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Role of Satellite Remote Sensing in Formulation And Execution of Environmental Regulations

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The problem today is the conflict between environment and economic activities; the former including land, water, air, sunlight and all the biotic components and the latter including all activities, agricultural, industrial, commercial, transport, communication and those in the non-market sectors. The approach to find out solution to this problem is through developing holistic perceptions of the processes causing the problems. The remote sensing technique when taken as a system of data acquisition from satellite platforms supported by data collection from aerial platforms or sample areas and measurements and observations at sample locations on the ground, can have significant contribution in several ways for developing an integrated information system.

I. Introduction

THE TERMS like ecosystem, environment, ecology, bio-diversity *etc.*, are the ones which have made it a habit to appear even in the semi-educated common man's parlance in the recent times. But they are definitely used not always in terms of their scientific definitions *per se*. In scientific sense an ecosystem is a unit, whether large or small, in which the various natural elements are in a state of dynamic equillibrium. In the past, man has been one of the elements in only some of the several natural ecosystems. But his mobility and ability to adapt have forced his influence into almost all the natural ecosystems to the extent that there are now absolutely manmade ecosystems. Therefore, man has become an integral part of an ecosystem, either by physical presence or by indirect influence. This omnipresence of man is warranting an anthropocentric approach to the concept of ecosystems giving regional, continental and even global connotations. The urge for protecting ecosystems is undeniably anthropocentric whether it is the 'Gene Bank' of Silent Valley for possible use in future or the habitat of lions in 'Gir forest', they all have a wide range of man's interest from economic to aesthetic, rather than purely academic.

The interest in 'environment' also is anthropocentric rather than purely ecological. Environment exists in moon and sun but we are concerned about earth's environment. What we really mean is ecology and environment conducive for human existence.

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Therefore, the term "human habitability" would be a more appropriate one, when the concern about environment is being expressed. Change in ecology induces change in environment in terms of all components of land, water and air. This brings about changes in human habitability. But it is the economic activities of man which is the major cause for changes in ecology.

II. The essence of the problem

Therefore, the issue today is the conflict between environment and economic activities; the former including land, water, air, sunlight and all the biotic components and the latter including all activities, agricultural, industrial, commercial, transport, communication and those in the non-market sectors. The problem is that man is compelled to increase and diversify economic activities to meet the increasing demand on one side which on the otherside disturbs and changes the ecology ultimately leading to degradation of habitability in both urban and rural areas.

III. The basic approach to find out solution

The approach to find out solution to this problem is through developing holistic perceptions of the processes causing the problems. As for the habitability, the factors and processes which change it for bad or good are to be understood. Models integrating the factors which affect the habitability are to be made to fix habitability indices and understand the trends. The point is to fix the threshold of degradation that can be allowed in order to maintain a standard and equitable habitability.

There is always a need to increase econimic activities. The pressure is not only to meet the increasing demand for the basic essentials required for the physical existence, food and shelter, but also for the essential luxuries required for the sense of well being. Beyond this is real luxury. But economic activities for luxuries, when they start showing tendencies to jeopardise the sources of the bare essentials, have to stop, to start with the unequitable luxuries. But to evolve the control mechanism one has to develop holistic perceptions, which means integration of factors and processes and derive the trends.

The habitability index models on one hand and economic production/activities models on the other, when integrated, could help in drawing the balance sheet between the two (figure 1). This should be the base for making decisions on optimisation and trade off. Sustainable development should mean sustainability of not only economic activities in terms of wherewithall and the need, but also the sustainability of habitability for the present and future generations.

IV. The role of remote sensing

(1) *Applications in general*

Where does remote sensing come into picture? Land, water, air, and solar energy resources which collectively form the life supporting system have a spatial distribution with variations from place to place. The economic activities also have a spatial distribution. Therefore a geographical information system (GIS) which gives information to geographical locations could help to synthesise an integrated perspective in each of these two areas. Since the processes and activities are dynamic in nature it has to have also a temporal dimension in addition to the spatial dimension. The remote sensing technique when taken as a system of data over sample areas and measurements and observations at sample locations on the ground, can have significant contribution in several ways for developing this integrated information system.

The layout of the land cover and land use is one of the direct information which can be provided by this system. The system provides opportunity for inferring detailed

information over large areas through a process of extrapolation of details derived from the sample areas over a semidetailed spatial framework. Inversely the synoptic perspective provided by the semidetailed framework helps in a better understanding of the processes involved in the genesis and present status of features in a smaller area of detailed study. The regular repitivity provided by the satellite remote sensing bring about the temporal changes and help in monitoring the natural processes.

In addition to the specific information that can be derived directly from remote sensing system, it could also function as the spatial framework for filling up and extrapolation of information collected through means other than remote sensing. For example, consider that a habitability index model is to be developed for an urban area. The habitability of an area could be the collective effect of surface cover (land cover/land use) micro meteorological factors, air and water pollution factors, and socio-economic factors, playing in discrete unit areas within the study area. While remote sensing can provide directly information pertaining to the distribution and quantities of surface features for these discrete units of study area and monitor the changes, it could also function as the basic template for sampling and filling up through extrapolation other information on micro-meteorological factors such as temperature, humidity, precipitation *etc.*, air and water pollution factors and socio- economic factors (figure 2).

As far as the modelling of economic production activities is concerned also, remote sensing systems can help in a significant way. Agriculture, industries and raw materials for industries, roads, communication networks, dams, power generation systems, mining and such activities are related to land and water resources. Micro to macro water sheds become the framework for modelling such economic activities. Remote sensing systems can build the information base for geographical information systems in the context also. It could function as the framework for integrating the various factors, but with a focus to economic activities

(2) *Applications specific to regulation for economic activities*

There are two areas in which the remote sensing can play a significant role in the regulation of economic activities. One is pertaining to the location of a certain activity. The other is the monitoring of the activity for their negative and positive impacts on the environment in order to enforce timely checks and balances. It can also help in making realistic assessments to check fradulent claims of damages as well as the quantum of expenditure for the developmental activities.

Agriculture is the most pervasive economic activity which sustains human race on earth. Nevertheless, it has to be regulated in terms of its encroachment into forests as the latter is a significant element of nature which sustains agriculture itself. It also provides very valuable products for comfortable living in addition to helping in maintaining the general habitability of a region. The expanding boundaries of agricultural lands can be monitored through remote sensing and timely regulations for preventing such expansions into forests can be brought in. The areas where the existing regulations are violated could be idenfitied and such activities checked before the land transformation becomes irretrievable. Cultural wastelands could be located and the claims of expenditure for wasteland development such as for raising plantations *etc.* could be cross checked.

Construction of dams are meant for giving fillip to agricultural activities by way of supplying irrigation facilities and also to industrial activities by supplying electricity.

While, remote sensing can help in locating dams to provide the maximum utility *vis-a vis* the structural stability of the terrain, it can also help in quantifying the loss due to submergence and in optimising the height of the water level in the reservoir.

Mining is another economic activity which can bring about permanent changes in the vicinity. Remote sensing can not only point out where such activities should not be taken up and where it can be allowed in terms of the extent and quantum of their impact on the environment as against the economic gains. Besides, it can also help in monitoring the mandatory environmental wastelands, raising plantations as substitute to the damaged vegetation at mining sites *etc.*

Industrial activities need regulations in terms of their impact on environment through pollution. Their location have a great bearing on the pollution through the effluence not only of water in streams and rivers but also the ground water. The seasonal wind directions with respect to the habitation around also are factors relevant to the location of such industires for allowing the already existing industries to continue functioning in the context of air pollution. Remote sensing can integrate the various factors involved and delineate the zones where the industrial activities either could be allowed or prohibited.

V. Conclusion

The problems evolving out of the interactions between economic activities of man and environment are the concern for the future. The economic activities could only increase as the human pollution on earth is only increasing. Avaricious and injudicious economic activities, however, will certainly dwindle the habitability. Therefore, there is a need for developing a balanced approach to meet the problem of sustaining the habitability on earth. The holistic concept which takes into consideration the imperative for increasing economic activities on one hand and the need for minimising their impact on environment should be the basis for such an approach. The technology of remote sensing from satellite and other platforms can provide the necessary spatial and temporal framework to locate the economic activities and the attendant impact in terms of land use and land cover transformations. This unique characteristic makes it a very valuable tool not only for laying down the policies from time to time but also for enforcing the laws on protection of environment.

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