

How can we overcome the impact of climate change on the world's water resources?

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Summary

It has been said that climate change mitigation is all about gases and climate change adaptation is all about water. Whilst most scientists and knowledgeable lay people now recognize that climate change is real, few strategic interventions have been made to tackle its impact on the world's water resources. This is probably because of the high degree of uncertainty about the impacts that climate change will have on water resources. Much of the output of the International Panel on Climate Change has been published at scales that are too small to readily assist with regional estimation of impacts. However, in some cases the global models have been downscaled to regional scales and potential changes in climate can then be more readily interpreted in terms of their impacts on water availability and agriculture. Elsewhere as in Central Asia, observations of changes in snowpack and glacier size have provided anecdotal evidence of the changes already occurring to these important sources of water.

Currently, observations suggest that regions including parts of Australia, parts of Spain and Morocco, and parts of Central Asia may be succumbing to the early negative impacts of climate change, whilst other areas may be benefitting from slight warming and rainfall increases. Evidence for these changes includes several years of drought, exacerbated by higher temperatures and evaporation rates than seen previously, reduced runoff into water storages, and glacier retreat. Specifically, in Central Asia it has been estimated that the glaciers in Tajikistan lost a third of their area in the second half of the 20th century alone, while Kyrgyzstan has lost over a 1000 glaciers in the last four decades. Examples of these phenomena and their impact on water resources will be presented during the talk. However, the critical issue from the scientific viewpoint is for the direction of changes and their impacts to be carefully modeled and monitored. This is easier said than done as many countries have removed financial resources from water resources modeling, or did little monitoring in the first place and have limited capacity with respect to modeling. Yet the first critical steps with respect to the development of adaptation strategies are those related to taking downscaled climate predictions from climate modelers and running the model output through hydrological and hydrogeological models to determine impacts on river flow and water resources.

Once predictions of future water availability are made available, serious effort can be put into development of appropriate management strategies. In the case of water resources these strategies will predominantly be focused on adaptation rather than mitigation. Even assuming global efforts on mitigation eventually succeed, it is highly likely that we will have many decades where we will have to deal with continuing detrimental impacts of climate change. Adaptive water strategies will be of three types. Firstly these will have

to consider what the changes to runoff, flow regimes and groundwater recharge mean with respect to water availability and allocation. Assuming that there will be less available water, reforms will be required to ensure that past water allocation practices can be changed and manipulated to ensure that supplies for each water using sector are sustainable. To achieve this, considerable effort will be required to determine appropriate institutional arrangements, develop new policies for water allocation, and improve management of the resource. The farming sector, being the biggest water user, may have to reduce cropped area and change to less water hungry crops in some cases. To avoid competition in and between different sectors of the economy and to avoid civilian unrest, it is vital that water reform measures are equitable and take all sectors including the environment, and individuals, including the poor, into account. Furthermore, renewed effort will be required in transboundary river basins to ensure that water is shared between upstream and downstream countries and does not become a source of conflict.

The second type of adaptive strategy needs to be focused around increasing water productivity in all sectors of the economy. In the agriculture sector this means increasing yield and using less water. In this way livelihoods will be protected as best as is possible. In industry and domestic sectors it means reducing demand, reducing wastage and potentially reusing waste water.

The third type of adaptive management strategy will include those measures required to ensure that changing rainfall patterns and intensities do not increase the risk of floods, or conversely, the risk of running out of water in drought periods. These will require engineering measures both to ensure public safety in extreme rainfall events and to increase the amounts and ways in which we store water. Large dams, small reservoirs, rainwater harvesting and groundwater recharge all need consideration in this respect.

In conclusion, whilst climate change is likely to have considerable impact on water resources, the key message to be delivered in this presentation is that by using a combination of proactive, science, engineering and policy making, it will be possible to adapt to much of the impact of climate change. Whether we are successful is going to depend to a considerable extent, however, on how politicians and senior community leaders provide the necessary leadership to ensure that such adaptation is possible.