

Macro to Micro Viewpoint of Climate Change—Linking Karnataka to Global Issue

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ABSTRACT

A numerous studies have been done on climate change at regional, national and global levels. Several climate models have predicted the global scenarios for climate in different parts of the world. However, the significance and practical implementation of such models at local level yet to be validated. This is because those national or global models do not consider micro variables such as such as environmental resources for example 'land availability, local climatic conditions, socioeconomic factors such as 'labour and capital', policy aspects such as 'subsidies, nature conservation strategies' and competition for labor and capital in relation of 'national economy'. India, with a huge diversity in land, topography, climate and socioeconomic conditions, divided into 15 agro-ecological zones. Further, to help develop location specific research and development strategies at the micro level, a total of 127 sub-zones (agro-climatic sub regions) have been identified in India. Therefore, research on climate change and its impact only at the regional or national level may not be a sound approach to provide solutions for adaptation to climate change at micro level. Thus the micro-level research needs to be undertaken that might help us understand climate change impacts on the landscape i.e. biodiversity, health, natural resource management, land use and land cover development, adaptation and the development of socio-ecological systems. The concepts presented in this article should provide the basis for a discussion on decision-making issues among multidisciplinary experts with regard to climate change and sustainable development within complex environments.

Keywords: Climate Change, Adaptation and Mitigation, Local Level Case Studies, Agro-Climatic Zones, India

1. Introduction

Observational evidences indicate that high carbon emissions and the associated climate change effects in the 20th century, already have affected diverse sets of physical and biological systems [1]. Carbon dioxide in the atmosphere has increased by about 30% from a pre-industrial level of about 270 ppm to the level of 380 ppm and is expected to further reach 600 - 700 ppm range by 2100 [1-2]. Developed nations representing about 20% of the world population, are responsible for 76% of total carbon emissions. For example, USA, amounting for just about 5% of the world population, alone is responsible for 30% of the total global carbon emission². In general the average per capita CO₂ emissions by the developing world stand at about 3.0 tons per year, however, related figure for the developed/advanced nations is about 13-14 tons [3]. In the Indian context, CO₂ emissions form just about 1.2 ton per person [4]. Hence to cope with climate change and adapt to its associated hazards, the United

Nations Climate Change Conference was held at the Bella Center in Copenhagen, Denmark, between 7th and 18th December 2009-commonly known as the Copenhagen Summit. The general consensus of the conferene reached by 192 nations was that the changing climate pattern was one of the greatest challenges confronting the world today. However, this consensus was no way different from what had been discussed earlier during the 2007 United Nations Framework Convention on Climate Change (UNFCCC) conference in Bali and twelve years ago in Kyoto.

Before summarizing the debates at Copenhagen it is important to remember here the gist of Kyoto protocol. At Kyoto, 37 rich countries had pledged to reduce their greenhouse gas (GHG) emissions by 5.2% at 1990 level; however, the evidences showed that most of the countries had in fact increased their emission levels and, as a consequence, the climate change issue became an irreversible reality which no one could refute. As a result, the advanced nations called for another summit meeting

which was held in Copenhagen.

Although at Copenhagen summit legally binding GHG emissions cuts could not be imposed on the developing countries despite the concerted efforts by some of the developed countries to bring a countries like-China and India in particularly under legally binding norms, the general consensus was that if all the countries were interested in avoiding “serious climate change effects”, it would be necessary to undertake appropriate measures to keep global warming to below 2°C, though there was not consensus on how to go about it. Now the global emissions budget, capped by 2°C guard rail, requires not only the industrialized countries, but also the newly-Industrializing and developing countries to adopt strategies towards a low-carbon future [5]. In the Indian context, this requires a proper science-policy research for developing policy responses intended for climate for different agro-ecological regions and a carbon-dioxide (CO₂) budget approach based upon a systematic and empirical research. Science-policy research would allow us to articulate and argue for a proper carbon space for achieving the goal of development without too many restrictions on the GHG budget under a future treaty on climate change effects.

There are many studies/reports available at the national and global levels [1,2,5-26] that deal with climate change and its potential impact on different sectors in a holistic manner. India, with a huge diversity in land, topography, climate and socioeconomic conditions, is divided into 15 agro-ecological zones. Further, to help develop location specific research and development strategies at the micro level, a total of 127 sub-zones (agro-climatic sub regions) have been identified in India [27]. In defining zonal boundaries several indicators (such as water availability, soil types, rainfall and pattern of rainfall, edaphic factors, land use and land cover, area under irrigation and rainfed, cropping pattern etc., were taken into consideration [28]. Therefore, research on climate change and its impact only at the national level may not be a sound approach towards adaptation and mitigation activities at the micro level. Several climate models have predicted the global scenarios for climate in different parts of the world. However, the significance and practical implementation of such models at local level yet to be validated. This is because that meso-level models do not consider region specific variables such as such as environmental resources for example ‘land availability, local climatic conditions, socioeconomic factors such as ‘labor and capital’, policy aspects such as ‘subsidies, nature conservation strategies’ and competition for labor and capital in relation of ‘national economy’.

2. Farmers’ Decision and Complex Land Use-Environmental System

Farmers act in complex environment and several driving

forces influence him to make his decision on land use [29] **Figure 1.** Land use is one of the sectors highly vulnerable to climate change. Changes in climatic conditions have lots of adverse impacts on the land use and associated activities. Climate change influence farmers to decide on land use. Farmers’ decision adjudicates for economic success as well as ecological performance of the chosen management systems. In rural landscape for the land use management, farmer could choose one or several criteria from different goals such as from the economic goal and/or ecological goal. The achievement of profitable economic goal in general found in priority of farmers decision [30]. The land use is not an independent sector but closely linked to the other sectors of the landscape thus influence the ecological resource flow in the system. Therefore, meanwhile the impacts of land use change and related land management practices on climate (at micro level) have to be evaluated when we study the impact of climate on the land use. The decision making behaviour of farmers is centered on maximization of this income from the existing resources available to his ease of access. In this endeavor the investigations were made to judge the attitude of the farmer towards overall scenario changes and development [31,32]. Farmers assess different conditions at the time - such as policy, demand for the produce, resource availability etc. Among all the options, farmer has to choose a few of them at higher scale while visualizing their potential in way to secure his livelihood in time to come. Farmers’ options are vary from region to region, hence need to investigate all the associated practices/background which directly or indirectly influence the farmers’ behaviour. Farmers’ decision makes the overall impact on the landscape up to certain extent [33]. The results of farmers’ decision on the different branches of the landscape management need to be evaluated in economic and ecological perspective. This approach is to develop the general trend in landscape development and examine the magnitude to use the resources such as land resource etc., and change in use of resource dynamics in time to time (for example collection of forest resources to sustain the traditional land use etc.). Therefore, the analyzing tradeoffs of this nature means that multiple indicators need to be evaluated simultaneously for the assessment of management strategies and this is the key requirement to understand the science behind the micro level case studies [34,35]. Empirical field studies need to be undertaken that might help us understand climate change impacts on the landscape *i.e.* biodiversity, health, natural resource management, land use and land cover development and the development of socio-ecological systems.

3. Climate Change in Karnataka Perspective

In case of Karnataka, national-level projections on cli-

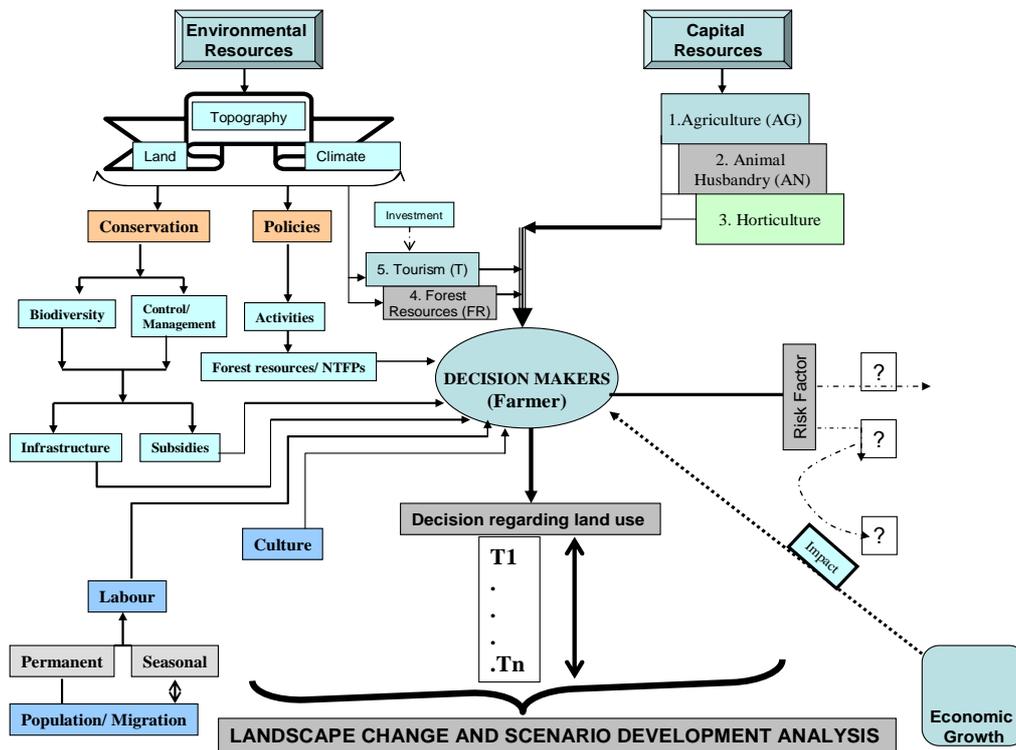


Figure 1. Complex rural ecosystem influence farmers’ decisions on land use thus influence the ecological resource flow.

mate change impacts have shown that the state is highly vulnerable to climate change uncertainties which could affect millions in rural and urban areas, in addition to adversely impacting food production, water resources, fisheries, biodiversity and livelihoods of the communities dependent on the natural resources. Hence, there is a need for a detailed identification and analysis of the ecosystems, dependent communities and production systems that are vulnerable to climate change uncertainties. Karnataka is divided into 10 agro-climatic zones viz., 1) North East Transition. 2) North East Dry. 3) Northern Dry. 4) Central Dry. 5) Eastern Dry. 6) Southern Dry. 7) Southern Transition. 8) Western Transition. 9) Hill. 10) Coastal Karnataka. Therefore, comparative studies across different agro-climatic zones of Karnataka are considered important as that could help us draw some major conclusions concerning climate change impact for developing better strategies for rural, urban and peri-urban sustainable landscapes development and conservation of biodiversity. With regard to climate change research, there is a need to formulate a research and policy framework including carbon budgeting for carbon credits particularly to know carbon ‘income’ and ‘expenditure’. In this process, special attention needs to be given to the vulnerable groups in our society, for example, rural farmers who emit almost negligible amount of carbon turn out to be the first victims of climate change impact. In general, the pro-

jected impacts of climate change will be on both the natural and socio-economic systems in Karnataka that include *Food production systems, Water resources; Fisheries, Forest ecosystems, Biodiversity, Coastal zones, Health, and Energy sector*. For example in case of food production system Karnataka agriculture is one of the most essential attributes of Karnataka economy. Agriculture in Karnataka has occupied around 19 million hectares of land, out of which about 10.6 million hectares of land is being cultivated in all the three seasons in a year [36]. The main season for agriculture in Karnataka is monsoon as irrigation is done below 28 percent of the total cropped area. Thus the agriculture sector is likely to be more affected by climate change. This poses a challenge to the state due to its dependence on climate-sensitive economic activities and predominantly in practicing rain-sustained agricultural activities. With in the broader framework there is a need to understand the interface between policy and science-addressing climate change and agriculture in Karnataka to enhance the dialogue between scientists and policy makers for better policy formulations. Similar attention need to be given to other natural and socioeconomic sectors.

As mentioned in the previous section of this article, globally, many studies are available, but the impact of climate change at the micro level along with adaptation and mitigation strategies is yet to be studied in detail

[37-38]. Hence, the issues concerning landscape management (land use and cover), human health, human and ecosystem interactions, livelihood development of the people, natural resource management and biodiversity conservation in various parts of Karnataka need to be prioritized from the perspective of climate change research. The approach needs to be strengthened to generate a better understanding of all the stakeholders and provide required information for advanced research and training in socioecological sciences for improving the quality of life of the people whose livelihoods are based on climate sensitive sectors such as agriculture, fisheries, animal husbandry, forest products etc.

In response to a suggestion made by the Prime Minister, Dr. Man Mohan Singh, for State governments to prepare a state level climate policy plan, Karnataka has a better opportunity for mitigating climate change effects through the spread of energy use efficiency and renewable energy technologies along with large-scale afforestation activities so as to facilitate sustainable use of biodiversity and environmental flows. But, in the meantime, various reports show that communities and habitats in Western transition, Southern transition, Hill, Low-lying and Coastal areas, Arid & Semi-arid regions of Karnataka may get increasingly exposed to climate change impacts that are interacting with urbanization, development, and pollution in the 21st century and beyond. Therefore, from an aggregate perspective, following points need to be addressed for devising a holistic plan with regard to climate change uncertainty in Karnataka. To identify climate variables for assessing the impact of climate change-sensitivity, adaptive capacity, vulnerability; to document assumptions, choices and the limits of scientific knowledge on climate change across different agroclimatic zones of Karnataka and enhance communication between researchers, policy makers and stakeholders; to develop an action plan for climate change adaptation and mitigation, identification and assessment of vulnerability towards climate change for different sectors of Karnataka (agriculture, water bodies, forests, energy); to synthesize a knowledge base (scientific and traditional ecological knowledge) on climate change in support of decision making, communication and implementation; to quantify the carbon budget of rural, peri-urban and urban landscapes in Karnataka for encouraging low-carbon high growth and carbon credits in the global carbon market; to develop strategies for predicting the outcomes of climate changes on land use, forestry, fisheries, water & energy sectors, sustainable livelihood development of people and biodiversity conservation and natural resource management.

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