IMPACT ASSESSMENT AND MITIGATION OF SOURCES RESPONSIBLE FOR CLIMATE CHANGES

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ABSTRACT

This article aims to assess the impact of climate changes on biodiversity in tropical regions. The changing rainfall pattern, weather disturbances and their impact on ecosystemare examined.The study further includes assessment of major threat due to climate change from genes to species including community, agro-ecosystem tobiome level. The potentiality of working as well as proposed models to mitigate the impact of changing climate and global temperature are discussed. The major challenges due to climate changes on biodiversity, the projected data's, management strategies and outcomes arealso highlighted. The review finally concludes that there should be a national agenda to combat thisglobal crisis by reducing greenhouse gas (GHG) emissions along with analyzing carbon accounting through forest resources, implementation of acts and regulation. Moreover there should be a "common will" to cut short the GHG emissions that directly or indirectly affects all the components of the ecosystem of any region.

Keywords:-*climate change, tropics, rainfall, modeling andbiodiversity*

1. INTRODUCTION

Climate change are attributedto several extremeevents like disastrous floods, weather disturbances, increasing temperature, melting of glaciers, and alteration in meteorology and ecology mainly due to anthropogenic activities. In the past hundred years, the world has witnessedrainfall patterns changes, decrease in Arctic sea ice,and increasedaverage global temperature by0.74°C, increased sea level along with the initiation and duration of the season. These changes not only show adverse impact on biophysical components, but also on existence, abundance and distribution of biodiversity [1].The Saharan hot desert and Central Asia cold desert exhibited an increasing annual temperatures and hot desert experienced a rise in temperature in summer on contrary the cold desert shows increasing temperature in winter, which is mainly due to warming of global temperature [2].The changes in thetropical cyclone (TC) tracks due to natural and anthropogenic climate change in west pacific regions causes reduction in the easterlies due to which the storm movement slows down, making favor for the beta drift carrying the storm northward [3]. The Co_2 imbalances in the atmosphere causes rise in sea surface temperature (SST) along with the weakening of the tropical circulation affecting hydrological cycle and tropospheric stratification in pacific along with Hadley circulation. The increase in Co_2 shows indirect effect on land–sea warming and also strengthens the Walker circulation. However, the change in upper-level velocity nullifies the effect of SST and does not weaken the Walker circulation even if it has El Niño–like intensity [4].

Climate change often shows negative social, cultural and economic effect; however the impact of extent and speed of climate change on biodiversity and ecosystem along with the thresholds of climate change that tends to irreversible change and modification in functioning from their current form, is still uncertain [1]. Technological stagnation in the agricultural sector climate change is more important than land use change and the plant diversity in dry and humid regions of the tropics respond differently to climate and land use change [5].The climate change predictions and responds and increase or decrease in temperature are not easily managed in various parts of the globe and in this situation weather stations can play significant role in providing information on changes in climate [6]. Thus global scientific community should focus on conservation and management efforts especially for vulnerable biomes that are at most risk [7]. Impact of climate change on genetic diversity [1] and species survival including human society, their movement or loss and their mass extinctions in tropical regions should therefore be addressed as a global crisis and also requires an immediate and appropriate action by framing relevant policies, strategies and programs at global, national and local levels [8]. Therefore the policy makers have to design models/strategies with wider approaches that should mitigate the GHG emissions along with the otherfactors that directly or indirectly shows impact on metrology and ecosystem of any region.

1.2. CLIMATE CHANGE AND VARIATIONS IN RAINFALL

Meteorology data's in tropical regions has represented alarming figure with reduction up to 10—20 per cent in average rainfall, an increased frequency of drought and a rise of surface temperature in the Indian Ocean up to 1.2 degrees during the last hundred years [9].Increase in greenhouse gas concentrations affects the zonal-mean distribution of precipitation in two ways, changes in hydrological cycle and atmospheric circulation patterns and these changes in global precipitation are mainly due to external influences like human activities [10]. In Southeast Asia the precipitation and temperature anomalies before the 1970s have shown general increases in undulating pattern but after this period it shows a significant variations with increases in global temperature anomalies causing delay in the onset of the monsoon, and sometimes the frequency and intensity of rainfall causes intermittent flooding of some areas causes serious consequences on the community of the region [11]. This impact also brought modification in magnitude, distribution and variation in annual rainfall and many regions in tropics have increased rainfall regimes, especially the drier region that witnesses high rainfall intensity, occurrence and duration over the past century [12].In India the southern monsoon that contributes 59.8% of the annual rainfall, but starting from the year 1951 to 2009 have shown a decline to nearly 54.7% that is mainly due to a significant increase of long-term annual and monsoon rainfall along withoccurrence of erratic winter and post monsoon rainfall. Further among the two global climate phenomena the annual rainfallhas also shown positive correlation to Pacific Decadal Oscillation (PDO) and negative correlation with Indian Ocean Dipole (IOD) [13]. In future various types of conflict due to deviations from normal rainfall patterns are predicted giving rise to disruptive activities such as demonstrations, riots, strikes, communal conflict, and anti-government violence. Thus in broader sense the environmental shocks generate human unrest such as violent events are more responsive to abundant than scarce rainfall [14].

1.3. IMPACTSOF CLIMATE CHANGE ON ECOSYSTEM

The anthropogenic climate change has shown a significant impact on distribution and composition of ecosystem [1] along with biodiversityresulting in either extinction or modification in life cycle pattern of the species.However the influence of this event is not always negative, and most of these changes are modest with some species adapting in the changing environment [1]. The risk of extinction generally depends on the climate scenario of any region and climate change is a significant threat to species decline, but not the important cause of biodiversity loss and hence requires conservation strategies [15]. Based on biodiversity loss metrics, taxonomic group, spatial scales and time periods the present estimates of the effects of climate change on the future of biodiversity shows great variations leading to rapid extinction rates that would be very close to the sixth mass extinction on the earth [16].Even an increase of every 1^0c in global mean temperature can cause a high risk of extinction of nearly 10% of known species from the earth [1].

Climate change is linked with biological events, such as changes in vegetation phenology. The occurrence of seasons plays a significant role on the plants making it accordingly of their environment, and even a slight shifts in the phenology provides evidence that species and ecosystems are being affected by climate change. Rise in temperature has a significant role in germination, vegetative growth, flowering and fruiting of plants[17]. In the age of modern technologyclimate change is more significant than land use change for agriculture sector and the vegetation diversity in dry and humid regions of the tropics shows different responses for both these changes. The study on future changes in plant diversity reveals that up to year 2050 the climate and land use change in tropics shows negative impact on plant diversity however humid regions are more affected in terms of species loss [5]. The lesser Himalaya regions in India have shown decrease in oak and pine forests replaced by mixed forest, increase in barren land and river-bed mainly due to climate change and anthropogenic factors. The generation of scrub and agricultural land are mainly due to anthropogenic factors and climate change plays a supporting role [18].

Rainfall is a major constraint in agriculture production thus the quantum, distribution or even a short break of monsoon causes soil moisture loss affecting crop productivity [19]. Variation in yield brings modification in nutrient cycling, changes in food, fibre, timber resources, carbon account, water cycle and disease regulation [1]. The interaction between human society and environment is an important factor causing vulnerability to climate change. The rise in temperature in summer and decline followed by decrease in precipitation and increase in aridity in Central Asia mainly due to climate change requiring mitigation to the problem. In order to study vulnerability and adaptation due to this event there should be assessment of food security, water shortage and human health [20].

Various parts in Central India like Bundelkhand region have shown significant long-term decrease in the total amount of annual rainfall mainly due to changing climate.The past data of drier regions of Central India reveals a decreasing trend in annual rainfall and thus probability analysis of some regions suggest seed bed preparation in the third week of the June and first week of July for sowing operation [21]. Simulation studies of different agro-climatic zones under the influence of climate changes shows variation in crop yield and the pulses, sorghum and spiked millet are worse affected, thus requiring crop insurance policies to poor and marginal farmers [22]. In these circumstances the sustainable productivity of agricultural crops can be achieved by modification in cropping pattern and cultural practices like mulching, relay cropping or re-sowing [19].

2. ASSESSMENT METHODOLOGIES FOR CLIMATE CHANGE

Burning of fossil fuels has modified greenhouse gas account in the atmosphere that is responsible for climate change events.As the world is concern about the climate change thusits predictions can play a significant role in many applications and at regional scales the assessment of its reliability is a major challenge. The present global scenario the assessment of vulnerability and impact of climate change becomes necessary as it helps to collect information of scientific data and local knowledge which helps in designing more effective, context-specific adaptation responses [23].

2.1 Climate change and rainfall

Global weather patterns have shown a long-term change that range from hundred to millions of years causing climate change which may be either limited to a specific region, or may occur across the whole globe. The natural and anthropogenic climate change due to tropical cyclone lke El Nino results in changes in genesis location which influence the large-scale steering flow, thus should be examined in due period to assess anthropogenic warming [3].In case of continental Indian monsoon assessing reliability using historical trend reveals an increase in Coupled Model Intercomparison Project – phase 5 (CMIP5), a standard experimental protocol for studying the output of coupled atmosphere-ocean general circulation models , but no improvement in skill in projections since CMIP3. Thus, it becomes necessary to use acceptable models for specific assessment of the events[24].The integration of Holdridge Life Zone (HLZ) classification with the ECHAM5 model, developed by the Max Planck Institute incorporated with the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) A2, A1B and B1 can be effectively utilized to assess the impacts of climate change. It was reported that one type of HLZ shifting to another forest type and in many cases the shifts, result in lost in their entirety. In future Elevation-associated life zones should become vulnerable to climatic changes[7].

The beta and advection model (BAM) employed to assess impact of natural and anthropogenic climate change on tropical cyclone (TC) tracks represented a slight change in Pacific decadal oscillation and monsoon rainfall in India. The 17 CMIP3 models and 26 CMIP5 models used for projections of TC tracks over the western North Pacific (WNP) reveals significant decreases in westward moving TCs and a rise in recurving ocean TCs per decade over the central WNP [3].

2.2CLIMATE CHANGE MODELLING AND BIODIVERSITY

In recent years several climate change assessment models have been introduced that help to study the vulnerability or to predict their impact on the global ecosystem. Various models that are popular in colder regions can also be applicable in tropical regions of the globe. Climate envelope, dynamic, population and mechanistic models are the popular modelling tools that helps to assess potential impacts, magnitude and direction of change on both species and ecosystems [1]. A vulnerability, impact and adaptation methodological framework that has been developed through three sub-regional pilot assessments as part of the Regional Gateway for Technology Transfer and Action on Climate Change in temperate regions helps practitioners to utilize outputs that are holistic, and provide relevant information about the vulnerability [23].

The global climate change has shown a wide impact on ecological processes and biodiversity. The integrated data of land use-informatics and climate-informatics of any region helps in impact assessment and mitigation through sustainable land use [18].The assessment at state and regional levels becomes necessary to design adaptation strategies for wilderness in the biogeographically vital regions like Indian Himalayas [25]. It also gives information on individualistic nature of species' responses to these changes, which has a probability of a large impact on composition of ecosystems in the future [1]. The assessment of climate change impact and vulnerability of forest under 'current climate' the indicator-based approach and for 'future climate' scenarios climate and vegetation impact models were found promising for adaptation planning and identifying vulnerable forest regions. Further it helps policy makers and forest managers to prioritize allocation of resource and forest management interventions, and also to restore forest health and productivity and to build long-term resilience to climate change [25]. In order to investigate species richness for a novel future the LandSHIFT model using One-class support vector machines (SVMs) together with current and future (2050) climate projections at a 0.1° resolution has shown a promising results revealing that the flora of warm tropical regions is primarily negatively impacted by future climate and land use changes whereas the more humid regions are more affected in terms of species loss [5].

Agriculture sector contributes a third of greenhouse gas (GHG) emissions globally. Thus should be an integrated approach to mitigate GHGs, and the tools like integrated management options for agricultural climate change mitigation (IMPACCT) were found effective in providing a broader knowledge transfer programme through different media along with information on economic and other environmental impacts. The model also advocated for developing carbon calculators in the future that will help in mitigation of GHGs for sustainable food production [26]. To project biodiversity outcomes using a complex seed dispersal models integrated with alternative climate change and habitat restoration scenarios, shows a larger effect on projected biodiversity than dramatically different climate change events. Even a simple dispersal model shows reduction in the area of occurrence of plant species and loss of diversity in fragmented tropical forest remnants under climate change events. Thus the complexity of these dispersal models has changed the habitat restoration approach that was identified as the best for projecting biodiversity under climate change should be given priority to understand and respond to the impact of climate change on biodiversity[27].

2.3.MODERN TOOLS FOR ASSESSMENT OF CLIMATE CHANGE

In recent years GIS database management system (DBMS) has been employed to assess the environmental and socio-economic impacts and risks of climate change on land use-informatics for decadal changes and annual changes, and climate-informatics for climate change detection through daily, monthly and annual weather data.The data of Kosi Basin in lesser Himalaya regions in India shows upslope shifting of existing forest species due to climate change factor resulting increase in temperature in these areas than past in the last two decades[18]. The use of modern tools like remote sensing can also play a crucial role in evaluating long term data of climate change and its interrelationship helps to predict impact of climate change on plant phenology that islinked with ecosystem as well as community dynamics, and in future research should be focused on impact of temperature, soil moisture and atmospheric composition on earlier leaf unfolding and leaf fall [17]. The computation of economic damages caused by climate change using evaluation model for environmental damage and adaptation (EMEDA) shows damages in the primary industry sector and whereas the developed nations has neutralized damage in their secondary sectors. The other region shows more severe losses whereas several regions are able to recover their tertiary sector losses yet the other regions have shown significant increase in damages except East Asia where the economy was influenced by increase in temperature [28].

3. CONCLUSION

Therefore it can be concluded that the assessment of impacts and vulnerability of climate change through climate modeling, ecological monitoring, and using modern tools like automatic weather stations, remote sensing and designing databasescan help inunderstanding, gathering and compiling data’s that can help in mitigation of climate change in the region.

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