The Blue Revolution: Adapting To Climate Change

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06

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Thought Leadership Series #6

Introduction: If mitigation is about energy, adaptation is about water

The global climate has been changing since time immemorial, and the inhabitants of the Earth have had to either adapt to these changes, or disappear. Some changes have been slowly evolving over millenniums; others have been faster, evolving over centuries, or even decades. Whilst in the past climatic change has been due to natural causes, the past century has seen such rapid changes, and indications of more changes to come, that only a combination of natural and man-induced causes can explain it. So, while climate change is not new, the present pace and scale of it is worrying, to the extent that it now dominates the global political discourse.

The debate has two dimensions: Mitigation and adaptation. The *mitigation* dimension is concerned with looking at how to reduce the human impact on the main drivers of climate change by limiting emissions of greenhouse gases, primarily by reducing our energy consumption or changing the energy mix. The *adaptation* dimension is concerned with how to deal with the impacts of climate change: those already observed, those predicted to happen with a high degree of certainty, and those more uncertain, but also more frightening impacts that may happen.

For good reasons the political debate has centered on the first aspect, the root cause of the problem. This needs to be the subject of binding global agreements and treaties. The second dimension, the adaptation challenge, has so far taken second place in the debate, including at COP15, the UN Climate Change Conference in Copenhagen in December 2009. The political debate on adaptation has focused almost entirely on "*how much*", i.e. on the level of financial support from rich to poor countries; the "*what*" and "*how*" discussion has largely remained in the technical spheres and are not likely to enter into a new treaty, other than – at best - in the Annexes.

Obviously the world community is concerned, and extensive work has been carried out to predict impacts on a broad scale, not least by the Nobel Prize Winning Intergovernmental Panel on Climate Change (IPCC), former US Vice President Al Gore, and the sobering analyses on the economics of climate change by Lord Nicolas Stern.

However, how to move from the global predictions and impressive global modeling outputs and maps produced by the IPCC and others, to *understanding the actual impact at the local level -the consequences for the affected population, and the possible courses of action for them-* has not been an important part of the debate. The reliance on broad global assessments, and the lack of understanding of the real issues facing the exposed populations, implies that our decision-makers do not appreciate the nature and scale of the adaptation challenge, with the risk of acting by *doing too little too late*.

The purpose of this essay is to contribute to the understanding of how climate change impacts affect us, and how we may adapt to these impacts. A basic message is that most of the climate change impact in fact "hit" through the land and water system, or in other words, *if mitigation is about energy, then adaptation is about water.*

At the same time, we offer a new perspective on the water challenge: the parallels to the climate challenge are evident – and, hence, so are many of the solutions.

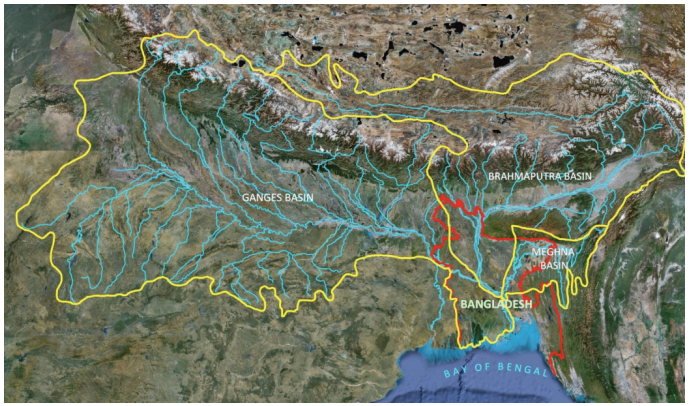
The Challenge

Water is like the blood of the body?

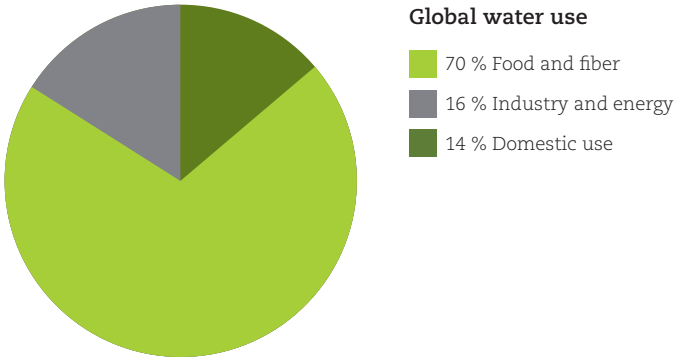
Human existence is linked to water. Without drinking we can live only few days, our ecosystems and biodiversity depend on water, we need water to grow our food, we need water to sustain almost all our productive activities, and we need water to carry away our wastes. Water is everywhere around us: the rain and snow hits the land, where it either runs off and appears as rivers or lakes, or seeps into the ground to sustain vegetation and replenish our vitally important bank of groundwater. *Water is to our environment like the blood of the body*[1]: it nurtures all parts of it, and all parts depend on it to function properly.

But water is also a finite and vulnerable resource, easy to destroy. Some places, like parts of North America and Europe, water is plentiful; in these regions our main challenge is to maintain its quality. But in most parts of the world water resource is under stress, especially in the monsoon climates where 80% of rain falls in 3 months, resulting in too much water and often serious floods in the wet season, and too little, and often serious droughts, in the dry season. Bridging the gap between wet and dry, balancing the uses between competing demands in water scarce areas, meeting the rapidly growing water demands of the big cities, sharing scarce water between countries sharing the same river, investing in treatment of wastewater etc. etc. are all critically important challenges. This is particularly so in the poor and populous countries of the South, with little technical and financial capacity.

1 ...and as expressed by Falkenmark "the lymph carrying our wastes"



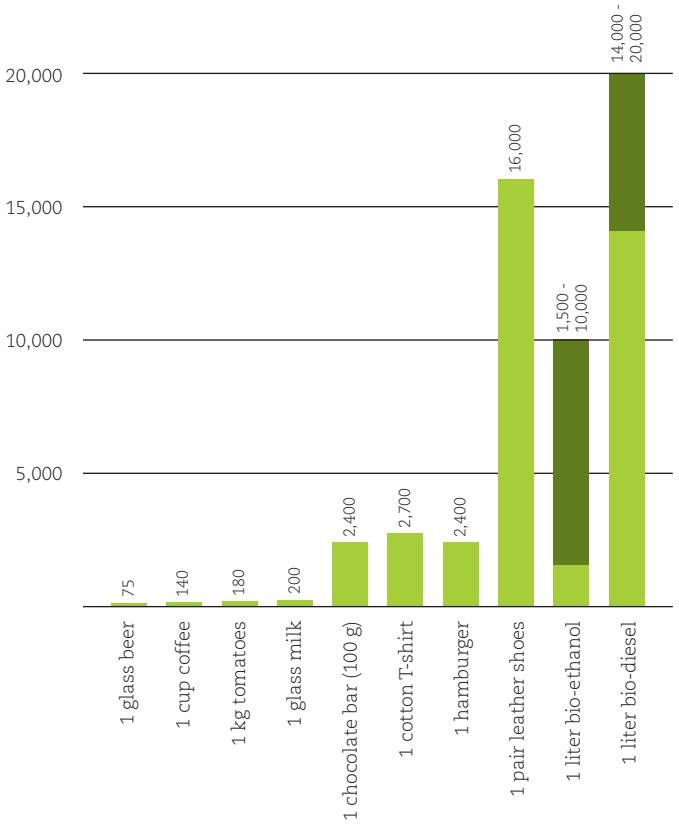
The Ganges-Brahmaputra-Meghna
The river basin as the life line of a major region: as evident from looking at a map of any major basin, the river system "feeds the land", and any change in water flows will affect the environment and livelihoods and people living there.



Globally only some 14% of all water use is for domestic use (drinking, cooking, washing etc.). 70% of all water is used for growing food and fiber, with most of the remaining 16% being used for industrial and energy purposes[2]. Each day, a person drinks 2–4 liters of water but eats food that requires 2,000–5,000 liters of water in its production. Hence, providing the basic water needs to people is not a water problem; it is a *political problem*. All countries can do that. But feeding 9 billion people in 2050 (an additional 2.5 billion people from today) is a *water challenge*, which calls for fundamental technological and management changes, and international solidarity and cooperation.

2 The figures in this section are from World Water Development Report (WWDR), UNESCO, 2009, the Comprehensive Assessment of Water in Agriculture, CGIAR, (CA), 2007, the 2003 Water Resources Group (2009) and the World Development Report (2009)

The "water footprints" of select products (liters per product)



Definition: The water footprint of a product (good or service) is the volume of fresh water used to produce the product, summed over the various steps of the production chain. 'Water use' is measured in terms of water volumes consumed (evaporated) and/or polluted. Source: www.waterfootprint.org

The status as of today is sobering: global water use has tripled over the last 50 years, and almost 50% of the world's population is estimated to live under water stress by 2030 in a 'business as usual'-scenario. More than 20% of our food production is unsustainable, relying on over pumping of finite groundwater resources. A major boost to agricultural production, and also to productivity of water in agriculture ("more crop per drop"), was achieved with the green revolution. *The International Water Management Institute now calls for a blue revolution as the only way forward*. While many developing countries use precious water to grow 1 ton of rice per hectare, other countries produce 5 tons per hectare under similar social and water conditions, but with better technology and management.

Hence the message, and the ***call for a blue revolution***, is a constructive one. If we behave intelligently, and collaborate between neighbors, between neighboring countries, between North and South, and in the global trading system, we shall not 'run out of water'. If we do not, and "business as usual" prevails, then local and regional water conflicts will accelerate. *The world does not face a "water crisis", but a "crisis of water governance" which can be prevented*.

In this sense the so-called "water crisis", and the "climate change crisis", have common features: they are largely created by man, they impact poor nations more, there is a global inbalance in consumption patterns and it impacts heavily efforts to eradicate poverty and improve health conditions. It is up to us, as hopefully intelligent societies, to reduce their magnitude and negative consequences.

Total renewable water ressource per capita (cum/capita/year)

Industrialized		Developing	
Above "min requirement for active and healthy life"			
Greenland	11,000,000	Guyana	320,000
Canada	94,000	Solomon Islands	100,000
Russia	31,000	Ecuador	34,000
Australia	26,000	Congo	25,000
United States	11,000	Vietnam	11,000
France	3,400	Cuba	3,400
UK	2,400	China	2,200
Germany	1,900	India	1,900
Below "min requirement for active and healthy life"			
		South Africa	1,100
		Tunisia	480
Israel	280	Yemen	270
		Maldives	100
		Bahamas	70

Wet getting wet, dry getting drier

Global warming affect us in many ways, some very directly through the direct impact of temperature increase, but most of the climate change impacts are indirect, such as e.g. sea level rise caused by a combination of accelerated melting of snow and ice, and expansion of sea water due to higher temperature.

In a very general sense the expected effects of climate change are for "wet getting wetter", and "dry getting drier", and with a general acceleration of extreme events: rain storms, floods, droughts and cyclones. Hence the effects through the water cycle are two-fold: *climate change* leading to changed patterns of rainfall, run-off (river flow) and water quality, and increased *climate variability* leading to a worsening of extremes events. In the coastal areas these effects are compounded by the sea level rise. The three types of impacts are different, and call for different responses in terms of adaptation, but they are also strongly inter-related.

Climate change is by IPCC estimated to result in 10-40% increase in precipitation in higher latitudes, and a 10-30% decrease in mid-latitudes and the dry tropics[3]. The former is "bad news" to many Westerners for whom a wetter climate may be uncomfortable. But the latter is catastrophic to millions of poor people in the developing countries, such as parts of Africa where 70-250 million people are expected to be exposed to increased water stress by 2050, in areas which already suffer from water shortages most of the year. A derived effect of that is an expected decrease in agricultural production in parts of Africa of up to 50%, impacting people who already struggle to grow food, and in many cases suffer from hunger.

In other parts of the South millions of people depend on the flows of the big rivers from the high mountain ranges, such as the Himalayas and the Andes. These rivers are fed by a combination of rainfall and snowmelt. With the snow cover reducing over time due to warming, as is already observed in receding glaciers, people in the lower reaches of these rivers will experience both changed timing and magnitudes of flow. The Brahmaputra-Ganges-Meghna delta in Bangladesh, for example, is expected to face increased floods in the wet season, and reduced flows in the dry season. The IPCC estimates that snow cover reduction alone will negatively affect 1/6th of the world's population.

The increasing *climate variability* is in the short term even more serious, and is already resulting in increases in the frequency and severity both floods and droughts. *Flooding* tops the list of natural disasters claiming losses of human lives[4], economic assets and livelihoods. With climate change flooding is likely to increase in severity in most parts of the world, to the tune of an estimated increase in world population subjected to floods of 20% by 2080. While floods are very visible, *droughts* can be even more serious in economic and development terms. A bad drought in Zimbabwe cost the country 40% of its agricultural production and 15% of its GDP that year, associated with suffering by many poor people in want of food and jobs. But also the rich world can have difficulties coping with drought; Australia saw its national economic growth lowered by 0.75% during the drought years 2006-2007. Countries like Brazil and Australia that depend strongly on hydro-electricity have seen serious energy problems during droughts.

In many ways these effects combine and accumulate in the *coastal zone*, affected "from the one side" by the impact of changed river flow regimes, and "on the other side" *sea level rise*. The unhappy combination of these events includes increased coastal flooding in the wet season and increased salinity intrusion in the coastal rivers and groundwater in the dry season. More than one third of the world population lives less than 100 km from the coast, and more than 1 billion people live in the major coastal cities, making the mega-deltas of Africa and Asia, the small island states (some of which fear for their very existence) and the big coastal cities as "hot spots" for climate change due to water impacts. Sea level rise is likely to happen faster than previously envisaged, now projected to close to 90 cm rise by the end of the century, rather than the 60 cm originally predicted by the IPCC[5].

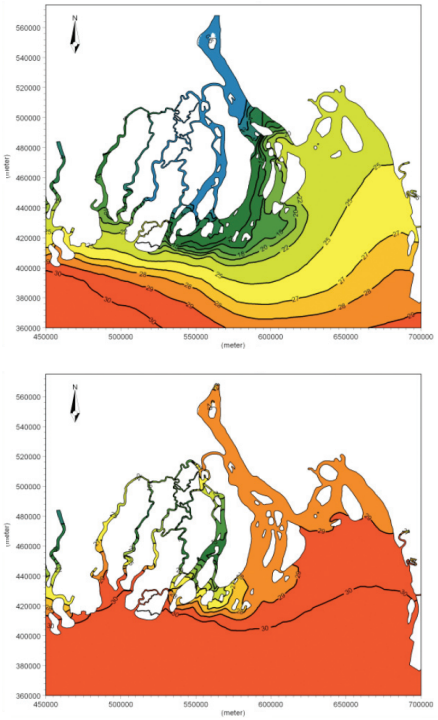
3 Figures in this section are mainly from IPCC's 4th Assessment Report, 2007

4 Flood losses were twice as large per decade between 1996 and 2005, than between 1950 and 1980, and economic losses were 5 times as great (WWDR 2009)

5 IARU Scientific Conference in Copenhagen, March 2009

Not only people are affected. Aquatic ecosystems, such as wetlands, coastal lagoons, inland lakes/seas (such as the Aral Sea and Lake Chad) have already lost half of their biodiversity during the last 50 years, and it is expected that most coral reefs will disappear within the next 50 years[6].

The conclusion of the above can be summarized by the statement of the IPCC that *"water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change"*



Salinity in the delta of Bangladesh
- now and with projected sea level rise in 2100
Results from models of the delta: the more "red' the colors, the higher the salinity. Simulations of the situation by the end of the century show that large parts of the area will become saltier, with serious effects for the water supply and productive activities of millions of poor people.

The poor are likely to suffer the most

Clearly, these changes will affect all of us, rich and poor, north and south, but with different force, and affecting people and societies with hugely different capacities to cope.

6 UNEP (GPA) estimates that 80% of pollutants to the marine environment are from land-based sources, i.e. from the river systems

The potential *impact* of climate change is a combination of our exposure to expected changes, and the sensitivity of these changes on our lives. The *vulnerability* is a combination of the impact and our capacity to adapt.

Countries of the North are generally less vulnerable than those of the South, even where impacts are potentially serious. The Netherlands, for example, with large parts of the country under sea level, depend on major coastal engineering structures such as dikes and sluices for their safety, and sea level rise is a serious threat to address. However, the Dutch have the knowledge, the technology and the financial resources to cope with that. Another low lying country, Bangladesh, to be affected by a combination of sea level rise, as well as increased floods and decreased low flows from the upstream Ganges- Brahmaputra River Basin, does not have the human, technological and financial capacity to address these changes, leaving the affected population in a very vulnerable situation.

The poor countries are already struggling to achieve the *Millennium Development Goals (MDG)*[7] to reduce poverty, hunger, diseases, illiteracy and environmental degradation. These goals all depend on water for their achievement: for basic domestic consumption and livelihoods, as well as for the production of food, and for the creation of jobs. At the same time the destructive characteristics of water are a threat to their achievement when floods and drought hit, when water-borne diseases strike, and when the lack of water forces girls to spend their day collecting water rather than going to school. With climate change the positive contribution of water to the MDGs will be reduced, and the destructive impacts will increase. It is the poor who live in the flood plains, the poor whose children are most likely to suffer, and die, from water-borne diseases; and the poor who lose their jobs when droughts destroy agricultural production.

As expressed by the IPCC Chair in 2008: *"Very soon, climate change impacts will exceed the capacities of local communities. And remember, poorest countries, and the poorest communities in these countries are the most vulnerable to these effects"*.

7 The Millennium Declaration of the UN

The Solutions

Protect, adapt or relocate

In the coastal zone three options are often mentioned: *protect, adapt or relocate*. Whilst logical in that situation, that thinking does in fact apply more generally: we can build new and "climate proof" existing infrastructure; we can try to adapt our ways to better live with changes; or we can give up and leave.

As argued, the most vulnerable are the poor population segments in the developing countries whose future livelihoods to a large extent depend on what happens to and through their water resources. In recognition of that, and as a contribution to the UNFCCC negotiations towards COP15, the Danish Ministry of Foreign Affairs/Danida, working with development partners, took the initiative to launch a "Dialogue on Adaptation to Climate Change for Land and Water Management", with focus on the poorest countries. Through a series of consultations from Copenhagen (November 2008) through Hanoi (Asia), Bamako (Arica), Istanbul (the world Water Forum), to a Ministerial Conference in Nairobi in April 2009 these issues were debated with stakeholders from developing countries and their international support partners with the aim of identifying the "way forward". The essence of that was distilled in the final conference in Nairobi in five simple "guiding principles", as can be seen in the Box.

Land and Water Guiding Principles for Adaptation to Climate Change

Preamble
Land and water resources, essential to development and livelihoods, are particularly vulnerable to impacts of climate change. Actions to adapt to climate change through an integrated approach to land and water management are urgently needed.

Guiding Principle No. 1 (Sustainable Development)
Adaptation must be addressed in a broader development context, recognizing climate change as an added challenge to reducing poverty, hunger, diseases and environmental degradation.

Guiding Principle No. 2 (Resilience)
Building resilience to ongoing and future climate change calls for adaptation to start now by addressing existing problems in land and water management.

Guiding Principle No. 3 (Governance)
Strengthening institutions for land and water management is crucial for effective adaptation and should build on the principles of participation of civil society, gender equality, subsidiarity and decentralisation.

Guiding Principle No. 4 (Information)
Information and knowledge for local adaptation must be improved, and must be considered a public good to be shared at all levels.

Guiding Principle No. 5 (Economics and Financing)
The cost of inaction, and the economic and social benefits of adaptation actions, calls for increased and innovative investment and financing.

Adopted in Nairobi, April 2009

The vital role of water in all sectors

The official negotiations and the public debate on climate change have all but cleared the front pages for several years, leaving the impression that climate change as a driver of change is the world's overriding concern. Such a one-dimensional focus on climate change, without proper understanding of the broader development context of change, may lead us to consider this driver of change in isolation. However, the world has recently been through series of crises – food crisis, energy crisis, financial crisis – the impacts of which have been serious in the short term and attracted almost all political attention. So while climate change, and what kind of world we leave for our grandchildren may be an overriding concern for the long term, it needs to be considered and balanced among other drivers of change such as population growth, economic growth, urbanization etc. in the short to medium term.

The concern for the poor and disadvantaged groups of society is linked to achieving the MDGs, and developing countries have committed themselves to pursue these goals and prepared policies, strategies and plans to do so. Water as a cross-cutting societal issue, linked to all aspects of achieving the MDGs, needs to be mainstreamed in these efforts. In some countries it is; in others water is still being treated in an uncoordinated and fragmented manner. The internationally recognized approach to promote this integration is "Integrated water resources management" (IWRM) which acknowledges the vital role of water in all societal sectors, and hence the need to manage it, and balance its uses, between all use sectors (domestic, agriculture, energy, industry etc.), and the environment, and in dialogue with concerned stakeholders.

Climate change impacts are equally cross-cutting, and both mitigation and adaptation to climate change calls for integrated and holistic approaches. With the pivotal role of land and water management in adaptation to climate change, IWRM becomes the logical approach, not only to water management, but also to adaptation to climate change for land and water resources management. This was acknowledged by IPCC which in the 4th Assessment Report states that "it can be expected that the paradigm of Integrated Water Resources Management will be increasingly followed around the world which will move water, as a resource and a habitat, into the centre of policy making. This is likely to decrease the vulnerability of freshwater systems to climate change".

Hence *adaptation should not be seen as a "new business", or "discipline", with its own life*, and with separate governance structures and programmes. That would only fuel the fragmentation that is already a main constraint to sustainable development. Adaptation must be mainstreamed and addressed as an integral part of society's development to achieve its "triple bottom line": economic development, social equity and environmental sustainability.

Adressing problems now, while designing for the future

Hydrological change and variability, including floods, droughts and cyclones, are not new, but most developing countries are not well equipped to address them. For floods, for example, lack of early warning and preparedness, human developments causing reduction in the retention capacity of natural ecosystems, lack of protective infrastructure (dams, dikes), lack of enforcement of flood plain zoning, lack of a functioning disaster risk reduction framework etc. all result in unnecessary loss of lives and livelihoods every year in the developing countries. Drought losses are similarly unnecessarily high due to poor foresight and management. Any action to deal with the present variability will help build robustness and resilience to face an uncertain future. In other words *there is no excuse not to start now by addressing existing problems*.

There are many types of measures to take which at the same time address existing problems and build resilience for the future. Flood and drought management is just one example, others include better, more robust and less water intensive agricultural practices[8] ; measures to conserve water and reduce domestic and industrial water demand through pricing and water conserving technologies; and measures to reduce the "water footprints" of energy production. The common term for such measures is *water demand management* which because it economizes on our

8 CGIAR (CA) estimates that of 75% of the projected "water gap" can be eliminated if 80% of farmers move from low to high water productivity

scarce water resources has been practiced long before we thought about climate change. However, with climate change as the "added driver" such practices now serve a dual purpose of good water management while at the same time building resilience to climate change. The potential gains are significant: the Mediterranean organization Plan Bleu estimates that water demand in that region can be reduced by 25% by 2025 through proper demand management more than 60% of which is in agriculture. A commonly used terminology for such action is *"no regret" solutions*.

However, not all adaptation challenges are "no regret". There is no way around biting the bullet and, in spite of the uncertainty involved, design measures specifically to address expected future climate impacts. Sea level rise on the Dutch coast, for example, can be addressed only by building more infrastructure; the new metro in Copenhagen needs to be designed – and "climate proofed" - for higher rainfall intensities than we have seen in the past; and dikes at selected locations will certainly be required to protect part of the dense population in the Mekong delta in Viet Nam. These are all examples of *"climate induced adaptation actions"*.

"Hard" and "soft" adaptation measures

Actions toward adaptation take many forms. In the case of the Dutch dikes they are structural solutions, or *"hard" adaptation measures*, which require considerable investments. Other examples include dams for water storage. The American and Australian societies have developed over centuries by building dams to secure food and energy production, protection against floods, and storage of water to increase dry season water security and reduce the impacts of droughts. About 5,000 cubic meters are stored per person in these countries. In Africa and parts of Asia, with monsoon climates and a lot higher hydrologic variability, countries such as Ethiopia have as little as 40 cubic meters in storage per person. Hence for such countries building robustness to climate variability (existing and future) require investments in water infrastructure in the form of dams, canal, dikes etc. In the Middle East and other dry zones of the world desalination may be the most appropriate solution, even at high financial cost and energy use.

On the other hand, as is the case with flood management and many forms of demand management, a range of *"soft" adaptation measures* can help building robustness and resilience by improved water governance and management. This involves building on the "three pillars" of integrated water resources management: strengthening the enabling conditions in the form of better water policies, strategies and laws; strengthening the institutional framework at national, local and basin levels; and strengthening the management instruments available to these institutions to do their job, including regulatory and economic instruments to promote more efficient water use.

Clearly, adaptation cannot be divided up in "hard" and "soft" alone. A combination of measures will often be required, as, for example, what is often called "3 R": recharging the groundwater; promoting natural retention of water by watershed management; and reusing and recycling water, e.g. by using domestic wastewater for irrigation[9] , or even for drinking as Singapore's "NEWater".

Strengthening capacity on all levels

The impacts of climate change, and the adaptation measures required, span a wide range from the village level where people themselves will need to adapt to changing circumstances, through actions at the national level, to international cooperation between countries sharing the same river. It is a major cross-cutting governance challenge which calls for collaboration between sectors and ministries, as well as involvement of people through multi-stakeholder consultation and dialogue. Some adaptation measures can be taken and decided by government in a top-down process, others are purely local, but in most cases top-down and bottom-up processes will need to meet. These processes must build on generally recognized principles of good governance, such as participation of civil society, gender equality, subsidiarity[10] and decentralization.

The added "water dimension" is the trans-boundary nature of water: more that 40% of the world population lives in

9 Israel reuses 40% of its domestic wastewater for irrigation
10 Handled by the smallest, lowest or least centralized competent authority

shared river basins (such as the Rhine or the Danube in Europe; or the Nile, the Amazon or the Mekong in Africa, South America and Asia). Already, due to increasing pressure on limited water resources, the cooperation and sharing of water, and benefits to water such as hydro- electricity, is a challenge; with climate change such cooperation becomes even more critical, and difficult.

While countries of the north may have adequate knowledge, technology and administrative capacity to deal with this, that is not the case in most developing countries. The added pressure to deal with climate change in addition to all other challenges faced by these countries requires massive capacity building and technology transfers. This was recognized in the "Bali Action Plan" adopted at COP13 in Bali, Indonesia, in 2007.

Improving and sharing know-how

Although we find ourselves in a situation of great uncertainty about future climate change, we do know enough to act now. *Lack of information is no excuse for inaction* and a wide range of "no regret" actions call for immediate attention.

The global circulation models used by the IPCC (the many maps of changes that we always see) are very useful to get the overall picture. We need them. But they are very coarse (each point covering several hundred square kilometers), and in many places of the world they give different results. Some places detailed local models can be developed to predict impacts, but because of the uncertainty in the global models these detailed analyses may look very precise, but in fact be wrong. So in predicting climate change impacts it is often better *to be approximately right than precisely wrong*.

So, again, the local decision makers may be wise in *identifying immediate "no regret" actions for the short term, while investing resources in science and technology to provide better and more reliable answers for the future*. For planners and decision makers at the national level, including those preparing National Action Plans for Adaptation (NAPAs), some choices have to be made for now, pending better information in the future. Some countries, like those in the European, choose to believe in an (optimistic) *"2 degree world"*; others like Vietnam base their adaptation planning on a range of future scenarios.

A very nasty aspect of climate change from a water manager point of view is that our traditional hydrological sciences and methods have run into difficulties, or as hydrologist put it: *data stationarity is dead*. We used to be able to use historical records to predict the future and design water infrastructure to, say, a 100 year event, i.e. something that statically would happen only once in a hundred years. With climate change that is no longer possible; what used to be a 100 year event may now happen every 30 years. We simply don't know.

As climate change impact us through the hydrological cycle, knowledge about such impacts, whether long-term change or short-term early warning, needs to be shared among people and across river basins. Adaptation actions to be taken by farmers in the Mekong delta, for example, depend on information about both hydrological and man-made changes in the upper parts of the basin in China, the former about changes in snowmelt and rainfall, the latter about the construction and operation of dams on the river. This interdependency is not new; data and information sharing in trans-boundary river basin has always been a contentious and controversial issue. But with climate change as a "new" challenge, transparency and sharing of data and information becomes even more important. *Climate information needs to be considered a public good, to be shared all levels*.

Investment in adaptation is required - soon

Lord Nicholas Stern has said it very clearly: annual global investments needed to avoid the worst impacts of climate change could be limited to 1% of global GP each year if action starts now. The *cost of inaction* would be equivalent to losing at least 5% of global GDP each year[11].

While the global climate discourse so far has focused primarily on the cost of mitigation, the need for investment in adaptation has increasingly entered into the debate,

11 The Stern Review, 2006

with COP13 in Bali making some progress towards global funds for adaptation, along with promotion of technology transfer and capacity building to the developing countries. However, the current estimate of the magnitude of the global Adaptation Fund, based on transfers of 2% the Clean Development Mechanism (CDM) turn-over, would result in some 500 million US$ in the fund by 2012. This is far short of current estimates of billons of US$ needed for adaptation in the developing countries, or the order of magnitude of 1% of global GDP recently estimated by the World Bank. A range of other mechanisms, such as "green bonds" etc., are being created to support adaptation, but so far small compared to the needs. Donor agencies and development banks are currently busy earmarking funds for adaptation; the question is if these funds are *"additional"*, or simply a reallocation resulting in less support for other development needs towards achieving the MDGs.

Investing smartly – and exploring synergies between mitigation and adaptation

Many things indicate that it is a fundamental problem, that *"mitigation" and "adaptation" so far has been seen as separate issues*, and addressed by different people in different fora. The political will to discuss and invest in adaptation may increase if the links and synergies between the two were highlighted and reflected in financing mechanisms. There are many interconnections.

One obvious example is that of the *water-energy-climate nexus*. Electricity demands are increasing fast, in Asia some 8% per year, and production of energy requires water, sometimes lots of it, which is often not considered in energy planning. In the US and EU some 35-50% of all water abstracted is for energy, mostly cooling water that returns to the system, but needs to be made available. The production of one liter of first generation bio-ethanol consumes 2-3,000 liters of water, which in water and food short regions may, inadvertently, amount to "converting food to fuel". Hydropower, often seen as an ideal renewable energy source, results in significant evaporation losses to the atmosphere in some parts of the world. In that light solar and wind energy is water neutral. In short, the "water footprints of energy production" can be significant, and have significant consequences for water resources management, and hence for adaptation.

Conversely, water development may be very energy intensive, resulting in "energy footprints for water", which in turn increase greenhouse gas emissions and hence fuels the vicious water-energy-climate cycle. Most of this energy is used for pumping and treatment, with large-scale irrigation pumping, or even inter-basin transfer of water between rivers, being examples in the very high end. In the US alone water related energy use accounted for some 13% of the total electricity use in 2008, emitting the equivalent of 62 coal fired power plants[12].

Clearly, other considerations, not least economic, enter into the decisions on how to produce energy, and where and how to develop water resources. But the water and energy footprints could serve as a reminder of the inter-connectivity, and lead to *"energy smart" water investments, and "water smart" energy investments,* which in climate terms would contribute to both mitigation and adaptation.

Another example of the potential synergy between mitigation and adaptation is the potential of *improved land use and agricultural practices*. It is estimated that 14% of all greenhouse gas emissions come from agriculture, and an additional 19% from land use change and deforestation in the form of reduced carbon sequestration (carbon absorbed by the plants)[13]. When forest and other vegetation is cleared, and a land surface is left exposed to intensive rains that produce floods and erode the soil. Conservation and re-planting of forest and other vegetation will at the same time contribute to sequestering of carbon, and to reducing the impacts of intensive rains. The World Bank supports this under the slogan *"re-carbonizing the landscape"*.

Through improved land use and agricultural practices, im proved agricultural water management and increased water use efficiency, selection of drought and/or salinity resistant crop varieties, afforestation etc. the rural population may adapt and thus build resilience to climate change. At the same time these actions all contribute to both mitigation

12 The Carbon Footprint of Water, River Network, 2009
13 Ref: IFPRI, 2020 Vision for Food, Agriculture and the Environment, 2009

and adaptation, and should consequently qualify for additional "climate funding".

Finally, Lord Nicholas Stern recently argued that by eating meat we contribute to methane gas emissions, and hence to climate change. The same argument can be made for water: it takes 900 tons of water to produce one ton of maize, but 25,000 tons of water to produce one ton of beef. The conclusion is clear: *we can all at the individual level contribute to both mitigation and adaptation by becoming vegetarians!*

The role of the private sector

The title of the 2nd World Water Forum in The Hague in 2000 was *"water is everybody's business"*. All stakeholders have their role to play in the development and management of the resource: the governments, civil society, NGO's, academia and, not least, the private sector. The same is true for our efforts to mitigate and adapt to climate change. In a globalized world the private sector is becoming increasingly important, from the global corporations with capacity to mobilize technologies and financing for major projects, to the small local business or entrepreneur.

Looking at the former, and their engagement and potential role in water related climate mitigation and adaptation, the world is changing fast. "Corporate social responsibility" (CSR) now extends into environment/energy (being "green"), climate and poverty consciousness. At the same time, with the investment gap in water infrastructure in the developing world increasing rather than closing[14], the role of the private sector in engaging broadly in the development process is becoming critically important. Poor governments and inadequate international assistance cannot do it alone.

In addressing water and climate the private sector has a wide ranging and important role and potential: the financial institutions providing investments in water supply, hydropower, irrigation and other water related developments; the large industrial users requiring water for industrial, mining, energy and other developments; the agricultural producers and other players from "soil to table"; the knowledge and technology providers on whom we rely for everything from "source to sea" in providing, treating an transporting water; and increasingly the *construction sector* engaging in water infrastructure development. Most of the major businesses have not only CSR strategies, but also policies and strategies related to environment water and climate. As an example, Shell, The Coca-Cola Company, Nestlé S.A. and others all have water departments, and they participate actively in the European Water Partnership[15] and its activities to promote better "water stewardship" in Europe, focusing among other things on reducing the water footprints of industrial products and possible moving towards "water labelling" in Europe.

How do we mobilize this potential to the benefit of the developing countries? Both parties have an interest, and both parties need to contribute. For the developing countries, and for the international agencies and banks supporting them, the *political framework conditions and local capacity* of the recipient governments to deal competently with the private sector need to be enhanced. This is already happening in many places, such as in large parts of Asia; the good examples should be shared and replicated. For the private sector the challenge is to continue research and development into new knowledge and technologies for both mitigation and adaptation, including practical tools for the develop ing countries to apply. This will require investments and resources from both the industry itself and from the international community.

A recent manifestation of the consciousness of big industry in addressing the global water challenges is the *"2030 Water Resources Group"* formed in 2008 "to contribute new insights to the increasingly critical issue of water resources scarcity", and hence by implication the additional challenge of climate change. This group was initially sponsored by the International Finance Corporation (IFC) of the world Bank Group, with McKinsey & Company as the overall manager. Members include The Barilla Group, The Coca-Cola Company, Nestlé S. A., SAB Miller plc, New Holland Agriculture, Standard Chartered Bank and Syngenta AG, i.e. a very diverse and powerful group illustrating the wide range of

14 "Charting Our Water Future" by 2003 Water Resources Group, 2009

15 http://www.ewp.eu/

opportunities for business engagement. With technical and financial resources that may otherwise have been difficult to mobilise that Group has recently worked with more than 300 experts to produce the important publication "Charting Our Water Future" which, although it does not address climate change specifically, takes a fresh look at economic frameworks to inform decision-making in water. Other groups such as the *world Business Council for Sustainable Development* also mobilize the resources and perspectives of the private sector to move the water and climate agenda forward.

An important aspect of engaging stakeholders more deeply in the global response to the water crisis is no doubt the opportunities inherent in this. Improved frameworks and wider, even global collaboration on water solutions presents opportunities for sustainable growth, new "blue" jobs both for the industrialised and the developing economies, e.g. through technological partnerships.

Indeed, the growth potential is a compelling argument for the private sector to become involved vis-a-vis the CSR-arguments.

Turning the risks into new opportunities for society and business has been a core concept of the *Copenhagen Climate Council* and some of the Danish-based knowledge providers and industries involved. This applies not only from the low carbon solutions, but also water solutions. And there are plenty of good examples of how the private sector can engage and add value to mitigation and adaptation to climate change.

The Grundfos example

There are several examples of water technology suppliers with an important role in both mitigation and adaptation. One example is *Grundfos*, well known as a global leader in pump solutions. However, the company is also recongnized as a leader in global water consciousness and knowledge, trying to develop holistic solutions with concern for the environment and our climate, and in recent years very focused on the water-energy-climate nexus. Hence reducing energy use in pumping has been an important goal for the company even before the climate debate emerged. Grundfos was the first to market A-level circular pumps which use up to 80% less energy than the traditional D-labelled pumpsThe EU has just adopted legislation which imposes stricter requirements for circulators based on the technology that Grundfos innovated and implemented. This is an example of how companies can take the lead in green innovation subsequently adopted by the political system.

The political system on national and international level should also take the lead in close dialogue with responsible companies and make demands that can foster the creation of markets where technologies are promoted and protected. This example shows that it is feasible. The political system need to create incentives for green innovation. But like individuals it is also important for businesses to be champions, to "show the way". In the case of Grundfos their own water consumption has been reduced by 34% from 2000 to 2008, and the company has set new and ambitious targets for the future.

The "knowledge industry" has been confronted with major challenges in addressing climate change: reducing the uncertainty within which all future adaptation decisions have to be taken. One such knowledge and technology provider is *DHI*, known for its state-of-the-art standing in addressing almost all aspects of the water environment and its interrelationship with society. In the chain from global scenarios and GCMs to local decision-making suchmodels and decision support tools are being put to the test. The example above showing the salinity development in the delta of Bangladesh is produced by a local Bangladeshi institute for which capacity has been built by DHI to model the complex

water environment of the country, from the basin scale to the headwaters of Brahmaputra-Ganges-Meghna Rivers to the water levels, flows and water quality at village level. Other examples of the use of such technologies are prediction of climate change impacts, and strategies to address them, in cities and on the coast. Specialized knowledge providers typically join hands with the big general consulting companies to ensure that adaptation solutions are addressed from a comprehensive development perspective.

These are but two examples. In another essay in this series Dong Energy is mentioned as an example of an industry which decided to disengage from first generation bio-fuel development ("converting food to fuel") to advanced technologies for production of second generation bio-fuel with a much smaller water footprint.

By sharing experiences in various groupings such as the Copenhagen Climate Council, the 2003 Water Resources Group etc., modern industries and companies are making rapid progress to deliver on the goals of the global climate negotiation processes of providing technology transfers and capacity building to the countries of the South, while at the same time building socially responsible and healthy businesses.

Final remarks

The process leading up to and beyond the Copenhagen COP15 in December 2009 hopefully delivers an efficient global response to address the causes and consequences of climate change, hopefully with binding protocols.

Mitigating the causes of global warming by limiting emissions of greenhouse gases has naturally been the main focus, and obstacle; but during the negotiations the need to also address the impacts of climate change through *adaptation* has increasingly been acknowledged. While the rich countries bear the main responsibility for the causes of climate change, it is primarily the populations of the poor countries in the South that suffer the consequence, and their capacities to cope are inadequate. Our responsibility to help them to adapt should be a key element of the new, global treaty on climate change.

Why? Should not the focus be on the root causes first, before we turn to addressing the consequences?

The answer is no. The cost of inaction is too high. The political will to act, and to allocate priorities and resources towards this endeavor, depends on awareness and understanding of the adaptation issue. Building that understanding has not been a priority in the climate debate and the negotiation process. How climate change will affect the poorest; in what way it will threaten their health and livelihoods; how they may adapt to these changes; and what and how much assistance they will need from the international community, has been discussed at the technical level and among civil society and environmental organizations, but will at best make it to the annexes of the Agreement.

This essay has argued that the main *impacts of climate change "hit us through water"* - through changes in the water balance, through increased floods and droughts, and sea level rise – and that addressing these impacts is a matter of urgency. Even without climate change the world is already water stressed and faces major challenges to ensure food production and other water related development needs for a fast growing world population. *Climate change is an added driver*, acting on top of population increase, economic

growth and urbanization, all of which stress our water resources even more in the short-term.

Taking a positive view: *climate change has acted as a wake-up call for us to address existing challenges* which will only become more serious with global warming. Already, the poorest populations suffer due to our inability to cope with existing climate variability, so addressing these immediate problems will help now, while building resilience for an uncertain future. Such actions are *"no regret"* and our political leaders should be aware of that and act now.

But "no regret" action is not enough. "Hard" measures such as dams, dikes and other infrastructure need to complement "soft" actions to reduce the pressure and economize on our water resources. We have to do so in the face of inadequate knowledge and information employing adaptive and risk management, while continuing to refine the global, regional and local climate information and models.

Global awareness of the challenges and impacts of climate change has risen sharply since 2005. Today, we see most countries – developed and developing – accepting the fact that we all need to change our ways and collaborate on a global scale to sustain our economy and the environment. This has been a long and hard process. We must hope that we have learned a lesson. We must hope that the awareness about the world's water challenges will reach a mature level quickly, and that global action will follow soon. The two issues are deeply intertwined and have many similarities. First and foremost, they affect the poor of this world the most; they pay the price. Luckily the solutions are well documented and known – and the investments will pay off. It is time to learn from the past, build on the momentum - and act.

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About the Copenhagen Climate Council

The Copenhagen Climate Council is an international initiative that brings together leading authorities on climate change, including the world's most renowned scientists, business leaders and diplomats, who are dedicated to turning the challenges of climate change into new opportunities.

The goal of the Copenhagen Climate Council is to create a constructive and positive global dialogue based on effective solutions to climate change. The recommendations of the Council are delivered directly to the Danish government, which takes them forward to the United Nations Climate Change Conference in December 2009. This has given business a voice at the negotiating table and the opportunity to help build an effective framework to tackle climate change.

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About the founder: Monday Morning

Monday Morning, the leading independent think tank in Scandinavia and founder of the Copenhagen Climate Council, facilitates the ongoing work of the Copenhagen Climate Council.

Monday Morning (www.mm.dk) was founded in 1989 and is based in Copenhagen. Its main objective is to enable decision makers to successfully navigate an increasingly fragmented and competitive global society.

Transforming the most important news and trends into strategically useful knowledge, Monday Morning publishes numerous reports and papers, including weekly magazines in Denmark and in Norway, and facilitates key networks for Scandinavian decision makers.

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