

Water: cause for conflict or co-operation?

Irna van der Molen & Antoinette Hildering

P VAN DER MOLEN: Department of Technology and Sustainable Development, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands; p.vandermolen@utwente.nl.

PA HILDERING: MeerKeuze/MultipleChoice, Velperweg 52, 6824 BM Arnhem, The Netherlands; a.hildering@meerkeuze.org

Several authors, politicians, leaders of international organisations and journalists have cautioned the world community that the increasing scarcity of freshwater resources might lead to national and international conflicts. When relating this to climate change forecasts – most of which indicate that climate change will have a significant impact on the availability of freshwater resources, on water quality, and on the demand for water – this is alarming news for humankind as it threatens human security [1]. Not only can one expect a significant impact of climate change on the availability and quality of freshwater resources, one can also expect an increase in conflicts which are water related. Fortunately, there are also voices which question the empirical evidence for this ‘conflict scenario’, pointing to the opportunities for, and experiences with, cooperative arrangements for sharing river resources [2,3, 4]. This article gives an outline of this debate and touches upon some relevant issues involved. The article is primarily based on secondary information from previous studies.

A comparison of freshwater withdrawal per country and per sector (domestic use, industrial use, agricultural use) shows a large variation between various countries. For example, in 1994 the withdrawal for domestic use in Malawi was 9 m³ per person per year, whereas for Iceland this was 176 m³ per person per year [5]. Such variation is not only present between countries: the inequality within countries is enormous as well. Water consumption in Israel and in the settlements is much higher than that of their Arab neighbours in occupied territories who are restricted from pumping water. It seems that – in some cases – controlling groups are able to capture resources at the cost of politically marginalised groups due to asymmetrical power relations.

Acreman [6] and Pearce [7] show that there is overexploitation of water in several regions, and have calculated water exploitation indexes as a percentage of renewable annual water resources. These are: 83 % for Tunisia; 92% for Egypt; 140% for Israel; 169% for Gaza; 644% for Libya (because 84% comes from non-renewable fossil water from beneath the Sahara); 50% for Syria; 25% for Lebanon; 20% for Algeria and 40% for Morocco (referred to in [8]).

Figures on water supply and sanitation reflect the harsh reality of life for many people, most of whom are living in developing countries. More than one billion people do not have access to clean drinking water, and approximately 2.4 billion people do not have access to adequate sanitation. Gleick [9] indicates that an estimated 80% of the diseases in developing countries are water related. Every day 14 to 30 thousand people, mainly children and elderly, die because of waterborne diseases [10], or due to floods and droughts.

Problems related to the supply of freshwater resources, and more in particular to safe drinking water, can not be addressed properly without recognising the interrelation between multiple functions and uses of water. Water resources are used for human consumption, for sanitation, washing, bathing and cultural or religious rituals, and for economic purposes, such as agriculture, livestock, industry, tourism, and transportation [11]. Water resources are also considered to be an integral part of the ecosystem, for wetlands, coastal areas, mangroves, and more in general for humid, arid and semi-arid areas. Over-extraction of water for industrial use may severely affect ground water levels, affecting not only the ecosystem, but also agriculture in the area and potentially the access to safe drinking water [12].

At UNCED in 1992, the international community emphasised this interrelation stating that 'the extent to which water resources development contributes to economic productivity and social well-being is not usually appreciated, although all social and economic activities rely heavily on the supply and quality of freshwater.' (Agenda 21, Chapter 18; Protection of the Quality and Supply of Freshwater Resources). Due to this interdependence, any change of sub-national, national or regional water regimes and property rights has inevitably an impact on the availability of water for different uses and competition over water among different user groups [13]. This complexity clearly requires a coherent approach which not only addresses the existing inequalities in access to water, but also foresees actual or potential competition over water between different user groups. But first and foremost, it requires an understanding of the factors which could contribute to water scarcity.

Therefore, for analytical purposes, first, a typology of resource scarcity and scarcity related conflicts is provided based on earlier work by Ohlsson [14] and Homer-Dixon and Blitt [15,16]. The next sections explore how climate change and privatisation may result in water scarcity using this typology. The final section focuses on the question whether water scarcity is indeed a source for conflict, or whether there are reasons to believe that such conflict is avoided by co-operation and joint management in potential conflictuous areas.

Different types of scarcity and conflicts

In order to explain why and under which conditions countries co-operate, it is useful to look at the theories and studies which have been conducted about conflicts and their relation to scarcity of natural resources. First of all, one can make a distinction between different types of conflicts. Ohlsson [14] makes a distinction between first-order conflicts, which are those resulting from natural resource scarcity itself; and second-order conflicts, which result from the adaptation strategies by which societies try to overcome natural resource scarcity, such as conflicts which emerge when large numbers of people are displaced by dam-building projects.

Ohlsson further indicates that water scarcity can be demand-driven, supply-driven or that it can be the result of structural inequalities between different groups of water users. Demand-induced scarcity results from the water needs of increasing populations with justified demands

for increased welfare; supply-induced scarcity results from rivers running dry, lowered water-tables, and polluted groundwater and surface water courses; and structural scarcity emerges ‘when more powerful segments of water users confiscate a larger part of the scarce resource, resulting in the ecological and economic marginalisation of the less powerful’ [17]. Homer-Dixon and Blitt indicate that these three types of environmental scarcity often interact in two patterns, to which they refer to as ‘resource capture’ and ‘ecological marginalisation’:

Resource capture occurs when demand- and supply-induced scarcities interact to produce structural scarcity: powerful groups within society, anticipating future shortages due to increased population growth and a decrease in the quantity and quality of the resource, shift resource distribution in their favour, which subjects the remaining population to scarcity. *Ecological marginalization* occurs when demand-induced and structural scarcities interact to produce supply-induced scarcity: lack of access to resources caused by unequal distribution forces growing populations to migrate from regions where resources are scarce to regions that are ecologically fragile and extremely vulnerable to degradation [10, cited in 18]

Homer-Dixon distinguishes between five types of violent conflict related to environmental scarcity: (i) disputes arising directly from local environmental degradation, (ii) ethnic clashes arising from migration and social cleavages due to environmental scarcity, (iii) civil strife caused by environmental scarcity, (iv) scarcity-induced interstate war, (v) North-South conflicts over mitigation of, adaptation to, and compensation for global environmental problems. In his study, Homer-Dixon shows that the fourth type – interstate scarcity wars over, for example, water – is the least probable [19]. Nonetheless, water scarcity may be used strategically as a component of war strategies, as has been the case with food aid and food production in the past.

Both Ohlsson and Homer-Dixon focus on environmental scarcity as potential cause of conflict. Various studies of armed conflict (e.g. Knauff [20]) show that armed conflict is seldom mono-causal. However, the distinction between different types of environmental scarcity and conflict enables us to look at different measures and policies. Some measures enhance the potential for conflict while other measures reduce it. Examples of the former category are measures which aim at improving supply-side management by large-scale engineering efforts or which aim to maximise the economic return of water (allocation efficiency). If, for example, a government authority decides to redirect water to cities and industries and thus away from agriculture, this will directly affect peoples’ livelihoods and food-security and can therefore be a source for future (domestic) conflict [14]. Paul Richards emphasises that the problem may not be ‘scarcity’ of resources as such, but the perceived injustice (scarcity of justice) in the allocation of resources [21]. This will be the case if asymmetry of power is reflected in the allocation of, and access to, resources [22].

Naturally, measures which could be characterised as resource capture by powerful groups within society are more likely to result in conflict than measures which do the opposite by trying to reduce demand-induced, supply induced and structural scarcity through a coherent and integrated approach.

In the following two sections, we will look at two significant changes or trends which are believed to affect the availability, quality and demand for, and access to, fresh water resources:

climate change and the global trend towards privatisation. While climate change is likely to result in *supply induced scarcity*, privatisation in the water sector and commoditisation of water resources is likely to result in *structural scarcity*. Following the argument by Ridgeway and Jacques [18], the discussion on the contribution of population growth to environmental stress and violence is left aside in this article since this tends to disguise questions related to unequal distribution of, access to, and control over, natural resources within society.

Climate change, water, and human security

Various studies and models suggest that climate change will have a significant impact on the availability of freshwater resources, on water quality, and on the demand for water. Climate and regional hydrologic models suggest changes in the variability of storms, in the frequency, intensity, and area of tropical disturbances, and in the frequency of droughts and flooding in particular areas. The availability of water resources is not only influenced by climatic conditions, but also by other environmental changes, such as rapid deforestation. Deforestation is known to result in erosion, lower water retaining capacities of the soil (soil-moisture deficit) and diminished soil fertility. The characteristics of the impacts of climate change are explained in more detail by Tao et al [23]:

The water cycle is an integrated and dynamic component of the earth's geophysical system and both affects and is affected by climate conditions. Changes in the earth's radiation balance affect winds, temperatures, atmospheric energy and water transport, cloud dynamics and more. Changes in temperature affect evaporation and transpiration rates, cloud characteristics and extent, soil-moisture, and snowfall and snowmelt regimes. Changes in precipitation affect the timing and magnitude of floods and droughts, and shift runoff regimes. Synergistic effects will alter cloud formation, soil and water conditions, vegetation patterns and growth rates.

Ragab and Prudhomme provide estimates of changes in temperature and rainfall per region. They indicate that, over the past century, there has already been a decrease in rainfall throughout the Mediterranean region, southern Africa and the Sahel, Australia and the Aral Sea Basin [24]. They furthermore state that by 2050 rainfall is expected 'to be reduced in North Africa, parts of Egypt, Saudi Arabia, Iran, Syria, Jordan and Israel by 20-25% less than the present mean values and a temperature rise between 2 and 2.75 °C'. The estimates for the Thar Desert (India, Pakistan, Afghanistan) are a decrease of mean annual rainfall of 5-25% and an increase of mean annual temperature by 1.75-2.5 °C [8].

Several country case studies show in more detail the potential impacts of climate change on water availability and human security. For example, Tao et al analysed the possible impact of climate change on the dryland crop production in North China (including Northwest and Northeast China and the north China plain), where an estimated 24% of Chinese total food production is produced. They conclude that, 'although the expected increases in precipitation may alleviate water stress on crop in Northwest China, the expected increases in water demands and soil-moisture deficit, and decreases in precipitation would challenge the rain-fed crops in the north China plain and Northeast China'.

Climate change has not only an impact on arid and semi-arid regions, but also on regions where flooding frequently occurs. Mirza shows [25] the potential impact of climate changes on the probability of the occurrence of floods in Bangladesh and its implications, in terms of characteristics of floods and crop damage, for the basin areas of the Ganges, Brahmaputra and the Meghna river:

future changes in precipitation regime have four distinct implications. *First*, the [...] onset and withdrawal of monsoons may be delayed or advanced. *Second*, an increase in monsoon precipitation in the Ganges, Brahmaputra and Meghna basins may increase the magnitude, frequency, depth, extent and duration of floods. *Third*, timing of peaking in the major rivers may also change [...] *Fourth*, increased magnitude, depth and duration of floods will bring a dramatic change in land-use patterns in Bangladesh.

These studies show that the data on climatic and hydrological conditions from the past are not reliable anymore to guide decisions on long-term water planning and construction of new water supply and irrigation systems for the future. If governments and water authorities want to address demand- and supply-induced scarcity, or respond to an increase of 'magnitude, frequency, depth, extend and duration of floods', it is a prerequisite to re-examine existing policies and instruments, using new information from climate change forecasts [26] and using information from forecasts on the upcoming trends in population growth and migration patterns (urbanisation, regional transboundary migration) [27].

The question is not only how climate change affects human security directly in terms of protection from floods, food security, or access to safe drinking water. The question is also how governments and powerful groups will respond to domestic water scarcity, to changing soil and water conditions, and to climate change as such. As indicated before, the impact of climate change will strongly vary among states due to a number of reasons, including their geographic location, widely different capacities [28] to mitigate the expected impacts of climate change, and due to asymmetrical power relations at the international level. Even within countries, different impacts can be expected for different groups. The impacts of climate change are likely to be much more severe for many developing countries, whereas these countries are less able display effective responses. In her book on the climate change convention, Gupta [29] observes that climate change is still a 'pseudo-domestic agenda item' in many developing countries: at the time, it is not perceived as a priority by domestic actors [30]. One of the reasons mentioned by Gupta is the ideological vacillation, which reflects confusion about the world-view which is most appropriate for their country. One of the competing frames is between the environmental ideology and the liberalisation ideology. According to Gupta 'The environmental hype [with UNCED (United Nations Conference on Environment and Development)] has come at the same time as the liberalisation hype' [with the World Bank's Structural Adjustment Programmes]. The environmental ideology has been imported at a rhetorical level, and the liberalisation ideology is being implemented in policy'.

Privatisation of water and human security

The global commitment made in Johannesburg to reduce the proportion of people without access to safe drinking water by 50% by the year 2015 [31], seems to be contradictory to global

patterns of privatisation and liberalisation which are reported to affect the demand for, quality of, and access to, water [32]. Over the past decades, one could observe a rapid and global trend towards transfer of the production, distribution, and management of water or water services from public entities into private hands [9]. This transfer of responsibilities towards the private sector is partly caused by inappropriate management of water by government agencies. In recent years, several international aid organisations and the Bretton Wood Institutions (BWI) have pushed developing countries towards privatisation and public-private partnerships in the water sector. Water rights [33] and water markets have become common terms, and water is increasingly treated as a tradable commodity. The poor implementation of these privatisation policies and the lack of attention to vulnerable groups in society are subjected to severe criticisms. Gleick *et al.* [9] observe that: 'Rapid implementation of private-public partnerships for water supply has, in too many cases, blatantly disregarded the needs of the poor'.

The denial of the control by communities over their own natural resources, the sharp increase in water rates, the withdrawal of water for industrial purposes or large scale production, and the distrust of the power of multinational corporations, have resulted in protests and marches, sometimes in social unrest and violence. In many cases where civil protests seem to revolve around water resources, other socio-economic problems play a role as well. Again, not only the scarcity as such, but in particular the perceived injustice in allocation of, or access to, water resources is likely to inflame sentiments among the affected population groups.

One of the examples in which such changes led to social protest is the 'water war' in Bolivia. This 'war' erupted in 1998 when the Bolivian government entered into a contract with Aguas de Tunari, a consortium led by the Italian-owned International Water Limited and the US-based Bechtel Enterprise Holdings. The new company modified the rate structure, resulting in much higher rates for local residents (up to 200% of the original price). Aguas de Tunari claimed that the increases in prices would mainly affect industries, not the local population, but this was contradicted by local farmers and residents of the town. As stated by one of the managers of the company, their aim was to make profit, not to contribute to development. Thousands of people participated in a march to protest against the concession to the consortium which, according to the local population, did not have attention for the concerns of the poor. It was one of the few cases where the demonstrations and fights resulted in defeat of the water company: in late April 2000, the Bolivian government cancelled its contract with Aguas de Tunari [34]. Unfortunately, as referred to by one of the women activists involved in this struggle, 'afterwards, what had we gained? We were still hungry and poor' [35].

Regional conflicts related to water scarcity

Several authors, politicians, leaders of international organisations, and journalists have cautioned the world community to the fact that the increasing scarcity of freshwater resources might lead to national and international conflicts [36]. These predictions are not new: water scarcity is often related to future war. Three observations seem to support this assumption. First of all, more than 200 river systems are shared by two or more countries. Tøset [37] indicates that 'many rivers run between countries with a history of conflict, where water plays an important role in the economic life of the country'. Secondly, some countries depend for more than 80% on upstream countries for their renewable water resources, such as Syria, Sudan, Turkmenistan, Egypt, Mauritania, Kuwait and Bahrein [8]. Such dependency is expect-

ed to create potential for conflict. Finally, overexploitation of water, as shown in section one, in combination with the impacts of climate change, may well lead governments to divert major rivers, construct large dams, or tap underground aquifers which extend beneath their neighbours' territory. Ragab and Prudhomme [8] view the potential draining of these aquifers as major potential for future conflict. Examples of such aquifers are the great fossil-water-filled aquifers beneath the Sahara desert; the Eastern Erg artesian aquifer, south of the Atlas Mountains (Algeria, Tunisia); and the Nubian aquifer (Libya, Egypt and Sudan).

One of the most visible areas where regional instability is partly related to the control over water resources is the Middle East. Ragab and Prudhomme explain how structural scarcity and resource capture of freshwater resources by the Israelis has played a role in the conflict between Israel and its neighbours, not only by diverting the River Jordan to the Sea of Galilee, but also by draining more than 300 Mm³/yr from the aquifer through boreholes on the Israeli territory near the coast. Obviously, although the occupation of territories offers Israel strategic control over water resources, it is not the main cause for political tension between the countries in the region. That the Israeli-Arab water conflict cannot be discussed separately from the overall conflict, is also indicated by Feitelson [38], who distinguishes two perspectives among political scientists and international relations experts:

One strand suggests that while the two levels of conflicts are intertwined water issues can be decoupled and addressed separately, perhaps setting the stage for a resolution of the wider conflict. That is, as water is not necessarily the crux of the inter-state conflict, and as there are benefits to be reaped from co-operation over water issues they can be indeed a basis for co-operation before the inter-state conflict is resolved [...] The second line of argument suggests that the way water conflicts are conducted, and the options for resolving them, are a function of the power relations between the parties, the hydrological situation, the importance of the water resource under contention for the different parties and the benefits of co-operation for each riparian. Miriam Lowi concluded on the basis of an extensive study of the Israeli–Arab water conflicts that in this case the second strand applies.

One can distinguish between two different scenarios. The *conflict scenario* foresees serious water scarcities and an increasing potential of conflicts between numerous countries. In this scenario, access to water may be seen by nations as a matter of national security. The other scenario is the *co-operation scenario*: 'while freely admitting the possibility of conflict, it denies its inevitability [...] The co-operation scenario further points to the possibility of co-operative arrangements for sharing river resources between the upstream and downstream countries, including treaties and joint river administrations' [37].

Kliot, Shmueli and Shamir [3] examined the nature, characteristics and shortcomings of co-operative arrangements for the management of 12 transboundary river basins [39]. They indicate that co-operative water resource management faces several obstacles, such as the critical nature of water for human existence; the multiple use of water; the sheer scale and the gap between policies and implementation of these policies. However, they conclude that:

many institutions which govern the management of transboundary water resources point to the fact that in many river basins countries are able to overcome their differences and co-operate to the benefit of all.

Similar findings have been presented by Wolf [4] and Yoffe, Wolf and Giordano [40,41]. They conclude: 'We found that international relations over freshwater resources are overwhelmingly co-operative and cover a wide range of issue areas, including water quantity, quality, joint management and hydropower' and 'Most of the commonly cited indicators linking freshwater to conflict proved unsupported by data. Neither spatial proximity, government type, climate, basin water stress, dams or development, nor dependence on freshwater resources in terms of agricultural or energy needs showed a significant association with conflict over freshwater resources' [41]. Also Toset reaches a similar conclusion: although the results of their study indicate that 'the low availability of water in both countries in the dyad is significantly related to disputes' they conclude that there is not sufficient evidence to claim that sharing a river provides a major source of armed conflict [37].

Conclusion

The last section clearly showed that at the international level, water appears to pose a reason for transboundary co-operation rather than for war, often preventing escalation instead of causing it. Yoffe, Wolf and Giordano found that highly co-operative events often involved more than two countries. Furthermore, the analysis of multilateral treaties on fresh water resources shows that a large share of these treaties stressed several objectives: economic development, joint management and water quality, rather than only water quantity and hydropower [41]. This confirms the effectiveness of a coherent approach which foresees actual or potential competition over water between different user groups as was indicated in the introduction of this article. This positive conclusion does not mean that there are no concerns left. The degrading situation under which many people have to live gives no reason to celebrate the stability of the *status quo*. Further co-operation to improve their position is required in order to have a larger group of people living in relative security. Such improvement might at the same time empower them to stand up against an existing elite.

One of the main concerns is the unequal access to freshwater resources at the national level. Although privatisation measures in the water sector are not necessarily negative with respect to the water demands of the population, it can result in concerns and resistance among the population as could be seen in the case of privatisation in Bolivia, where the contract between the government and the company bypassed the local population, worsened economic inequities, and ignored the affordability of water. Therefore, these measures and reforms should be accompanied by measures to 'permit equitable access to water for poor populations, include affected parties in decision-making, and improve water-use efficiency and productivity' [9]. Gleick also emphasises the need for openness, transparency and strong regulatory oversight. This dimension has hardly received attention in this article. In an administrative-political context where the institutional framework is weak and regulations are easily circumvented, this dimension can be extremely important.

Another concern can only be answered in the future. When the expected impacts of climate change increasingly become reality, will governments be able to address the challenges

at the national and international levels without resorting to resource capture? Will they be able to formulate a coherent framework with policies and instruments which reduces structural forms of water scarcity?

Notes

1. In defining 'human security', the Human Development Report 1994 distinguishes two main meanings. Human security means, first, safety from such chronic threats as hunger, disease and repression. And second, it means protection from sudden and hurtful disruptions in the patterns of daily life – whether in homes, in jobs or in communities.
2. A. Dupont, *The environment and security in Pacific Asia*, International Institute for Strategic Studies, Adelphi paper 319, Oxford, Oxford University Press, 1998.
3. N. Kliot et al., *Institutions for management of transboundary water resources: their nature, characteristics and shortcomings*, *Water Policy* 3 (2001) 229-255.
4. A. T. Wolf, *The transboundary fresh water dispute database project*, *Water International* 24(2) (1999) 160-163.
5. For more data on water use per country per sector, see: <http://www.worldwater.org/table2.html>
6. M. Acreman, *Wetland and hydrology*, in: J. Skinner and R. J. Crivelli (Eds.), *Conservation of Mediterranean Wetlands (MedWet)*, Tour du Valat, Arles, France, 2000.
7. F. Pearce, *Wetlands and water resources*, in: J. Skinner and A. J. Crivelli (Eds.), *Conservation of Mediterranean Wetlands (MedWet)*, Tour du Valet, Arles, France, 1996.
8. R. Ragab and C. Prudhomme, *Climate change and water resources management in arid and semi-arid regions: prospective and challenges for the 21st century*, *Biosystems Engineering*. 81 (1) (2002) 3-34. (Published by the Silsoe Research Institute).
9. P. H. Gleick et al., *The New Economy of Water; the Risks and Benefits of Globalization and Privatization of Fresh Water*, Pacific Institute for Studies in Development, Environment and Security, Oakland, CA, 2002.
10. For more information on waterborne diseases, see: <http://www.worldwater.org/table22.htm>.
11. For more information see: *World Water Assessment Programme*, 2003.
12. Falling groundwater levels may reduce water levels in shallow dugwells located in the same area.
13. Ridgeway and Jacques [18; p. 601] refer to Homer-Dixon and Blitt who 'identify five key social effects of environmental scarcity: constrained agricultural output, constrained economic production, migration, social segmentation, and disruption of institutions'.
14. L. Ohlsson, *Water conflicts and social resource scarcity*. *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere* 25 (3) (2000), 213-220.
15. T. Homer-Dixon and J. Blitt (Eds.), *Ecoviolence: links among environment, population, and security*, Rowman and Littlefield, Lanham, MD, 1998.
16. T. Homer-Dixon and J. Blitt (Eds.), *Environmental Scarcity and Global Security*, Foreign Policy Association, New York, 1998.
17. One of the questions which is not that often addressed in the literature on water scarcity, is the question whether water scarcity has been induced as instrument to cause human suffering among particular groups of the population. Earlier publications on food distribution policies suggest that deliberate withholding food from populations has been used by various regimes as means to weaken particular groups in society such as by the former Iraqi regime toward Kurdish people. In India, discrimination in access to water and land resources between members of various castes reflects an

- asymmetry of power relations between these castes. This discrimination further weakens the position of Dalits (<http://www.idsn.org>).
18. S. Ridgeway and P. Jacques Population-conflict models: blaming the poor for poverty, *The Social Science Journal* 39 (2002) 599-612.
 19. T. F. Homer-Dixon, *Environment, Scarcity, and Violence*, Princeton University Press, 1999.
 20. B. M. Knauff, *Melanesian warfare: a theoretical history*, *Oceania* 60 (1990) 250-311.
 21. P. Richards, *No Peace, No War: An Anthropology of Contemporary Armed Conflicts*, Ohio University Press, 2004.
 22. This can also include non-material dimensions, such as access to media and political titles (see [21; p. 7]).
 23. F. Tao et al., Future climate change, the agricultural water cycle, and agricultural production in China, *Agriculture, Ecosystems & Environment* 95 (1) (2003) 203-215.
 24. Ragab and Prudhomme [8] discuss the disruption of prevailing water balance in more detail. Population increase and large scale irrigation development has led to a large reduction of the Aral Sea, and to loss of climate modifying function, and a change of the climate with 'shorter, hotter, rainless summers and longer, colder, snowless winters' (p. 24).
 25. M. Monirul Qader Mirza, Global warming and changes in the probability of occurrence of floods in Bangladesh and implications, *Global Environmental Change* 12 (2) (2002) 127-138.
 26. The Intergovernmental Panel on Climate Change (which published its main assessment reports in 1990, 1996 and 2001) has urged water managers to begin a systematic re-examination of engineering design criteria, operating rules, contingency plans and water allocation policies.
 27. The West Africa Long Term Perspective Study (WALTPS) is an example of a large-scale programme which sought to consider the relations between population, economy, space and social change in the long term, although climate change was not included. See J. M. Cour and S. Snrech, *West Africa Long-Term Perspective Study: preparing for the future – a vision of West Africa in the year 2020*, OECD/Club du Sahel, 1998.
 28. This capacity is related to the availability of economic resources, human resources, technological capacity, political willingness, legislative powers, etc.
 29. J. Gupta, *The Climate Change Convention and Developing Countries: From Conflict to Consensus? Environment and Policy*, Vol. 8, Kluwer Academic Publishers, Dordrecht/Boston/London, 1997.
 30. Gupta argues that the domestic position of policy makers 'has been influenced by (a) a lack of domestic debate; (b) the lack of well-developed scientific communities on climate change and hence the resort to a historical perspective; (c) issue linkages and the different order of priorities; and (d) ideological vacillation (or uncertainty)' [29; p. 52].
 31. See <http://www.johannesburgsummit.org>.
 32. For a detailed analysis of the relation between globalisation and privatisation of fresh water, see [9]. See also A. Hildering, *International Law, Sustainable Development and Water Management*, Eburon Academic Publishers, Delft, 2004, chapter 5 (on water as an economic good).
 33. Domestic conflicts over water are often related to economic or agricultural reforms, or changes in water legislation, which affect water rights of different groups. For a more detailed discussion, see Boelens and Hoogendam (Eds.), *Water Rights and Empowerment*, Van Gorcum, Assen, 2002.
 34. The company filed a case against the Govt. of Bolivia for several million of dollars compensation.
 35. Based on the presentation of one of the female activists at the Seminar on 'Globalisation, power and gender'; IUED, Geneva, 31 January-1 February 2003; see also Gleick et al. 2002, p. 32.
-

-
36. For several quotes reflecting the assumption that water shortages are likely to develop into violent conflict, see [37; pp. 972-973].
 37. H. P. W. Tose et al., Shared rivers and interstate conflict, *Political Geography* 19 (2000) 971-996.
 38. E. Feitelson, The ebb and flow of Arab-Israeli water conflicts: are past confrontations likely to resurface?, *Water policy* 2 (4-5) (2000) 343-363.
 39. The Mekong, Indus, Ganges, Nile, Jordan, Danube, Elbe, Rio Grande and Colorado, Rio de la Plata, Senegal and Niger.
 40. They conducted research on factors which contribute to conflict or co-operation, including biophysical, socio-economic, and geopolitical variables at multiple spatial and temporal scales from a GIS of international river basins and associated countries, testing these variables using a database of historical incidents of water-related co-operation and conflict across all international basins, 1948-1999.
 41. A. T. Wolf, S. B. Yoffe and M. Giordano, International waters; identifying basins at risk, *Water Policy* 5 (1) (2003) 29-60. S. B. Yoffe, A. T. Wolf and M. Giordano, Conflict and co-operation over international freshwater resources: indicators and findings of the basins at risk project, in: S. B. Yoffe et al. (Eds.), *Basins at Risk: Conflict and Co-operation over International Freshwater Resources*, 2000, pp. 64-120.
-