

**IMPACT OF CLIMATE CHANGE ON WATER
RESOURCES IN HARYANA**

**EXECUTIVE SUMMARY SUBMITTED TO THE UGC
FOR
MAJOR RESEARCH PROJECT**

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IMPACT OF CLIMATE CHANGE ON WATER RESOURCES
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Haryana is mostly arid or semi-arid with limited rainfall ranging from 300 mm in the south-west to 1100mm in the north east. There are no perennial rivers running through the State, and about two-third of the area is underlain natural drainage. The State is situated in the basins of the Indus and Yamuna rivers and receives water from the Sutlej and Yamuna rivers and its share of surplus water from the Ravi and Beas rivers. It mainly occupies the Indo- Gangetic water divide and forms a part of Indo- Gangetic plain. The Shiwaliks extend into its north-eastern corner, in which originates present day seasonal rivers, viz., the Ghagger, Tangri, Markanda and Chautang which flow taking a south-Western course. The several ephemeral streams, viz. the Sahibi, Krishanawati and Dohan from south to north. The Aeolian tracts with sandunal activities are common in the south, northwest and western districts, in which outcrops the Aravalli hills occurs intermittently. All peripheral features have distinct relief and have higher elevations than the central structural basin, which represents a characteristically lose basin comprising flat alluvial plain.

During the last thirty years of hydro climatic studies two by- products of men's industrial and agricultural activities were recognized as potential causes for climate change in the form of global warming. These by-products are the heat and gases released to the atmosphere. It is estimated that in 1973 the heat released by global energy consumption was 0.01 percent of the incoming solar energy. Hence, on the global scale the effect of the added heat on climate change will be small. This is an amount which can have significant effect on climate warming over a

geographical region, such as peninsular Malaysia, with serious hydrological consequences as to soil water storage, groundwater storage and stream flow magnitudes. Therefore, the future impacts of climate change on the hydrology and water resources of a geographical region needs to be studied in order to quantify in detail the potential changes which may occur in hydrological water balances in that region due to such a climate change. Accordingly, such study is undertaken for Haryana.

RESEARCH PROBLEM

Impact of climate change on water resources are potentially large and could result from increase in temperature and could result from mean annual values and variability of precipitation. The quantity and quality of water are likely to be directly affected by climate change. Available water supplies are also likely to be affected by changes in demand multiple sectors competing for water resource. Change in hydrological cycle will cause change in ecosystem, which in turn, affect human health (e.g. by altering the geographical distribution of infectious diseases) and biological productivity and diversity. The evidence of last decade of research shows the climate change is real, is happening now and is likely to increase in the coming decades. While a number of national trends are clear, particularly temperature and precipitation, the regional implication of climate change are likely to differ widely. There is not yet complete understanding of the likely regional impacts of climate change. Moreover, there are key knowledge gaps regarding the impacts of climate change on water availability. Following the publication of the third Assessment Report (TAR) of the Intergovernmental panel on Climate Change (IPCC) in 2001, it is evident that the climate system of the planet Earth is about to change significantly. It is obvious that anticipated changes will not be evenly distributed; rather it would induce abrupt and shocking events to take place in

different parts of the world. The TAR also prognosticated that a general warming superimposed on erratic monsoon activity in the dry season over the semi-arid (western) parts of Indo-Genetic plain (IGP) would lead to increased susceptibility to droughts, while increased monsoon activity over the eastern parts of IGP would cause higher floods in terms of both extent and frequency.

21st Century is going to face tremendous challenges in water resource sector. Population and economic growth and area appreciation of the value of water in ecosystems, means that water demands are growing and shifting. Tensions over water rights are increasing at the level of village, city and basin. Shifting patterns of precipitation and runoff associated with climate change will depend on the baseline conditions of water supply system and ability of water resources managers to respond not only to climate change but also to population growth and changes in demand, the expenditure human population, competition for water is growing such the many of the world's major aquifers are becoming depleted. This is due to both for direct human consumption as well as agricultural irrigation by groundwater. Millions of small pumps of all sizes are currently extracting groundwater throughout the world. Irrigation in dry areas of India is supplied by groundwater, and is being extracted at an unsustainable rate in the States like, Tamil Nadu, Gujarat, western Uttar Pradesh, Punjab and Haryana, water sector challenges need proper monitoring, evaluation and management not only from the policymakers but also from academicians too. Substantial work has been done at global and national level to evaluate climatic impacts, but so far less information is available on regional and local scales. Therefore, this investigation will initiate to find out some of the consequences of climate change on water resources and water system in Haryana.

Objectives

This investigation will be carried out under the following objectives:

- I to evaluate regional trends and variations of temperature and precipitation;
- II to estimate the surface runoff and groundwater recharge;
- III to examine the biophysical impacts of climate change in terms of water quantity, (annual and seasonal) and quality;
- IV to investigate the socio-economic impacts of climate change on water demand and supply;
- V to build the climate change scenario for most consistent and plausible future for regional climate change.

Study Area

Haryana shows tremendous spatial variation in climate aspects agro-ecological conditions, groundwater and surface water quality and quantity. In addition, the surface water network is very wide and varied in nature. Before taking up the investigation, it is essential to understand the nature of parameters which are liable to change the climate and in the long run affect the water resources. These effects can be seen in terms of depletion in groundwater levels, variations in water quality, less amount of run off. Climate, groundwater and surface water system of Haryana needs to be understood in particular before linking it to the problem of climate change.

Data Source

Collection of necessary data and information through available reports or other sources, survey and field investigation is a pre-requisite to determine the

impact of climate change on water resources in Haryana. Discussion with the local inhabitants can provide many clues about the hydrological and geohydrological conditions in the study area. Such investigations are beneficial for the extraction of the past information through questionnaire or otherwise . consequently, in this investigation it is tried to extract maximum information through reports available from different sources, personal surveys and field investigation.

Secondary Data

Meteorological data essential for water resource planning and research is fairly difficult to obtain for the Indian citizen. At the same time, in the past decade, several international initiatives have put online published global datasets that represent a significant knowledge bank that could be put to good use in India. Therefore the database used for this work is downloaded from India Water Portal, that extracted the data from Climate research Unit (CRU) TS 2 out of he Tyndall Centre for Climate Change Research, School of Environmental Sciences, university of East Anglia in Norwich,UK.

Primary Data

Although, there is no single model or approach appropriate for all socio-economic assessments of climate impacts. In this investigation primary data is collected from the personal surveys of sampled villages. This survey is conducted to collect the information relating to socio-economic aspects of the people. With the help of this survey, biophysical factors such as temporal change in water quality, effect of water quality change on human being , slope, drainage pattern rock type and their structure which control the surface run off and percolation of surface water were evaluated and mapped.

CONCLUSIONS

While climate change affects surface water resources directly through change in major long-term climate variables like temperature, precipitation and evaporation, the relationship between the changing climatic variables and groundwater is more complicated and poorly understood in the State. Therefore, downscaling of precipitation and temperature has to be carried out from the GCM grids to a small scale. Daily rainfall and temperature are modeled as processes conditioned on atmospheric circulation. A2 scenario shows that in the study area the temperatures have increased up to 5C during the period of 2071-2100 with reference to 1961-1991 baseline. Temperatures scenario, generated by all these General Circulation Models, manifest that in the months of DJF temperature will vary from 4 to 19 degree Celsius. Whereas, in the month of MAM, this scenario of temperature will vary from 13 to 35 degree Celsius. More interestingly, temperatures are going to increase in the months of June, July and August.

Likewise, it is observed that during the months of DJF in the 21st century rainfall will vary from 0.1 mm to 2.4 mm per day per day. It is predicted that during the second group of months i.e. MAM rainfall will not change. These models indicate that rainfall will have an increasing tendency during the months of September, October and November. It shows that the rainfall period will increase towards the end of the monsoon season. Consequently, Water is an important resource for meeting the water requirements for irrigation, domestic and industrial uses. In the sub-region the ground water is extensively used for irrigation and domestic purpose. Due to tremendous increase in the requirement of ground water for agriculture, industries and by newly developed urban areas, water level have shown a continuous declining trend in a number of districts.