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Climate change and Anthropogenic impacts on water of the Subarnarekha river at Jamshedpur due to Hydro-Electric at Chandil

By

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ABSTRACT

The present Study deals with the impact of Climate change and anthropogenic activities on water quality of Subarnarekha river situated at Jamshedpur region. The water sample are taken seasonal from eight sampling points and analysis for basic water quality parameters. The worst affected parameters were salinity and TDS in the most of the sampling sites. The rest of water quality parameters have shown changes with respect to temperature. The climate change introduced a change in rainfall and vegetation cover which have eventually caused the change in magnitude and intensity of hydrological variables.

KEYWORDS : Climate Change, Anthropogenic Activities, Water Quality, Subarnarakha River

INTRODUCTION

Climate change is the expected outcome of increases in atmospheric concentrations of "greenhouse" gases resulting from human activities. Many greenhouse gases, including carbon dioxide (CO_2), occur naturally and keep the earth warm by trapping heat in the atmosphere. However, since the Industrial Revolution, anthropogenic sources of CO_2 have added greatly to the atmospheric concentrations," Other man-made greenhouse gases, such as CFC's, are believed to exacerbate the process. Enhanced levels of greenhouse gas concentrations are predicted to cause a significant rise in temperature. The rates of increase are anticipated to be greater than at any time in the past. The current scientific consensus is that under present rates of economic and population growth global mean temperatures will rise by 3°C by the end of the next century. This is expected to be accompanied by increases in global precipitation levels of 15% [1].Subarnarekha multipurpose project is a Significant hydroelectric facility located on the river up Stream of Jamshedpur.

The main technique for avoiding the worst extremes of climate change is to limit the increase in greenhouse gas concentrations by reducing emissions. As electricity production is responsible for a significant portion of the emissions, much of the burden will fall on the energy sector. Possible measures include transferring to lower carbon fuels like natural gas, any predicted shortfall in hydro output by constructing additional generating plant [4]. The likelihood is that fossil fuels will be used, further enhancing radiative forcing [2]. Climate change may also result in some planned projects being cancelled or adapted.

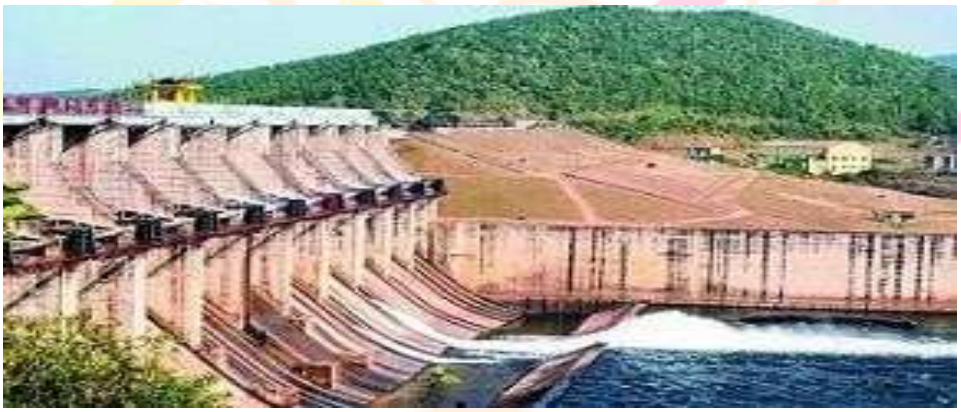
Map of India, Jharkhand, Jamshedpur and Hydro Power plant of Chandil on Subarnarekha River

FINANCIAL ASPECTS :

Hydroelectric stations are characterised by low operational costs but high capital costs. Generally, revenue from electricity sales is the only way of servicing the capital debt. Thus reductions in electricity sales will affect the return on investment and hence the viability of the plant [2]. The loss of together with increased use of renewable energy sources including hydropower [1].

Hydropower is an attractive energy source as it is renewable with minimal operational emissions of greenhouse gases. In addition, there are no fuel charges and the civil works have a long useful life. However, large dams may necessitate population displacement and can impact on the ecology of the basin [2, 3]. Exploitation of hydropower potential is considered by many governments and international bodies to be a key feature in economic development, especially in less developed countries.

At first glance, increased global precipitation would appear to suggest more water available for hydroelectric power production. However, higher temperatures will lead to increased evapotranspiration levels. Whether increased global precipitation is seen as increased river runoff depends on the regional climate and hydrology. In



the past, feasibility studies have relied on historical rainfall and river flow data for the assessment of hydroelectric potential at a proposed site. However, climatic means that these can Subarnarekha multipurpose Project, no longer be relied on to indicate future potential [2]. It is perhaps ironic to consider that attempts to reduce climatic change by switching to non-fossil fuels could be hampered by the legacy of their use.

CLIMATE CHANGE IMPACTS ON HYDROPOWER AND ENERGY SECTORS

Changes in the quantity and timing of river runoff, together with increased reservoir evaporation will have a number of effects on the production of hydroelectric power. These include impacts upon system operation, financial effects and impacts on other energy sectors.

OPERATIONAL SYSTEM AND DEVELOPMENT

Changes in the availability of existing hydroelectric plant, together with system constraints will affect the ability of the electricity supply system to meet average and peak demands. In the longer term, as demand levels increase, system planning may have to address increased temperature results in non-linear variations in runoff due to changes in precipitation.

hydroelectric generating capacity will require additional plant to, be constructed to meet demand, requiring additional capital and thus reducing overall system returns.

Many large hydropower developments in less development countries are built with the intention of stimulating economic development. Generally, this requires international financing with a requirement for the loan repayments to be in hard currency. Reductions in revenue may affect the ability to repay the hard currency debt

and this may severely stress a weak economy. In addition, the fall in electricity availability will hamper Governments' attempts to aid economic development.

IMPACTS ON OTHER ENERGY SECTORS

Climate change will have impacts on both electricity demand and supply. Higher air temperatures will tend to lower winter heating demands but increase summer cooling demand. Thermal generating stations requiring rivers for cooling water may suffer operational constraints due to reduced river flows [2, 5, 6]. Warmer river and sea water will reduce the efficiency of steam cycles, resulting in lost output or increased fuel consumption. Predicted sea level rise may also threaten coastal stations; climate change may lead to more extreme weather patterns causing increased system damage costs. Climate change may affect other renewable technologies: wind patterns may change as a result of changed temperature gradients, and changes in cloud cover may affect the performance of solar panels [7].

CLIMATE IMPACTS ASSESSMENT

The potential impact of climate change on water resources has been suggested since the 1980s, as work progressed on predicting climate change [5]. Although GCM's can be used to predict runoff directly, the coarse scale used means that this information is only useful for the most general studies. As a result, many studies have been carried out on individual basins, showing that river basins display a range of sensitivities to climate change [8]. Figure 1 shows the response of a typical river basin to variations in precipitation and temperature. It can be seen that

DETERMINISTIC

The first type requires a relationship to be established between climate inputs (e.g. rainfall) and hydrological outputs (i.e. runoff). The second type uses a simplified representation of the physical processes to mimic the storage and flow of water. The technique requires such models to be calibrated for each catchment using relevant climate and river flow data. The final approach is based on complex physical theory and most examples are spatially distributed in two or three dimensions. Such models claim to give a more explicit representation of hydrological processes, but suffer from the requirement for significant quantities of information for operation.

RIVER BASIN RESPONSE TO CLIMATE CHANGE

Later studies have considered not only the effect on river flows but also the impact on generation from hydroelectric stations [9]. In particular, one study examined a number of international river basins [4].

MODELLING IMPACTS

Climate impact assessment requires scenarios of future climate to be translated into potential changes on natural and human systems. To assess climate impacts on hydropower production a number of key steps must be taken [4]:

1. A river basin is selected and its rainfall-runoff processes are modelled and calibrated;

2. Climate data emanating from different general circulation model or arbitrary climate scenarios is applied to the model and the runoff computed;

3. River runoff values are converted into estimates of hydroelectric power production. The first step involves the accurate modelling of the hydrology of the chosen river basin. A wide variety of modelling techniques have been applied to simulating runoff processes [10]. Three basic approaches exist:

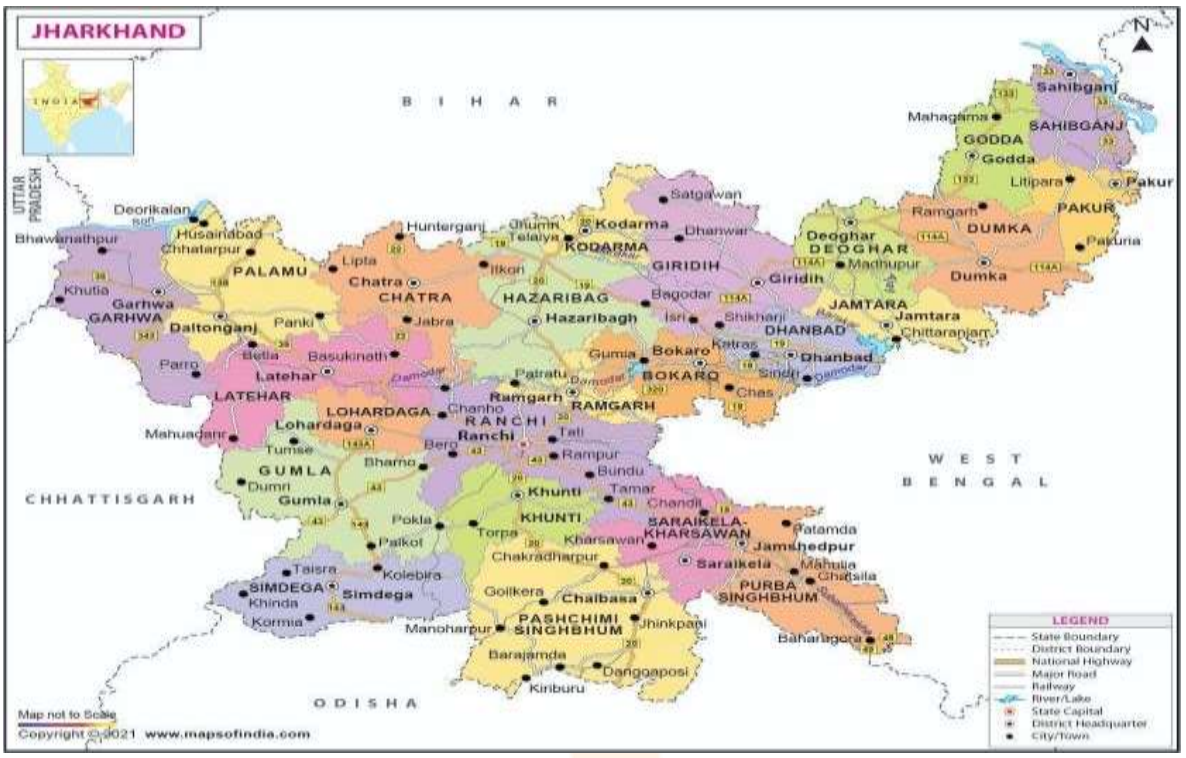
- Empirical
- Conceptual

development of the country and the policies of governments and international organizations.

COMPUTER MODEL PROPOSED :

This work is concerned primarily with the design and development of a generic hydropower assessment tool suitable for use with any hydropower scheme and relevant climate scenario. The assessment tool will be implemented on a PC and would consist of:

A (simple) self-calibrating hydrological model that would be able to derive suitable input-response relationships, given suitable climate and river flow data. After calibration, the model will convert input climate data into estimates of river flows of water of Subernrekha, Chandil, Jamshedpur.



EFFECT OF CLIMATE CHANGE ON RUNOFF

The potential for hydroelectric generation approximately follows runoff, so here it can be seen that hydroelectric potential would also be affected. A more accurate estimate of climate impacts on hydropower would involve assessment of the relative importance and cost of hydro, the economic result would be processed by the hydropower component which when given suitable technical and operational parameters would compute the electrical power generated.

With this structure, the model will give indications of the power generated for desired baseline and predicted climate scenarios. This will enable projections to be made concerning the investment performance of the hydroelectric scheme together with assessments of the impact on the economy. In addition, the generation scenarios may be used for analysis of the electrical system, in terms of its generation mix and overall power requirements.

In general, consideration of hydropower impacts has been concerned with the potential annual production of electricity, and not the impact of changes in the monthly availability. Month-to-month changes in electricity demand are generally greater than year-to- year, so a consideration of the monthly availability is likely to have more relevance. Consideration of spillage and the likely actual production under climate change will allow a more realistic representation.

CONCLUSION

Human activities are expected to lead to substantial changes in climate. One outcome may be reductions in river runoff with potentially serious ramifications for the provision of hydroelectric power. Recent attempts at quantifying these impacts have been described and a methodology proposed to enable analysis of the impact on the electrical system as well as the investment performance of hydroelectric plant.

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