and effect of political tension and military conflict. Nations have fought to assert or resist control over raw materials, energy supplies, land, river basin, sea passages and other key environmental resources.

It further says, "such conflicts are likely to increase as these resources become scarcer and competition for them will increase."¹ A more precise definition of environmental conflict is given by Libiszewski when he states:

An environmental conflict is a conflict caused by the environmental scarcity of resource, that means: caused by human made disturbance of its normal regeneration rate, environmental scarcity can result from the overuse of a renewable resource or from the overstrain of the ecosystem's sink capacity, that is pollution. Both can reach the state of a destruction of the space of living.²

Some skeptics argue that environmental scarcity is rarely an important cause of violent conflict. It may be admitted that environmental scarcity by itself is neither a necessary or nor sufficient cause and when it does play a role, it always interacts with other contextual factors to generate violence. But this fact should not lead one analyst to say that environmental scarcity is always unimportant and does not lead directly to conflict. In order to gauge the causal role of environmental scarcity's contribution to a specific case of violence, what is necessary is to weigh its power relative to other factors contributing to that violence.

This framework linking the environmental scarcity of resources and violent conflict has been studied in the area of water resources.

¹ World Commission on Environment and Development, *Our Common Future* (The Brundtland Report) New York : Oxford University Press 1987.

² Stephan Libiszewski, "What is an Environmental Conflict", *Environment and Conflicts Project* (ENCOP), Center for Security Studies and Conflict Research, Swiss Federal Institute of Technology and Swiss Peace Foundation, Bern/Zuich July 1992, Occasional Paper No. 1, p. 6.

ENVIRONMENTAL DEGRADATION AND SCARCITY OF WATER

Resource scarcity has become an omnipresent feature of human existence. Scarcity of renewable resources has become so severe that it has the potential to seriously threaten the very survival of human beings. It can arise in three ways which can be called supply induced, demand induced and structure induced.³ Supply induced scarcity occurs and becomes worse when the resource base shrinks because it has been degraded in quality and depleted in quantity.

Any human caused increase in supply induced scarcity is the product of three factors: the total human population in the region, per capita use of technology available to that population and the amount of resource consumption or degradation produced by use of each unit of these technologies.

Apart from this, renewable resources will be depleted or degraded not by direct consumption but by technological activities that indirectly harm the resources. The western pattern of development based on industrialization and extraction of non-renewable resources can have immense indirect effects on renewability of resources in terms of degradation and pollution.

Demand induced scarcity arises, when a burgeoning population divides the static resources into smaller slices for each individual. It is a function of population size multiplied by per capita demand for a given resource. An increase in either population or per capita demand increases total resource demand. For example, the number of people living in an arid region might go up which, all other things being equal, will increase total demand for water. Or a constant number of inhabitants might instead demand, on average, more

³ Thomas F. Homer Dixon, *Environment, Scarcity and Violence*, (Princeton/New Jersey: Princeton University Press, 1999), p. 48.

water for new agricultural technologies. In both these cases, if only a constant or limited flow of water is available, water scarcity will increase. If water is further degraded or polluted by industrial activity, the problem of water scarcity is compounded. Thus increased population size and increased per capita demand for a given resource can both decrease supply by contributing to the resource's depletion and degradation.

Structural scarcity is caused by unequal distribution that concentrates resources in the hands of some groups and subjects and rest to greater than average scarcity. Heightened competition for fresh water poses a major threat to human security the world over. It could well prove to be the major source of conflict in the 21st century, not unlike oil in the present century.⁴ As the world population continues to burgeon and consumption levels spiral upwards, supply induced scarcity is bound to intensify.

In 1999 human beings were estimated to have withdrawn about 4,250 cubic kilometres of freshwater a year from various sources returning about 1,700 cubic kilometres to these sources often in polluted condition.⁵ This consumption is growing at a rate of 2 to 3 percent a year. Total river resources at any one-time amount to about 2000 cubic kilometers. But because of the constant cycling of water between atmosphere and surface of the earth, the annual quantity available from rivers is closer to 40,000 cubic kilometers.⁶ Though the aggregate figures seem to indicate abundance, there are great differences in water availability among regions. Many areas

⁴ Mikiyasu Nakayama, *Water: The 21st Century's Oil*, The United Nations University, 1998, p. 18.

⁵ WRI, *World Resources 1990-91*, pp. 170-71, Washington D.C.: (World Resources Institute).

⁶ Homer Dixon, *op. cit.*, p. 67.

including much of Europe, large parts of the United States, north western provinces of China and Ganges basin in South Asia are using virtually all of their locally generated river run off. In a number of arid developing countries rapid population growth threatens to reduce water availability below 1,000 cubic meters of water per capita per year which is considered as the minimum necessary for an adequate quality of life in a moderately developed country.⁷ As average per capita water availability drops below the benchmark 1000 cubic meters in a developing region, a significant portion of the population will face serious water problems. Irrigated agriculture will be restricted. Rural families will often have to walk far from their villages to fetch water from ponds and streams and residents of urban squatter settlements and slums will often have insufficient water for their hygiene.

The possibility of greenhouse gas induced climate change introduces some uncertainty into these estimates. Climate change would shift precipitation patterns and therefore, the overall water supply.⁸ Despite this uncertainty, the Middle East and parts of Africa are confronting water scarcity since in these regions populations are expanding rapidly and water is already extremely scarce.⁹

Taking the world as a whole, the number of people living in countries with water stress or chronic water scarcity in 1997 was about 430 million. By the year 2025, using the UN's medium

⁷ Peter Gleick, "Water in the 21st Century" in Peter Gleick ed., *Water in Crisis : A Guide to the World's Fresh Water Resources* (New York : Oxford University Press, 1993), p. 105.

⁸ See, J. T. Houghton et al., eds, *Climate Change 1995-The Science of Climate Change*, Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Cambridge : Cambridge University Press, 1996).

⁹ Malin Falkenmark, "The Massive Water Scarcity Now Threatening Africa-Why It Is Not Being Addressed", *Ambio*, Vol. 18, No. 2, 1989, pp. 112-18.

population projections the number is expected to rise to 3 billion.¹⁰ Appendix 1 shows regions where water crises are very likely in the next decades as a result of population growth.

The impact of supply induced scarcities of freshwater on agricultural productivity, health and economic development is very much alarming. Salinization, population and contamination of water bodies seriously affect the food productivity which, in turn, becomes injurious to health. Inadequate and contaminated water supplies contribute to the high frequency of gastrointestinal and parasitic infections.

INTERACTIONS AND SOCIAL EFFECTS

The three kinds of environmental scarcity outlined above often interact and two patterns of interaction such as resource capture and resource marginalisation are found. Resource capture occurs when a deterioration in the quality and quantity of a renewable resource interacts with population growth to prompt powerful groups within a society to shift resource distribution in their favour subjecting poorer and weaker groups to dire environmental scarcity and its social effects.

Ecological marginalization occurs when unequal resource access combining with population growth causes migration to regions such as upland slopes, tropical rain forests, urban areas and other areas at the risk of desertification which are ecologically fragile.¹¹

¹⁰ Tom Gardener – Outlaw and Robert Engleman, *Sustaining Water, Easing Scarcity : A Second Update* (Washington, D.C. : Population Action International, 1997) : and Malin Falkenmark and Asit Biswas, "Synopsis – Further Momentum to Water Issues: Comprehensive Water Problem Assessment in Being", *Ambio*, Vol. 24, No. 6, 1995, pp. 380-82.

¹¹ Thomas F. Homer Dixon, *op. cit.*, p. 73.

Environmental scarcity and its various patterns of interaction including the above two may cause innumerable changes in the developing societies. Research has identified five main social effects that either singly or in combination may increase the probability of violence in developing societies:¹²

- Constrained agricultural productivity
- Decline in economic productivity
- Migration of affected people in search of better lives
- Greater segmentation of society usually along existing ethnic cleavages
- Disruption of institutions, especially the state.

These effects are often causally correlated, sometimes with feedback relationship. For example, the migration caused by a decline in food production can reduce the amount of labour available for work in fields further causing a fall in food production. Economic decline can lead to flight of people with education and wealth to within or outside of state which, in turn, eviscerates universities, courts and institutions of economic management – crucial to a healthy economy.

Agricultural Productivity

Reduced agricultural productivity is one of the serious consequences of environmental degradation. Scarcity of water has a worsening effect on agricultural production. Increased run off rates of water due to decongestion, changed hydrological cycles including changed transpiration rates, soil moisture and precipitation patterns, overuse and pollution of water suppliers due to industrialization and

¹² Thomas F. Homer Dixon, *op. cit.*, p. 80.

use of chemical fertilizers, pesticides, more frequent floods and droughts, sea level rise, coastal flooding and storms due to global warming have damaging impacts on food production.

The effects of global warming on food production have been significant. Since water resources are likely to be seriously affected by greenhouse effect and global warming, the shortfalls in agriculture production are likely to be widely felt, the developing countries are likely to bear the brunt of the crisis.¹³ According to Peter H. Glaick,

Among the expected impacts of climatic changes on water resources are increases in global average precipitation and evaporation, changes in the regional patterns of rainfall, snowfall and snow melt,[sic] changes in the intensity, severity and timing of major storms; rising sea level and salt water intrusion into coastal aquifers, and a wide range of other geophysical effects. The changes will also have many secondary impacts on freshwater resources, altering both the demand and supply of water, and changing its quality.¹⁴

Studies show the growing population in interaction with land degradation and water scarcity has caused an overall decline in food production. The rate of increase in global agricultural production has dropped in the last thirty years, from 3 percent per year in 1960s to 2.3 percent in the 1970s and to 2 percent in the period from 1980 to 1992. Growth in global cereal production has shown as even steeper decline from 3.6 percent per year in 1960s to 2.6 percent in the 1970s, to 1.6 percent from 1980 to 1992.¹⁵

¹³ Cynthia Rosenzweig and Martin L. Parry, "Potential Impact of Climate Change on World Food Supply", *Nature*, Vol. 367, No. 6459, 13 January 1994, pp. 133-38 and G. Fischer, K. Frohberg, M. L. Parry and C. Rosenzweig, "Climate Change and World Food Supply, Demand and Trade: Who Benefits, Who Loses?" *Global Environmental Change*, Vol. 4, No. 1 (1994) pp. 7-23.

¹⁴ Peter H. Gleick, "World's Water: The Biennial Report on Fresh Water Resources" (Washington D. C.: Lovels, California: Island Press, 1998), p. 140.

¹⁵ Nikos Alexandratos, "The Outlook for World Food and Agriculture to Year 2010", Chapter 3 in *Population and Food in the Early 21st Century: Meeting Future Food Demand*

Economic Decline

Environmental scarcity's most serious negative social effects is the constraint it sometimes imposes on economic development. It has been seen that environmental degradation might influence economic productivity directly or indirectly via other social effects, such as changes in agricultural productivity. Per Pinstrup Anderson points out "in most low income developing countries, growth in the agricultural sector, whether food or non food agricultural commodities is the most effective and often the only viable lead approach to sustainable economic growth and poverty alleviation."¹⁶ Consequently, if environmental scarcity constraints agricultural production, it may have a large effect on a country's overall economic development. Jeffrey Leonard writes: "Millions of previously very poor families that have experienced less than one generation of increasing wealth due to rising agricultural productivity could see trend reversed if environmental degradation is not checked".¹⁷

Along with soil degradation and deforestation, water scarcity and degradation has seriously affected agricultural production and ultimately the economic development. Gaza offers a stark example to the impact of supply induced scarcities of freshwater on agricultural productivity, on health and ultimately on economic development.¹⁸ The population of Gaza depends almost on water

of Increasing population, ed., Nural Islam, (Washington, D. C. : The International Food Policy Research Institute (IFPRI), 1995) pp. 25-48

¹⁶ Per Pinstrup-Andersen, "Global Perspectives for Food Production and Consumption," *Tidsskrift for Land Okonomi*, 4, No. 179, 1992, pp. 145-69.

¹⁷ Jeffrey Leonard, "Overview" in *Environment and the Poor : Development Strategies for a Common Agenda* (New Brunswick, N. J. : Transaction, 1989) p. 27.

¹⁸ Kimberley Kelly and Thomas Homer Dixon, "Environmental Scarcity and Violent Conflict; The Case of Gaza", Occasional Paper of the Project on Environment, Population and Security (Washington D. C. : American Association for the Advancement of Science and the University Toronto 1996).

drawn from an aquifer underneath the territory. This limited supply has been overexploited for decades. Consumption of aquifer water has exceeded recharge rates by almost 60 million cubic meters per year, which has caused falling water tables, salt intrusion and chemical contamination.¹⁹ Unregulated use of pesticides, herbicides, and fertilizers contributes to severe pollution, especially since the aquifer is close to the surface. Because of both salinization and chemical contamination, Gaza's ground water is often unsuitable for irrigation as it can damage the soil and lower crop yields. Farmers are already experiencing declining crop quality and yields in many areas due to the regular use of high salinity irrigation water. Anna Bellisari argues that the routine consumption of contaminated or saline water by Gaza population contributes to deterioration of the overall health of population.²⁰

Similarly, another study by Mao Yushi, the Director to the Unirule Institute of Economics in Beijing shows the combined effect of supply induced environmental scarcities on China's economic output. The main burdens resulting from environmental scarcities are lost water and timber resources as a result of deforestation, higher human morbidity and mortality and reduced industrial output because of water and air pollution.²¹

Migration

Studies show that environmental scarcity will produce vast numbers of environmental refugees.²² Sea level rise will drive people

¹⁹ See, Thomas F. Homer Dixon, *Environment, Scarcity and Violence* (Princeton, New Jersey: Princeton University Press, 1999), p. 92.

²⁰ Anna Bellisari, "Public Health and the Water Crisis in the Occupied Palestinian Territories", *Journal of Palestinian Studies*, Vol. 23, No. 2, 1994, p. 56.

²¹ *Ibid.*

²² Jodi Jacobson, "Environmental Refugees : A Yardstick of Habitability", *World Watch Paper*, Vol. 86 (Washington D. C. : World Watch Institute, 1988). see Norman Myers,

back from coastal and delta areas in Egypt and Bangladesh. Scarcity of land along with water degradation and combined population growth can result in economic decline and reduced agricultural productivity contributing to migration within a state from rural and urban or to neighbouring states.

Social Divisions

Severe environmental scarcity can aggravate divisions or segmentation among ethnic, religious and linguistic groups.²³ Constrained agricultural productivity, constrained economic productivity and large migrations can precipitate social divisions.

Disrupted Institutions

The above social effects due to environmental degradation are likely to tear the fabric of legitimized, accepted and authoritative institutions such as state and governments. For example, environmental scarcities increase financial and political demands on state. To deal with severe water scarcity, the Chinese government must spend huge sums on new infrastructure such as wells, dams, canals, pipelines and irrigation systems, and it must build large facilities to control industrial and municipal population.²⁴

Second, resource scarcities affect the state via their effects on elites. Scarcities threaten the incomes of elites that depend on

"Environmental Refugees in a Globally Warmed World", *Bioscience*, Vol. 43, No. 11, 1993, pp. 752-61.

²³ Valerie Percival and Thomas Homer-Dixon, "Environmental Scarcity and Violent Conflict: The Case of South Africa" *Journal of Peace Research*, Vol. 35, No. 3, May 1998, pp. 279-98.

²⁴ Elizabeth Economy, "Reforms and Resources : The Implications for State Capacity in the People's Republic of China", Occasional Paper of the project on Environmental Scarcities, State Capacity and Civil Violence (Cambridge, Mass : American Academy of Arts and Sciences and University of Toronto, 1997).

resource extraction. These elites often compete among themselves for shrinking resource rents. They may turn to the state for compensation or they may act to impede institutional reforms that would distribute more fairly the costs of rising scarcity.²⁵ Thus, evermore critical water scarcity in China is opening up sharp divisions between Beijing and other provinces, and among the provinces themselves.²⁶ Water scarcity has been a point of conflict between states in India. The management of such conflicts requires immense amounts of state attention, time and money.

On the other hand, environmental scarcities generate opportunities for powerful coalition of elite members to capture windfall wealth. In particular, they often lobby to change the property rights and other laws governing the use of scarce resources such as land, water and other forests. These rent seeking elite groups influence the state through bribery, kickbacks and other forms of corruption.

Third, the struggle for resource control between powerful and weak groups and among weak groups themselves worsens social segmentation and cleavages. This, in turn, debilitates civil society and erodes the trust building processes and the state's failure to meet local need then depresses its legitimacy.

Violent Water Conflict: Some Case Studies

Environmental scarcity's main negative social effects is violent conflict. Conflicts over natural resources among states are

²⁵ The logging industry in the Philippines offers a good example of this elite behaviour. See Robin Broad with John Cavanagh, "Plundering Paradise: The Struggle for the Environment in the Philippines" (Berkeley: University of California Press, 1993).

²⁶ Elizabeth Economy, *op. cit.*

understood within traditional realist (or balance of power) paradigm of international relations theory.²⁷ According to Nazli Chourci and Robert North, countries facing high resource demands and limited resource availability within their territories would seek the needed resources through trade or conquest beyond their boundaries.²⁸ Four environmental resources in particular would appear likely to ignite simple-scarcity conflicts- agriculturally productive land, forests, river water and fish. Simple-scarcity conflict emanates directly from the overuse and/or pollution/ destruction of a renewable natural resource.

One of the renewable resource most likely to engender inter state conflict is river water. Water is a critical resource for personal and national survival, it is essential to the production and use of military power. Rich countries are as dependent on water as poor countries.²⁹ Dispute over water use, diversion, pollution and quality are found in virtually all parts of the world. These are due to reduced water flow through dams and projects constructed by up stream riparian nations. Water diversion, industrial agro-chemical pollution, salinization due to excessive extraction of ground water for irrigation, siltation of riverbed and floods aggravated by deforestation and soil erosion. As estimated 40 percent of the world's population depends for drinking water, irrigation and hydroelectricity on the 214 major river systems shared by two or

²⁷ R.B.J. Walker, "Realism, Change and International Political Theory", *International Studies Quarterly*, Vol. 31, No. 1, 1987, pp. 65-86. Robert Gilpin, *War and Change in World Politics* (Cambridge: Cambridge University Press, 1981).

²⁸ Nazli Chourci and Robert North, *Nations in Conflict* (San Francisco : Freeman, 1975).

²⁹ Peter Gleick, "Water and Conflict", Occasional Paper No. 1 Project on Environmental Change and Acute Conflict (Cambridge Mass: American Academy of Arts and Sciences and the University of Toronto, 1992); and Peter Gleick, "Water and Conflict: Fresh Water Resources and International Security", *International Security*, Vol. 18, No. 1, 1993, pp. 79-112.

more countries and 12 of these are shared by five or more nations.³⁰ So conflicts are very much likely to be among or between nations due to above reasons depending on the extent, severity, intensity and immediacy of the environmental scarcity of water resources. Thus at a meeting in Stockholm in August 1995, Ismail Serageldin, the World Bank's Vice President for Environmentally Sustainable Development, declared that the "wars of the next century will be over water" not oil.³¹ The same words were echoed by Wally N Dow, Secretary General of the United Nations Conference on Human Settlements, held in 1996 in Istanbul when he stated: "I suspect that in the next 50 years, we will see a shift from oil to water as the cause of great conflicts between nations and people."³²

In reality, wars over river water between upstream and downstream neighbours are likely only in a narrow set of circumstances. For example, "If a downstream riparian threatens to go to war against an upstream riparian because the latter pollutes river water so gravely that it cannot be used by the inhabitants of the downstream riparian, who are highly dependent on this water, then the environmental character of the conflict is evident".³³ This kind of situation may sometimes result in a war, if the downstream riparian believes that it is militarily stronger than the upstream riparian and thinks to rectify the situation by military power.

³⁰ Environment and Conflict, Earthscan Briefing Document 40, 1984 London: International Institute for Environment and Development.

³¹ Ismail Serageldin, "Earth Faces Water Crisis", Press Release, World Bank, Washington, D.C. 6 August 1995.

³² Quoted in Mikiyasu Nakayama, "Water: The 21st Century's Oil", Work in Progress A Review of Research Activities of the United Nations University, vol. 15, No. 2, Winter 1998, p.18.

³³ Volker Boge, Proposal for an Analytical Framework to Grasp "Environmental Conflict" Center for Security Studies and Conflict Research, Swiss Federal Institute of Technology, and Swiss Peace Foundation, Bern/Zuich, 1992, p.5.

An inventory of unresolved international water conflicts since World War II as been presented in Appendix 2.³⁴ In what follows, a few case studies of disputes and conflicts over river waters are presented.

The Nile River

The Nile is critical to Egypt, which gets as usable rain and lacks other sources of water but has a few rapidly diminishing aquifers under the desert. Egypt's 65 million people escalating to 75 million in a decade are solely dependent on the river. The Nile flows through eight other countries before reaching Egypt. According to a 1959 agreement with Sudan, the Egyptians are entitled to 55 billion cubic meters of Nile water a year, while Sudan gets 18.5 billion. According to Sandra Postel, total water availability in Egypt was 63.5 billions cubic meters in 1990, but in 1998 demand for water already had soared to 68 billion and it has been rising rapidly since. U.S. AID office predicted in the mid-1990s that Egypt could experience a 16–30 percent water deficit by the end of the century.

Egypt threatened in the past that it was willing to go to war to prevent anyone upstream from tampering with its water flow. In the mid-1980s, it was on the point of ordering air attacks against Khartoum for perceived water threats. What has saved Egypt until now is that both Sudan and Ethiopia were too poor and wrecked by civil war to contemplate any large-scale water diversion. The current tensions between Egypt, Ethiopia and Sudan are in one way a continuation of two thousand years old struggle over who will control the waters of Nile.³⁵

³⁴ Quoted from Peter H. Gleick, "World's Water: The Biennial Report on Fresh Water Resources" *op. cit.* pp. 128-130.

³⁵ MarQ De Villiars, "Water Wars", (London: Weidenfeld and Nicolson 1999), pp. 239-40.

In 1993, a general agreement was reached between the new Ethiopian government and Egypt pledging that each country would not do anything to the Nile that might harm the other. As Jan Hultin said in a survey for Leif Ohlsson's *Hydropolitics*, that is not so much what the Ethiopians have done, but rather what they might be doing. Former UN Secretary General, Boutros Ghali, when he was Egypt's Foreign Minister in 1990, pointed out that "The national security of Egypt, which is based on the water of Nile, is in the hands of other African countries".³⁶ Later he was even more blunt: "The next war in our region will be over the waters of the Nile", echoing a comment made by Anwar Sadat fifteen years earlier.³⁷ So the potential for war is very real. There is no reason to suspect that things have changed.

Ganges Water Dispute Between India and Bangladesh

Another glaring example is Indo-Bangladesh Water Conflict over Ganges where Indian has constructed a huge barrage at Farakka with damaging effects on Bangladesh's agriculture, fisheries and economy. Although the barrage's effects are believed to have contributed to a large scale migrations out of Bangladesh into India, the Indo-Bangladesh Treaty on sharing of Ganges water signed in 1996 seemed to have resolved the crisis for the present. But the treaty does not address the basic environmental concern of depleting water resources. It has taken no account of environmental issues like pollution of the rivers, preserving the ecosystem or even taking measures to augment the water resources which is gradually depleting.

³⁶ *Ibid*, pp. 246-47.

³⁷ *Ibid*.

Euphrates River Conflict

In the early 1990s, Turkey turned down Syria's request for more water from the Euphrates - a river that watered human kind's earliest agricultural efforts. The then Turkish Prime Minister Suleyman Demirel remarked: "We do not say we should share their oil resources. They cannot say they should share their water resources". In the early next century Turkey plans to build a huge complex of twenty dams and irrigation systems along the upper reaches of the river.³⁸ This \$21 billion Great Antolia Project will reduce the annual average flow of the Euphrates within Syria from 32 billion cubic metres to 20 billion.³⁹ Syria is already seriously plagued by short of water, with an annual water availability of not much more than a thousand cubic metres per capita.⁴⁰ The Euphrates meets 80 to 85 percent of the water needs of its towns, industries and farms, Syria has been vulnerable to chronic drought in recent years. The water that passes through Turkey and on to Syria is laden with agro-chemical, fertilisers, pesticides and salts posing serious threats to the cropland and agricultural productivity. Syria's growing population at a rate of 3.3 percent per year in 1995 - one of the highest in the world, can multiply further country's water demands.

Both Turkey and Syria have locked themselves in an exchange of acrimonious words over this situation. Syria is too weak relative to Turkey to rectify the situation. Instead it has provided sanctuary to guerrillas of the Kurdish Workers Party (PKK) which was long been launching an insurgency against the Turkish Government in eastern

³⁸ Nurit Kliot, "Water Resources and Conflict in the Middle East", (London: Routledge, 1994), Ch. 2, See, also Alan Cowell, "Water Rights: Plenty of Mud to Sling", *New York Times*, 7 Feb 1990.

³⁹ John Kolars and William Mitchell, "The Euphrates River and the South East Anatolia Development Project" (Carbondale: Southern Illinois University Press, 1991)

⁴⁰ Quoted in Homer Dixon, p.140.

Anatolia. Turkey suspects that Syria might use its moral and material support to the guerrillas as a leverage in bargaining over the Euphrates water. In October 1989, the then Prime Minister, Turgut Ozal suggested that Turkey might impound the river's water if Syria did not restrain the PKK. The tensions have not yet been resolved between the two countries as of today.⁴¹

One indication that this gigantic water development project is likely to cause major tensions with neighbouring states are the surface air missiles that Turkey has installed to protect the project from military attack. This does not imply that the dam would automatically lead to open war between Turkey as the upper riparian, Syria as the middle riparian and Iraq as the lower riparian. The real sources of animosity is the Ataturk Dam in Turkey that is supposed to turn South East Anatolia into a prosperous dynamic economy. Both present day requirements and further consumption targets of these countries are far in excess of the river basin's capacity. Whereas Turkey is able to mobilise strong economic and environmental arguments in support of its claim as upper riparian to be responsible for water use in the entire basin. Syria and Iraq on the other hand are trying to vouch for a national supply basis that is independent of Turkey as possible. Syria and Iraq have divergent intents. For Syria, in particular, Euphrates is the central source of water for its industry and agriculture. If Turkey implements its plans for the upper reaches of the Euphrates, Syria might face severe and sustained water scarcity. On the other hand, Iraq has a stronger position vis-a-vis Turkey in view of the fact that it is not entirely dependent on the water the Euphrates, as it has the Tigris virtually all to itself. Another reason is that it is able to coalesce the flow of water from Turkey to the flow of oil into Turkey.

⁴¹ Françoise Chipaux, "Syria and Iraq Unite against Turkish Dam", *Manchester Guardian Weekly*, 17 February 1996.

Because of its own high level of water consumption and the history of hostilities between the two nations, Syria could be unwilling to join hands with Turkey against the downstream riparian Iraq. But a joint approach by Syria and Iraq is inconceivable since the second Gulf war governments in the region link solution to the Kurdish problem directly and indirectly to water issue. According to a report, "There is very little likelihood, in the present at least, that the water problems in the Tigris-Euphrates basin will escalate into armed conflict over the distribution of water resources. However, if the riparians continue to insist on unilaterally defined consumption targets, the security risks will mount ... Indeed, it is precisely the radical transformation of the basin's environment, mediated through the socio-economic problems of the rural producers in all the three countries that may destabilize international security".⁴²

Israel-Jordan Dispute

The Jordan basin (the Jordan and Yarmuk rivers) is the country's sole source of running surface water. In the 1950s, Jordan tried to gain control of its water resources by building storage system on the Yarmuk. Israelis destroyed them in 1967 war and have, on repeated occasions since, prevented maintenance being done on the Jordanian dams and canals withdrawal of water was seen as threats to Israeli farmers in the Jordan valley. In the 1970s, Jordan came up with a plan to build a dam at Markarin on the Yarmuk, near the border with Syria. But Israel being a downstream country objected to be consulted as per the World Bank financing rules. On the contrary, Israel demanded a larger share than allocated originally harking back to Johnston's notion of equitable

⁴² German Advisory Council on Global Change Annual Report 1997, "World in Transition: Ways towards Sustainable Management of Fresh Water Resources" (Springer- Verlag Berlin Heidelberg 1999)pp. 208-209.

distribution. In 1990, Jordan applied to the World Bank for money to build another dam called Wahda on the upper Yarmuk with Israel again objecting. According to Israel, this would affect its ability to cope with even escalating domestic water demands. King Hussain was driven to say that water is the only reason that could bring Jordan to war with Israel.

In 1994, the Jordan-Israel Peace Accord was signed devoting a large part of its text to resolving water issues. With no timetable fixed so far there is no sign of the water. Allegations were arraigned for being soft on the Israel. Jordan's water minister Mintler Haddadin resigned. There were many forebodings about it being a catalyst for broader confrontations.⁴³

The Okavango River

The Okavango river is shared by Angola, Namibia, and Botswana and is the largest river in southern Africa. Most of the flow originates in Angola, flows southeast to Namibia and then turns south into Botswana. The river drains into the Okavango delta – a world renowned ecosystem and a major tourist spot. Several years ago, Botswana proposed a major project called the southern Okavango integrated water development project in order to provide water for irrigation, urban uses, livestock and a large mine. International Union for the Conservation of Nature (IUCN) was critical about its environmental implications. Though the project is of much intent to Botswana, it is put on hold due to above environmental concerns.⁴⁴ More recently, the relationship between Namibia and Botswana has been bedeviled by Namibian plans to

⁴³ Marq De Villiers, "Water Wars" (London: Weidenfeld and Nicolson, 1999), pp.228-29.

⁴⁴ A.H. Conley, "A Synoptic View of Water Resources in Southern Africa", Department of Water Affairs and Forestry, Pretoria, South Africa, 1996.

construct a 250 Kilometer pipeline to divert water from the Okavango river to eastern Namibia and its capital of Windhock. Further, it intends to build an emergency pipeline to connect their eastern national water carrier with Okavango to deal with severe drought and water scarcity. While an Okavango river basin commission (OKACOM) comprised of Angola, Botswana, and Namibia was formed in September 1994, there is no long-term agreement over management or allocation of the river and no agreement that this project should go forward.⁴⁵ Negotiations and discussion between Namibia and Botswana are continuing. Some reports have come up suggesting that Botswana is increasing the size of its defense forces in response to this dispute, and there is concern in some quarters in Africa about the potential for conflict between the two countries over this issue.⁴⁶ According to Peter Mokaba, Deputy Minister for Environmental Affairs in South Africa, a change in the balance of power in the region could lead to an arms race.⁴⁷

Rivers of Kruger National Park: Tributaries to the Limpopo and Incomati Rivers

Six major rivers flow east from the Republic of South Africa into Kruger National Park and then into Mozambique, where they ultimately join the Limpopo or Incomati rivers. All these rivers and tributaries are highly threatened by burgeoning population and utilisation. Kruger is the most important tourist centre in South

⁴⁵ P. Heyns, "Existing and Planned Water Development Projects on International Rivers within the SADC Region", presented at the Conference of SADC Ministers Water Resources Management in Southern Africa: A Vision for the Future, Pretoria, South Africa, 23 November 1995.

⁴⁶ J. Leitch, "Okavango, a Disputed River", *Hydroplus: International Water Review*, vol. 77, 1997, pp. 20-24

⁴⁷ *Ibid.*

African region and also the most important centres of biodiversity. According to Peter Van Niekerk, "South Africa is very aware that the Mozambicans are unhappy about the quantity of water reaching them. In fact, the Mozambicans were so unhappy that they declined to sign a proposed Memorandum of Understanding".⁴⁸ Mozambique has even threatened to move to the World Court against South Africa. This was a move to put pressure on South Africa to address Mozambique's concerns which would tarnish South Africa's image both within the Subcontinent and in the Organisation of African Unity.

The end of the war in Mozambique and the considerable improvement in the relation between South Africa and Mozambique opens up new possibilities that water issues can be addressed explicitly and directly.

Conclusion

From the above cases studied, it is seen that water can be a military and political goal. Where water is scarce, competition for limited supplies can lead groups, communities and even states to see access to water as a matter of highest concern. This situation falls into the most traditional Cold War framework. This is dependent on the degree of water scarcity, the extent to which supply is shared by two or more groups, the relative power of these groups, and the ease of access to alternative resources. As seen above, the Jordan River Basin has been the scene of a wide variety of water disputes. In the 1960s, Syria tried to divert the headwaters of the Jordan away from Israel, leading to air strikes against the diversion facilities. The 1967

⁴⁸ J. Arenstein, "A River Barely Runs Through It", *Mail and Guardian, African Eyes News*, South Africa, October 13, 1996.

war in the Middle East resulted in Israel winning control of all of the headwaters of the Jordan as well as the groundwater of the West Bank. In these cases water was an important factor in both pre – and post 1967 border disputes. Though the multilateral and bilateral peace talks conducted in the 1990s included negotiations and agreements on the shared water resources of the Jordan river, Israeli and Syrian concerns over the Benians remain an important unresolved issue. Jordanian concerns about the Syrian dams on the Yarmouk, the major tributary to the Jordan remain still unanswered.

The usual tools and instruments of war are military weapons. But the use of water as both offensive and defensive weapons has a long history. For example, North Korea announced plans in 1986 to build a major hydroelectric dam on the Han river upstream of South Korea's capital, Seoul. The project would provide much needed electricity to the North, but South Korea sees only its potential as a military weapon. The destruction of the dam by the North would destroy most of Seoul. While the project currently remains on hold due to serious political and economic difficulties in North Korea, South Korea has built a series of levees and check dams over Seoul to defend against any such threat. Similarly, in 1997 Singapore which is dependent on Malaysia for much of its water needs, feared that Malaysia might use water as a weapon.

Where water resources and water supply systems are a strategic resource with economic, political, or military importance, they become targets during wars or conflicts. Syria, as seen above, tried to destroy Israel's National Water Carrier while it was under construction in the 1950s. The Persian Gulf saw several examples of this problem; the Iraqis intentionally destroyed the water desalination plants of Kuwait and in turn, suffered from the

destruction of their water supply system by the allied forces assembled to liberate Kuwait. The fresh water resources and the related environment of the world are under enormous stress. The growing population and industrial development based on extraction of fossil fuels have degraded water and other renewable resources. The demands on fresh water are escalating to the extent of making it environmentally scarce to millions. The various causes of degradation of water are to be removed but this depends on the cooperative efforts of the riparian countries sharing river water. The very western pattern of development needs a reexamination in order to make renewable resources like water not polluted or degraded. The impact of global warming on availability of water resources has set the need for such rethinking of what has so far been considered development. Though there has never been wars over water, intra-state conflicts or disputes between or among states are frequent and likely to increase with the environmental scarcity or degradation of water. After a long debate, discussion and analysis of environmental issues, it is widely acknowledged that environmental scarcity or degradation of renewable and non-renewable resources can play a major and definite role in local, regional and even international disputes. Not all water resources disputes will lead to violent conflict but in certain regions of the world water becoming increasingly scarce and important for economic and agricultural production, the probability of water related conflicts is increasing.

So far as interstate disputes over international water bodies are concerned the global community is badly in need of modalities to deal with international water bodies in a much better way both in terms of water quality and quantity. Attaining such goals can be difficult; it requires a degree of cooperation among riparian countries which is not usually forthcoming. As a result, many

countries are unable to utilise more fully their shared water resources due to unresolved riparian conflicts. With global water use doubling every twenty years, these scarcities and their consequent social effects and stresses are going to get much worse raising the prospects of water conflicts within states or among or between states. These conflicts due to increasing global scarcity of water may be regional at first; however, due to their potential to endanger peace, becomes international conflicts, invoking international community's interest to resolve these.

Appendix 1

Water Availability in 1995 and in 2025

		Per Capita Water availability 1995 (m ² /person/year)	Projected per capita Water Availability 2025(m ² /person/year)
Africa			
	Algeria	517	313
	Burundi	594	292
	Comoros	1,667	760
	Egypt	936	607
	Ethiopia	1,950	807
	Kenya	1,112	602
	Libya	111	47
	Malawi	1,933	917
	Morocco	1,131	751
	Rwanda	1,215	485
	Somalia	1,422	570
	South Africa	1,206	698
	Tunisia	434	288
The Americas			
	Canada	98,667	79,731
	United States	9,277	7,453
	Barbados	192	169
	Haiti	1,544	879
Asia/Middle East			
	Bahrain	162	104
	Cyprus	1,208	947
	Iran	1,719	916
	Israel	389	270
	Jordan	318	144
	Kuwait	95	55
	Oman	874	295
	Qatar	91	64
	Saudi Arabia	249	107
	Singapore	180	142
	Yemen	340	131

Source: Tom Gardner- Outlaw and Robert Engelman, *Sustaining Water Easing Scarcity: A Second Update* (Washington, D.C. Population Action International 1997). Water availability in 2025 was estimated using the United Nations medium population projections obtained from United Nations Population Division. World Population Prospects: The 1996 Revision. Demographic Indicators 1950-2050 (New York: United Nations, 1995).

Appendix 2

Chronology of Conflicts over water since World War II

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1940-1945	Multiple parities	Military target	Yes	Hydroelectric dams routinely bombed as strategic targets during World War II
1947 onward	East Pakistan, then Bangladesh and India	Inequitable distribution and use	No	Partition divides Ganges River between Bangladesh and India; construction of the Farakka Barrage by India beginning in 1962, in the faces of tension; short-term agreements settle dispute in 1977-82, 1982-84 and 1985-88 and thirty-year treaty is signed in 1996.
1947-1960s	India and Pakistan	Military/political goal, inequitable distribution and use	No	Partition leaves Indus basin divided between India and Pakistan; disputes over Irrigation water ensue, during which India stems flow of water into irrigation canals in Pakistan; Indus Waters Agreement reached in 1960 after 12 years of World Bank-led negotiations.
1945	Arabs and Israelis	Military tool	Yes	Arab forces cut off West Jerusalem's water supply in first Arab-Israeli war.
1950s	Korea and United States, others	Military tool	Yes	Centralized dams on the Yalu River serving North Korea and China were attacked during Korean War.
1950	Israel, Jordan and Syria	Military/political goal; water development	Yes	Jordan makes public its plans to irrigate the Jordan valley by tapping the Yarmouk River, Israel responds by commencing drainage of the Huleh swamps located in the demilitarized zone between Israel and Syria; border skirmishes ensue between Israel and Syria.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1951	Israel, Jordan and Syria	Military/political goal; water development	Yes	Israel begins construction of its National Water Carrier to transfer water from the north of the Sea of Galilee out of the Jordan basin to the Negev Desert for irrigation. Syrian military actions along the border and international disapproval lead Israel to move its intake to the Sea of Galilee.
1958	Egypt and Sudan	Military/political goal; military tool	Yes	Egypt sends an unsuccessful military expedition to the disputed territory amidst pending negotiation over the Nile waters, Sudanese general elections and an Egyptian vote on Sudan-Egypt unification; Nile Water Treaty signed when pro-Egyptian government elected in Sudan.
1960s	North Vietnam and United States	Military target	Yes	Irrigation water supply systems in North Vietnam are bombed during Vietnam War.
1962-1967	Brazil and Paraguay	Military/political goal; water development	Military maneuvers	Negotiations between Brazil and Paraguay over the development of the Parana River are interrupted by a unilateral show of military force in 1962 by Brazil which invades the area and claims control over the Gaura Falls site. Military forces were withdrawn in 1967 following an agreement for a joint commission to examine development in the region.
1963-1964	Ethiopia and Somalia	Military/political goal	Yes	Creation of boundaries in 1948 leaves Somali nomads under Ethiopian rule; border skirmishes occur over disputed territory in Ogaden desert where critical water and oil resources are located; cease-fire is negotiated only after several hundred are killed.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1965-1966	Israel and Syria	Military/political goal	Yes	Fire is exchanged over "all-Arab" plan to divert the Jordan River headwaters and presumably preempt Israeli National Water Carrier; Syria halts construction of its diversion in July 1966.
1967	Israel Syria	Military target and tool	Yes	Israel destroys the Arab diversion works on the Jordan River headwaters. During Arab- Israeli War, Israel occupies Golan Heights with Banns tributary so the Jordan Israel occupies West Bank.
1969	Israel and Jordan	Military target and tool	Yes	Israel, suspicious that Jordan is over diverting the Yarmouk, leads two raids to destroy the newly built East Ghor Canal; secret negotiations, mediated by the United States, lead to an agreement in 1970.
1970s	Argentina, Brazil and Paraguay	Political goal; water development	No	Brazil and Paraguay announce plans to construct a dam at Itaipu on the Parana River, causing Argentina concern about downstream environmental repercussions and the efficacy of its own planned dam project downstream. Argentina demands to be consulted during the planning of Itaipu, but Brazil refuses. An agreement is reached in 1979 that provides for the construction both Brazil and Paraguay's dam at Itaipu and Argentina's Yacyrets dam.
1974	Iraq and Syria	Military/political goal; water development	Military force threatened	Iraq threatens to bomb the al-Thawrs Dam in Syria and masses troops along the border, alleging that the dam had reduced the flow of Euphrates River water to Iraq.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1975	Iraq and Syria	Military/political goal;	Military maneuvers	As upstream dams are filled during a low-flow year on the Euphrates Iraqis claim that flow reaching its territory is "intolerable" and asks the Arab League to intervene, Syrians claim they are receiving less than half of the river's normal flow and pull out of an Arab League technical committee formed to mediate the conflict. In May, Syria closes its aerospace to Iraqi flights and both Syria and Iraq reportedly transfer troops to their mutual border, Saudi Arabia successfully mediates the conflict.
1978 onward	Egypt and Ethiopia	Inequitable distribution and use: military /political goal	No	Ethiopia's proposed construction of dams on the headwaters of the Blue Nile leads Egypt to repeatedly declare the vital importance of water. "The only matter that could take Egypt to war again is water" (Anwar Sadat- 1979). "The next war in our region will be over the waters of the Nile, not politics" (Boutrous Ghall-1988).
1981	Iran and Iraq	Military target and tool	Yes	Iran claims to have bombed a hydroelectric facility in Kurdistan, thereby blacking out large portions of Iraq, during the Iran-Iraq War.
1982	Israel, Lebanon and Syria	Military tool	Yes	Israel cuts off the water supply of Beirut during siege.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1992	North Korea and South Korea	Military tool	No	North Korea's announcement of its plans to build the Kungansan hydroelectric dam on a tributary of the Han River upstream of Seoul raises concerns in South Korea that the dam could be used as a tool for ecological destruction of war.
1990	South Africa	Military tool	No	Pro-apartheid council cuts off water to the Wesselton township of 50,000 blacks following protests over miserable sanitation and living conditions.
1990	Iraq, Syria and Turkey	Water development ; military tool	No	The flow of the Euphrates is interrupted for a month as Turkey finishes construction of the Ataturk Dam, part of the Grand Anatolia Project. Syria and Iraq protest that Turkey now has a weapon of war. In mid-1990, Turkish president Turgut Ozal threatens to restrict water flow to Syria to force it to withdraw support for Kurdish rebels operating in southern Turkey.
1991	Karnataka and Tamil Nadu (India)	Inequitable distribution and use	Yes	Violence erupts when Karnataka reacts to an Interim Order handed down by the Cauvery Waters Tribunal. The Tribunal was established in 1990 to settle two decades of dispute between Karnataka and Tamil Nadu over irrigation rights to the Cauvery River.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1991	Iraq, Kuwait and United States	Military target and tool	Yes	During the Gulf War, Iraq destroys much of Kuwait's desalination capacity during retreat. Baghdad's modern water supply and sanitation system is also intentionally targeted. Discussions are held about using the Ataturk Dam to cut off flows of the Euphrates to Iraq.
1992	Czechoslovakia and Hungary	Military/political goal; water development	Military maneuvers	Hungary abrogates a 1977 treaty with Czechoslovaks concerning construction of Gabclkovo/ Nagymaros project based on environmental concerns. Slovakia continues construction unilaterally, completes the dam, and diverts the Danube into a canal inside the Slovakian republic. Massive public protest and movement of military to the border ensue; issue taken to the International Court of Justice.
1992	Bosnia and Bosnian Serbs	Military tool	Yes	The Serbian siege of Sarajevo, Bosnia and Herzegovina, includes a cutoff of all electrical power and the water feeding the city from the surrounding mountains. The lack of power cuts the two main pumping stations inside the city despite pledges from Serbian nationalist leaders to United Nations officials that they would not use their control of Sarajevo utilities as a weapon. Bosnian Serbs take control of water valves regulating flow from wells that provide more than 80 percent of water to Sarajevo; reduced water flow to the city is used to "smoke out" Bosnians.

Year	Parties Involved	Basis of Conflict	Violent Conflict/ Military Involvement	Description
1993	Iraq	Military tool	No	To quell opposition to his government, Saddam Hussain reportedly poisons and drains the water supplies of southern Shiite Muslims.
1993	Yugoslavia	Military target and tool	Yes	Peruca Dam intentionally destroyed during war.
1995	Ecuador and Peru	Military/political goal	Yes	Armed skirmishes arise in part because of disagreement over the control of the headwaters of Canepa River. Wolf argues that this is primarily a border dispute simply coinciding with location of a water resource.
1997	Singapore and Malaysia	Political tool	No	Malaysia supplies about half of Singapore's water and in 1997 threatened to cut off that supply in retribution of criticisms by Singapore of policy in Malaysia.