



CLIMATE CHANGE AND THE ENVIRONMENT: ISSUES AND GEOINFORMATION CHALLENGES

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Abstract: *Global warming is real. Its direct impact is on the climate and consequently on the environment, human life and socioeconomic activities. Many countries of the world are experiencing extreme weather conditions and climate change natural disasters which scientists have concluded are being induced by climate change.*

Scientists and major research centers in industrialized countries have concluded that human activities, through the emission of CO₂ into the atmosphere is the single major cause of climate change and the unpredictable weather conditions the world over.

While the industrialized countries of the world, the major contributor to climate change have the capacity to respond to the impact of climate change, most developing countries do not have adaptive capacity to global warming. They therefore need help from developed countries to fight the effects of climate change on their environments and economic security. Man as a resource is the most precious within the biosphere, but equally at the same time the most dangerous as man's activities, especially the exploitation of resources, sustenance and creation of wealth, produce potentially adverse effects not only on the immediate surroundings but also on the ecosystem.

In all global warming and environmental issues, man is the problem and man is the solution. Without human activities the environment and nature will take care of the balance of the ecosystem in a sustainable manner. Therefore if man must continue to exist on earth, he must utilize and use natural resources in the most prudent and sustainable manner.

Key words: *Global Warming, Climate Change, Environment, Geoinformation*

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1. INTRODUCTION

Global Warming

Global warming is “the increase in the average temperature of the Earth's near-surface air and the oceans since the mid-twentieth century and its projected continuation.”The scientific community has reached a consensus that global warming is real and that human activities are causing the warming trend.

Global temperatures have steadily risen over the last century, and according to scientists, 2005 was the warmest year on record, and the warming trend is expected to continue through the 21st century and beyond.

From various scientific researches, it has been estimated that average global temperature of the Earth surface increased $0.74^{\circ}\text{C} \pm 0.18^{\circ}\text{C}$ ($1.33^{\circ}\text{F} \pm 0.32^{\circ}\text{F}$) during the 100 years ending in 2005.

Scientific climate modeling projections recently summarized by the Intergovernmental Panel on Climate Change (IPCC) indicate that global surface temperature will likely rise a further 1.1°C to 6.4°C (2.0°F to 11.5°F) during the 21st century.

http://en.wikipedia.org/wiki/global_warming.

Climate change

The direct effect of global warming is **climate change**, which means the disorder of climate pattern, and consequent impact on the environment and human life. **Climate** is the average state of the weather; it is fairly stable and predictable.

In general climate means weather pattern that is, averages of variables like cold and hot, humid and dry, cloudy and clear, light rain and cloudburst, light wind and snowstorm, and other variables that can be measured at any given site.

Climate change refers to the change in the state of climate that can be identified by changes in mean or variability of its properties and that continues for extended periods, typically decades or longer.

The variation occurs when the balance, for example between energy received from the sun and the radiated energy is disturbed. This disturbance can be caused by a number of natural mechanisms such as variation in the earth's orbit, variation in ocean circulation, and changes in earth's composition. In recent times the disturbance is caused by human activities.



http://en.wikipedia.org/wiki/climate_change

Environmental Sustainability

Sustainability is defined by the World Commission on Environment and Development (WCED, 1987) commonly called the “Brundtland Commission” as “development that meets the needs of the present without compromising the ability of the future generation to meet their needs”.

Sustainable Development has also been defined as “a process of social and economic betterment that satisfies the needs and values of all interest groups, while maintaining future options and conserving natural resources and diversity” (IUCN,1980).

Basic resources must be exploited in such a manner that the needs of future generation will not be compromised while satisfying the needs of the present generation.

In the Indian context, there is no adequate information on the location and state of resources, their rate of exploitation and socioeconomic activities and their impact on the environment.

In other words resources are not being exploited in a sustainable manner. The current situation is intensifying by climate change which is affecting the availability and or quality of these resources.

Geoinformation

The most basic tool for monitoring and managing the environment is Geoinformation. The world is becoming an information society and “information infrastructure” is regarded in developed nations as infrastructure like road, electricity, telecommunication, portable water, etc. In fact without Geoinformation these essential infrastructures cannot be implemented and sustainably managed.

The most basic of all information infrastructures is geoinformation, since all other information is location specific. Location is very important; everything happens somewhere, nothing happens nowhere. If we have a good knowledge about the nature of the location of where things happen, and the impact on the people and the environment, then “we can plan better, manage risks better and use our resources better.”



2. OBJECTIVES

This paper examines the issue of climate change and its impact on the environment. The effects of man's activities as well as those of natural phenomena on global warming, climate change and the environment are presented and discussed.

The options that are available as response to global warming: mitigation, adaptation and possible human suffering as consequences of what cannot be avoided by mitigation and adaptation are presented.

The status of environmental data and the need for environmental baseline survey and the creation of a comprehensive database for the country driven by geographical information system are presented and discussed.

The paper then highlights the need for governments at all levels to effectively support geoinformation production and cultivate the culture of its treatment for adequate and positive response to global warming, sustainable environmental management and national development.

3. RESEARCH METHODOLOGY

The main components of the geoinformation tool are: up-to-date topographical maps, remote sensing, geospatial information systems (GIS).

Topographical Base Maps

Up-to-date digital topographical maps at appropriate scales are key factors in environmental monitoring and management. Large-scale maps must be produced and updated at regular intervals of not more than 5 years.

The major advantage of base maps is its geometric infrastructural content to which all other geospatial datasets are positioned. Secondly the thematic contents of maps such as cultural features and topography provide a wealth of information on time-series changes and pre-disaster state of the environment.

A comparison of the baseline condition to subsequent environmental base maps will facilitate assessment and inventory of damage and other human factors, and influence decisions on appropriate actions.

Such maps are used to address the following questions: what exists at a particular location; what is the condition of what currently exists; and conditions that we want to attach to



what we plan to exist; what changes had occurred in an area or location over time; what is the concentration of certain activities and where are they located?

The availability of adequate geoinformation will facilitate the production of maps of basic environmental datasets such as Land Use and Land Cover, Topography, Demographics, Ecology, Hydrology, Soils, Infrastructure, Air Quality, Climatology and Water Quality.

Application of Remote Sensing

Apart from mapping, provision of information on the environment through monitoring is an important aspect of environmental management. This monitoring is best accomplished by remote sensing methods through mid-air photography and space satellite imagery.

Environmental information that could, among others, be remotely collected include: deforestation pattern, ocean pollution, desertification, atmospheric changes, oil spillage, sewage discharge, coastal erosion, slum and urban growth and other ecological and thematic changes due to climate change.

Geographical Information System (GIS)

A standard GIS system is capable of performing spatial analysis on the following queries which are very essential to decision making and subsequent actions on climate change and other environmental issues: location of what exist in a particular place; identification of condition of what exists at a given location, and location of where certain conditions are satisfied; trends in the differences of features within an area over time; analysis of multi temporal data.

Web enabled GIS is now available for efficient exchange of geodata for response to environmental issues. One of the major advantages of GIS is that it has the capability of bringing together previously separate discipline for the purpose of integrated analysis.

The ability to integrate spatial data of different themes and resolution as well as non-spatial data makes GIS a powerful tool for the monitoring global warming trend and management of the environment.

4. DISCUSSION

Indicators of Global Warming

Global warming produces increase in global temperature which impacts directly on human life and the natural environment. Increasing global temperature is having serious effects and consequences for the world, including rising sea levels, changes in climate patterns, change



in the amount and pattern of precipitation, and more severe weather including stronger tropical storms, droughts, and heat waves, likely including an expanse of the subtropical desert regions.

Other indicators of global warming include Arctic shrinkage and resulting Arctic methane release, shrinkage of the world's rainforest (already very damaged by deforestation from logging and farming), increases in the intensity of extreme weather events, changes in agricultural yields, glacier retreat, species extinctions and changes in the ranges of disease vectors.

The recent natural disasters caused by tropical cyclones, hurricane; flooding in Bangkok Thailand, Australia and India; sea level rise, heat waves in Europe, coastal erosion and flooding due to high precipitations are attributable to global warming and associated extreme weather conditions. In the Sub-Saharan Africa, there had been persistent drought and desertification in recent years, and the trend is likely to continue.

http://en.wikipedia.org/wiki/global_warming

The effect of global warming is not uniform all over the planet. The northern hemisphere has more landmass than the southern hemisphere therefore the greenhouse effect is more intense.

Furthermore the countries in this region are more industrialized and generate more CO₂ and hence higher warming due to greenhouse effect. The United States of America is the largest emitter of CO₂. While the industrialized nations contribute more to global warming and have the capacity to adapt to its effects, developing nations which contribute least are most adversely affected.

Response/reply to Global Warming

The available options are: mitigation to reduce further emissions; adaptation to reduce the impact of global warming on the environment and human life.

Mitigation

This means that the measures must be taken by various nations to reduce rate and magnitude of global climate change caused by human activities.

According to IPCC, the mitigation options includes reduction in burning of fossil fuels and reduction of greenhouse gases and soot from the energy sector; reduction of deforestation;



increase in reforestation and a forestation; modification of agricultural practices to reduce emissions of greenhouse gases and build up soil carbon.

Other mitigation options include: geo-engineering to reverse the effect of global warming by creating cooling effects which will equalize greenhouse heating; and conceiving the development of technology for clean the greenhouse gases from the atmosphere.

It has been estimated that at present the cost and benefit of mitigating global warming are approximately the same. In general, the IPCC concludes, without mitigation global warming will reach a point where it will be impossible for some natural systems such as ecosystem to cope and therefore may go into loss. As for humans the cost of adaptation will be so prohibitive that many will not cope. It is therefore essential to do a little of mitigation and a little of adaptation.

Adaptation

Adaptation means that we should take measures to reduce the poor impact of global warming on human life and the environment.

Some of the options that are available include: changing the cropping patterns; stopping further development on wetlands, flood plains, and close to sea level; developing crops that are resistant to drought, heat and salt; strengthening public health and environmental engineering defenses against diseases; designing and building new water projects for flood control and drought management; construction of dykes and storm flow barrier against sea level rise (Holdren, 2010).

Which is the Better Option: Adaptation or Mitigation?

It is evident that mitigation alone cannot work because global warming is already occurring and cannot be stopped. Equally adaptation alone will not work because adaptation will get costlier and less effective as global warming grows.

Therefore what is needed is enough mitigation to avoid the unmanageable consequences of global warming, and enough adaptation to manage the unavoidable.

Both mitigation and adaptation will not totally eliminate the impacts of global warming; there will still be some of the impacts which cannot be treated under mitigation and adaptation, which humans have to suffer. Therefore to avoid the amount of suffering, a lot of effective mitigation and a lot of adaptation have to be done. (Holdren, 2010)



Environmental Data Collection

Environmental data collection should cut across all aspects of the nation's socioeconomic activities and therefore all stakeholders in the public and private sectors must be adequately involved.

At present environmental data are been collected by various ministries, agencies, environmental NGOs, environment Consultants/Researchers, academic institutions and other private initiatives.

The activities of government organs responsible for environmental issues in the country and the various agencies are not coordinated, despite the fact that the Federal Environmental Protection Agency had existed since 1988 and the Federal Ministry of Environment was created in 1999.

Thus, available data are not coordinated, standardized and comprehensive enough to be used for creating an environmental database.

There is therefore the need for an environmental baseline survey of the country. This database will then form the basis of future measurements. The database must reflect all environmental indicators of climate change, biophysical environment, socioeconomic environment, natural disasters as well as appropriate policies and institutions.

Geoinformation Challenges

Appropriate response to global warming and climate change induced natural disaster as well as the implementation of a comprehensive environmental database must be based on the use of current digital topographical maps and other geoinformation tools as described herein. But the most important of these tools is current topographical base maps at appropriate scale. Unfortunately, these are not readily available in most developing countries. This makes geoinformation requirement a major capital component of all development projects. The implication of this is that government and her agencies are caught napping whenever there is a development project that requires such information. This has led to production of project specific maps and duplication of efforts and waste of scarce resources.

In most cases adequate geodata usage is sidetracked to the detriment of many development projects. Whereas all that is necessary is for government to put in place a



systematic programmed for geoinformation production, as its use cut across all sectors of the economy.

Apart from being the main ingredient in all development projects geoinformation is now being used in many developed nations as a tool for improving service efficiency in spatially enabled Government services, where “location” or “place” is used as key means of organizing their businesses. Government services can only be spatially enabled if the society is spatially enabled; and the society can be spatially enabled if geoinformation is made readily available ubiquitously as “common goods” and made available to citizens and businesses for decision making and improved productivity.

This is the major challenge for the nation. It is therefore imperative that governments at all levels embark on comprehensive mapping of their geographical space, and evolve a policy to make the exercise sustainable.

5. CONCLUSION

Global warming is real. Its impacts on socioeconomic activities and human life are clear. But India, like many developing nations has not put in place any sustainable policy measure to respond to this phenomenon.

The general public, outside the academia and the scientific bodies, is not aware of the causes of climate change and therefore need to be educated so that everyone could play his/her part in combating the effects of climate change.

In addition to organizing the State Summit, global warming and climate change education should be carried to the Local Government Areas, Ward level and also be thought at schools in order to ensure that individual responsibility in responding to the phenomenon are take in early in life.

In addition, as a starting point in her response to the effects of climate change, State should carry out an environmental baseline survey and create an environmental database using her current digital mapping as a base. This will be the basis for future measurements and for determining the extent of mitigation to avoid the unmanageable, and adaptation to manage the unavoidable impact of global warming.

The country has a many of environmental problems which is a challenge to governments and scientific communities; and measures must be urgently put in place to confront them.



The nation environment and natural resources are currently not being exploited and managed in a sustainable manner.

Environmental data collection is not coordinated and hence cannot be used to create an environmental information database, which is a prerequisite for a meaningful and sustainable environmental management.

There is therefore the urgent need to carry out a nationwide baseline survey of the impact of global warming on the environment, implement a systematic environmental data collection, and create a national environmental database based on adequate geoinformation.

The world is becoming an information society and “information infrastructure” is prerequisite to all developments. The most basic of all information infrastructures is geoinformation, since all other information is location specific.

Government at all levels must therefore pay adequate attention to geoinformation production and put in place a mapping policy to drive surveying and mapping activities; as the application of geoinformation products cut across all sectors of the economy.

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