WATER HARVESTING

AN SMD INITIATIVE

Climate Change Impact on Water Resources

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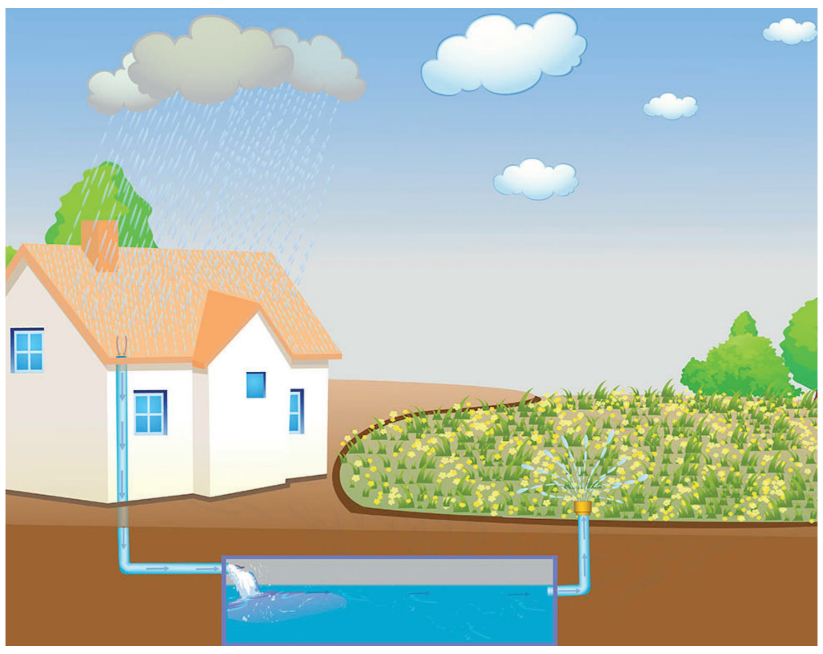
It is now widely acknowledged that water is becoming scarce due to overexploitation, pollution, inefficient management and increasing demand and competition among various water use sectors. Water scarcity will remain a major challenge to human security and development in general throughout the 21st century. Around 1.2 billion people, or almost one-fifth of the world's population, live in areas of physical scarcity, and 500 million people are approaching this situation. An area is experiencing water stress when annual water supplies drop below 1,700 m3 per person. When annual water supplies drop below 1,000 m3 per person, the population faces water scarcity, and below 500 cubic metres "absolute scarcity". Projections indicate that climate change, population growth, urbanization and economic development will interact in complex ways and across multiple scales to complicate or exacerbate future water scarcity. In particular, climate change will increase temperature and variability in precipitation, with adverse implications for water availability and requirement for crop production (IPCC, 2007).

Irrigation already accounts for 70% of global water withdrawal (or over 80% in semi-arid and arid agro-ecosystems), making crop production the most water intensive human activity. Direct competition between various water use sectors like agriculture, urban and industry is increasing day by day, especially in water short regions. Several researchers have studied the variability and trends in temperature and rainfall across the globe to understand the impact of climate change. The globally averaged combined land and ocean surface temperature data showed an average increase of 0.85 °C over the period 1880 to 2012. Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. IPCC AR5 report also say that over the period 1901 to 2010, global mean sea level rose by 0.19 m on an average and the rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia.



Impacts of Climate Change

Evidence of observed climate change impacts is strongest and most comprehensive for natural systems. In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality. Assessment of many studies covering a wide range of regions and crops shows that crop yield is affected. The projected changes in precipitation and temperature will alter the long-term mean water supply and demand.

Water Demand: Climate change will affect water demand from agriculture, urban and industrial activities and thus has an economic impact as well. Shifts in precipitation patterns can have adverse effects on crop production especially when peak water availability does not coincide with peak water demand by crops. Higher ET requirement and reduced precipitation can potentially increase net irrigation requirement. The irrigation requirements were projected to increase by 45 to 50% by the end of the 21st century, attributed directly to decreases in growing season water availability, increases in evapotranspiration, and changes in crop phenology.

Frequent and prolonged drought can increase physical water scarcity and irrigation requirement, while frequent flooding events can reduce crop yields through waterlogging. Increased variability in precipitation will also raise the imperative for irrigation in rain-fed cropping systems. The warmer temperatures can also increase competition for water by increasing demand in most water use sectors, particularly the domestic and industrial sectors.

Agriculture and Crop Yield: Climate change impacts on crop yield are different in various areas, in some regions it will increase, in others it will decrease which is concerned with the latitude of the area and irrigation application. The crop yield can be increased with irrigation application and precipitation increase during the crop growth; meanwhile, crop yield is more sensitive to the precipitation than temperature. If water availability is reduced in the future, soil of high water holding capacity will be better to reduce the frequency of drought and improve the crop yield. With climate change, the growing period will reduce, and the planting date also needs to change for higher crop production.

Projected increases in atmospheric CO_2 concentration could stimulate increased stomatal conductance in crops and thereby increase yields, particularly in mid- and high -latitude regions. However, this potential gain can be offset by other climate change effects such as warming and high water stress.

Countries like India are more vulnerable in view of the huge population depending upon agriculture, excessive pressure on natural resources and poor coping mechanisms. There has been a significant rise in the frequency of extreme weather events in the recent years affecting farm level productivity and adversely impacting stability in food grain availability at the national level, including the flood in Chennai and subsequent drought like situation in current times.

At the national and international levels, the needs of regions and people vulnerable to the effects of climate change on their food supply should be addressed. It is important to make experimental models for each of the climate change components. Information generated by climate change studies can be used to prioritise which components are most likely to become more problematic in the future. Climate change adaptation and mitigation in agriculture sector will have to be pursued in the context of meeting projected global food production demands. The lacuna is that there is no international agreement or national/global policy framework within which these activities can be undertaken. The ability to act depends up on improved measurement systems, tools and techniques for adaptation and mitigation.

The combination of these characteristics of agriculture—its importance as an economic sector, its vulnerability to climate change, and its contribution to emissions—make building resilience to climate change in Asia and the Pacific an enormous challenge. For the sector to meet the food and income needs of current and future generations, individual farmers, governments, community groups, and the private sector will need to implement comprehensive mitigation and adaptation strategies, which will require targeted investments.The combination of poverty in rural areas and the expected impacts of climate change and its remaining uncertainty will require careful planning for adaptation.

Water resources in India

India is a country with multiple cultures, climates, topography, cropping patterns, and food habits. Demand for water in India is rising and is estimated to have risen six to seven times from 1900 to 2001, more than the rate of population growth. The total water demand of the Business As Usual (BAU) scenario is projected to increase to 22 per cent by 2025 and 32 per cent by 2050 compared to that of the year 2000. It is a rise, which seems likely to accelerate in the future, because the population is expected to reach 1.3 billion by the year 2025 and 1.6 billion by 2050. The standing sub-committee report of Ministry of water resources, Government of India indicates that the total annual requirement of freshwater for various sectors in the country will be about 1093 billion cubic meter by 2025 AD (UNICEF, 2013). These freshwater requirements will be almost at par with the exploitable water resources including both surface and ground water by 2025 AD.

The BAU projection by the International Water Management Institute (IWMI) shows that the irrigation coverage would continue to increase to approximately 55% of the total cropped area by 2050 from its present level of 41% to ensure projected average irrigated grain yield of 4.4 tons/ha. It is also estimated that the environmental water demand will also increase substantially by 2050.

In a scenario of shrinking land and depleting water resources, the challenge of the new millennium is to increase biological yields to feed the ever-growing population without destroying the ecological foundation. It is thus important–not to package this challenge as a demand or imposition of society on farmers, for which farmers would bear the cost, but as a necessity and methodology to sustain their welfare and incomes. The concept of food security lies in the principle of overall development of all sectors such as agriculture, animal husbandry, rural industries, fishery etc. and for the success of all these activities, water is the limiting factor.

Climate change in India

It is estimated that the major impacts of climate change will be on rain fed crops, which account for nearly 60 per cent of cropland area. The loss in farm-level net revenue will range between 9 and 25per cent for a temperature rise of 2-3.5°C.

The precipitation increase of approximately 20 per cent is predicted in heavy rainfall days during the summer monsoon period and an increased inter annual variability. There will be increase in the frequency of heavy rainfall events too. Decrease in number of rainy days over a major part of the country is quite possible over the years.

The food and water security are interrelated and they can be achieved through judicious management of water by means of rainwater harvesting and community water management strategies. Brahmanand et al (2013) concluded that the food security in India can be achieved by paying higher attention to issues such as climate change, integrated water management, agricultural pricing and crop insurance. In this context, technologies to harvest rainwater are enlisted below along with a few strategies with respect to community water management.

Rainwater harvesting

Rainwater harvesting has become the order of the day for ensuring agricultural productivity and domestic as well as industrial water needs. The efficient utilization and management of available rainwater is the core issue if the cropping intensity and production is to be enhanced. The rainwater harvesting can be implemented as a viable alternative to conventional water supply or on-farm irrigation projects considering the fact that any land anywhere can be used to harvest rainwater. This is considered to be an ideal solution of water problem where there is inadequate groundwater supply or where surface resources are either not available or insufficient.

Rainwater harvesting (RWH) strategies are integrated under three basic approaches, namely: (i) Overhead rainwater harvesting, which essentially deals with the rooftop water harvesting systems, wherein the quality of rainwater collected can be improvised towards human consumption, cattle consumption and other household applications; (ii) Surface rainwater harvesting, which essentially concerns with the interception and storage of surface runoff on a watershed basis. The quality of surface runoff collected will always reflect the degree of contamination acquired along the flow path of runoff. Macro filters and micro filters are to employed widely for ascertaining the quality criteria at different stages of water usages out of surface storage; (iii) Subterranean rainwater harvesting which throws light on the ways and means for augmenting the groundwater aquifer storage and supplies. The degree of contamination is very much felt in areas of well irrigation, where the associate problems like salinity, alkalinity and hard water make the groundwater usage restrictable unless otherwise efficient surface and subsurface filtration mechanisms could eventually help recharge the groundwater with relatively pure rainwater percolation. Rainwater harvesting consists of a wide range of technologies used to collect, store and provide water with the particular aim of meeting demand for water by humans and/ or human activities.

To be continued...