

Water Security, Climate Change and Sustainable Development: An Introduction

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Abstract The global population is estimated to increase from 7.3 billion at present to about 11.2 billion by 2100. Providing good quality of life for the existing hundreds of millions of people living in poverty and for the additional 3.9 billion people will be a challenging task under the best of circumstances. Many parts of the world are already facing serious water problems, both in terms of quality and quantity. Adding climate change scenarios further intensifies the uncertainties and complexities of the global situation by several orders of magnitude. The realities and politics of water security, climate change and sustainable development are likely to be one of the greatest challenges of the twenty-first century. Each country must rise to and meet these challenges successfully since there are no other alternatives. Status quo or incremental progress will not be an effective option.

A major global concern for all the countries and all the people of the world is how to ensure a high rate of economic growth that is both sustainable and equitable so that hundreds of millions of people who are now living in poverty can have a significantly improved standard of living and quality of life. Equally, the middle class can at the very least maintain their current lifestyles but preferably improve them progressively over time. This has to be achieved with full recognition of the fact that the world population is estimated to increase to 9.7 billion in 2050 and 11.2 billion by 2100, compared to around 7.3 billion at present.

Achieving this goal will not be an easy task because the world will have to eradicate poverty of the existing population and concurrently will have to cater to some 3.9 billion additional people during the next 85 years. Virtually all of these extra people will be in developing countries where lifestyles and standard of living

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of a majority of the people need to be significantly improved. It is currently estimated that more than 800 million people (14 % of the global population) live in extreme poverty which is defined as having an income of less than \$1.25 per day. It should be noted that these global figures by the international organizations, though extensively quoted and mostly taken at face value all over the world, are highly unreliable. In all probability, the numbers are significantly higher than what is now commonly believed.

Unfortunately the growth rates of industrialized countries have been somewhat anaemic in recent years. In addition, China's growth rates, which have been the envy of the world over the past three decades and have been responsible for moving hundreds of millions of the Chinese out of poverty, are now showing signs of trouble and declining from the earlier heady rates. This could be a serious development concern since the country has been an important engine for driving global economic growth in recent decades.

Water is an important component of sustainable development. Not only drinking water is essential for human survival but also it is needed for all types of human activities and endeavours, inter alia, food production, energy generation, resources extraction, industrial development, commercial activities, ecosystem preservation and host of other uses.

Water and energy are two resources which are needed for conducting literally all types of human activities. In addition, they are closely interrelated. Water cannot be produced and used without significant amount of energy, and energy cannot be generated without substantial quantities of water. Thus, however sustainable development is defined or assessed, it cannot be achieved without water and energy securities. Thus, ensuring sustainable development for the world means adequate quantities of water of appropriate qualities are available on a reliable basis over short-, medium or long terms. With the current unsatisfactory levels of water management nearly all over the world, this is unlikely to be possible.

During the Second World Water Forum, held in The Hague, in March 2000, the Ministerial Declaration noted the importance of water security in terms of "ensuring that freshwater, coastal and related ecosystems are protected and improved, that sustainable development and political stability are promoted, that every person has access to enough safe water at an affordable cost to lead a healthy and productive life, and that the vulnerable are protected from the risks of water-related hazards."

Water security of course includes all these issues but it also incorporates many others which the Ministers did not even consider. For example, one important issue that was ignored has been becoming an increasingly serious business risk over the past decades. In fact, the World Economic Forum perception survey of business leaders indicated that water currently is accepted to be the number one business risk in terms of impacts. Lack of adequate quantities of appropriate qualities of water on a reliable basis because of consistent poor governance over the decades has made it a serious risk for many types of business.

If the issue of climate change is added to water security and sustainable development, the problems become infinitely more complex and degrees of risks and uncertainties consequently increase by several orders of magnitudes. The

world's water supply is dependent on the rainfall of the past and present which is stored in the ground, lakes and rivers and also retained by man-made structures like dams and barrages. If the rainfall and distribution patterns change in the future, both over space and time, it will make ensuring water security a more complex, formidable and uncertain task. If water security cannot be assured, sustainable development will remain a mirage.

Water management and sustainable development will be affected very significantly because of future climate changes through a variety of pathways, only some of which are known at present and can be predicted with some degree of certainty. There are also likely to be other impacts which are currently unexpected and uncertain and thus are not being considered for any planning or policy-making purposes in any serious and consistent manner.

Climate change will have impacts on various aspects of water management and sustainable development in many different ways. The extent of the impacts on the people, economy and ecosystems will depend on a multitude of factors, and how each of these factors are managed, as well as the interactions between them. Among these factors will be the rates, magnitudes and distribution of the changes, institutional capacities to anticipate and manage the anticipated changes; preparedness of the governments, individuals and the civil society organizations to ameliorate them, advances in science and technology, and rates of adoptions of the new scientific, technological and managerial breakthroughs, as well as social, economic and political perceptions and societal and political willingness to manage the changes.

There are a few countries which are already trying regularly to formulate, update and implement good future-oriented plans which are underpinned by responsible and proactive political and administrative support. These countries will do significantly better than those which are not making comprehensive plans and depending upon ad hoc measures to counteract the potential impacts of climate change as and when they do occur.

Effective future-oriented plans to ameliorate the adverse impacts of climate change should include formulation of good long-term plans which are implementable. It should consider efficient and equitable water management that should take into account the future water needs of the country, both in terms of quantity and quality, and how they could be affected by climate change. Only planning will not be enough: it must be implemented in a timely and cost-effective manner.

This planning has to be conducted within a framework of relentless pursuit of sustainable development that would steadily contribute to steady improvements in economic and social conditions of the people and also meet their future expectations. This will be an exceedingly complex and difficult task which only a select few countries will be able to do properly in cost-effective and socially acceptable ways.

A good example is Singapore, a low-lying island where much of its land lies within 15 m above the mean sea level. Some 30 % of its land area is within 5 m of the mean sea level. Thus, for a country like Singapore, the most immediate threat due to climate change is sea level rise.

In order to reduce its vulnerability from coastal erosion, nearly 80 % of the island state's coasts now have hard walls or stone embankments. The rest are natural areas like beaches or mangroves.

In 1991, Singapore made a policy decision that all newly reclaimed land must be built at least 1.25 m above the highest ever recorded tidal level. As the threat of climate change increased and the scientific evidence indicated that sea level rise may be higher than what was expected earlier, in 2011, the country decided to raise the minimum level of the newly reclaimed land at least by an additional metre. This could ensure that the country could be safeguarded from the long-term impacts of higher anticipated sea level rise. Because of such continuous long term planning and its execution, the country is likely to fare much better in adapting to the new conditions due to climate change compared to all its neighbours.

The social, economic, environmental and political impacts of climate change, both over space and time, are complex interacting issues with numerous known and unknown feedbacks loops which are still not fully understood at present. Lack of proper scientific understanding of how various physical, social, economic and environmental forces may interact with each other, as well as absence of reliable data and information, are only two factors which currently prevent most countries to make reasonably reliable and actionable predictions of future multidimensional, multi-sectoral and steadily evolving impacts. These uncertainties further contribute to taking timely planning and investment decisions in a cost-effective and socially-acceptable manner. These are truly most challenging tasks under the best of circumstances.

At our present state of knowledge there are a number of important uncertainties in predicting the impacts of climate change on the water sector. These include, but are not necessarily limited to, future global emission scenarios, analysing them for various greenhouse gas emissions, predicting how these are likely to affect future global, regional and local rainfall patterns over time and space, interpreting their overall impacts on the hydrologic cycle at different scales including river flow regimes, assessing the types of scientific and technological breakthroughs expected that would allow us to better understand, predict and ameliorate the various issues associated with climate change and evaluating their impacts. These are likely to be mammoth tasks.

At our present state of knowledge, it is not possible to predict even how the annual average temperatures in various regions of the world may change over time, let alone the rainfall distribution patterns. In addition, even if such average global and regional changes in precipitation patterns could be predicted with some acceptable degree of reliability, they will be of very limited use for water sector planning and management. It would be essential to obtain information at river basin and sub-basin levels, which are often units of planning: country-level information will be of very limited value. The reliabilities of the current generation of hydrologic models have to improve by several orders of magnitudes before they can be used for planning and decision-making purposes with any degree of confidence.

The problem becomes even more complex for the water sector where it is essential to have not only reasonably reliable information on the distribution of

rainfall at the river basin and sub-basin levels, but also, more importantly reliable information on extreme rainfall events which would contribute to heavy floods and prolonged droughts. It is a fact of life that water structures are not designed on the basis of average rainfalls but primarily on extremes of rainfalls.

The magnitudes of uncertainties increase several fold when attempts are made to forecast extreme rainfall events on the basis of increases in average annual temperatures, and even more when rainfalls have to be translated into river flows. The peak river flows not only depend on high rainfalls, though it is a major factor, but also on many other factors, including land use changes and efficiencies and capacities of institutions responsible for water planning and management.

For successful and intelligent planning of the water sector within the framework of sustainable development, knowledge needs to advance much more than what is available at present. Meeting these challenges does not depend exclusively on advances in climatological-hydrologic modelling. Policies for adaptation and strategies for cost-effective mitigation measures have to be formulated on the basis of what are likely to be potential impacts. The forecasts of these impacts have to be periodically fine-tuned and considered for implementation according to changing societal and political expectations and also availability of additional knowledge, data and information.

Even more challenging will be the politics of policy-making and implementing which will require a quantum jump in existing planning and decision-making practices and processes. The politics of water security, climate change and sustainable development is likely to be one of the greatest challenges of the twenty-first century. How the individual societies will navigate these challenges in the coming decades will most likely determine the levels of their relative successes.

These will be immensely difficult, complicated and challenging tasks. However, countries must rise to meet these challenges successfully since there are no other real alternatives. Status quo or incremental progress will not be an effective long-term option.