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Land use Change Detection: A Critical Analysis of District Pulwama

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Abstract: -

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times ***(Singh 1989; Mouat et al.,1993)****. "Timely and accurate change detection of earth's surface features provides the foundation for better understanding and interactions between human and natural phenomena to better manage and use resources"* ***(Lu et al.,2004)****.change detection normally the entails application of multi-temporal data sets to quantitatively analyse the temporal effects of the phenomenon. Because of the advantages of repetitive data acquisition, its synoptic view and digital format suitable for computer processing, remotely sensed data such as thematic matter (Spot radar and advanced very high resolution radio meter have become the major data source for different change detection application during the past decades cited by Lu et al 2004.remote sensing data have assumed an ever increasing strategic role in several application domains. A wide range of applications can be benefited from the study of change process over a specified area at different times. Information about land use is necessary to update land cover maps and for effective management and planning of the resources for sustainable development.*

The spatial setting of landscape elements is characterized by the combination of both biophysical and human forces **(Fernandez et al., 1992)**. In temporal scales of decades, human activities are basic factors in shaping land use change. Some of them are due to specific management practices and the rest are due to social, political and economical forces that control land uses **(Medley et al.,1995)**.The landscape is dynamic in relation to spatial, structural and functional patterns **(Hobbs., 1997)**.The purpose of land use change simulation modelling is to describe, explain, predict, assess, impact and to evaluate hypothesis **(Briassoulis, 2000).**

Changes in land cover by land use do not necessarily imply degradation of the land. However, due to shift in land use patterns, land cover changes that affect biodiversity, water and other processes that come together to affect climate and biosphere **(Riebsame et al., 1994)**

A detailed understanding of the changes in land use/land cover pattern has become necessary for the Pulwama district. Therefore present study was undertaken to analyze the extent of human induced landscape transformation in the pulwama district by interpreting temporal remote sensing data using geographic information system (GIS).land cover types(forest, agriculture, water body and open wetlands) were delineated in order to achieve the above objective. The areas /non-forest were also taken into consideration to know the trend due to impact of urban and industrial development in different time period.

Driving forces of land use land cover change

LULC change for several decades has become a global concern for researchers given its complexity that requires a deeper understanding of the extent and intensity of the changes and impacts of such changes on ecosystem goods and services. The concerns arose from the realization that land surface processes and transformation influences climate change and reduce biotic diversity but in the process it came to realized that LULC changes determine in part the vulnerability of the places and people to climate change or socio-political perturbations. The study of the underlying driving forces has a long tradition in geography and landscape research. Land change research is broadening its approach to assess the decisions of people and institutions that execute these actions **(Baudry et al., 1999; Lambin et al., 2001)**. Understanding the causes and consequences of land change is

one of the prime goals of global change research **(Lambin et al., 2003; Rindfuss et al., 2004 and Lambin and Geist, 2006)**.Consequently, land change has become an important research topic in the last two decades **(Turner et al., 2007; Turner and Robbins, 2008)**. The of land change science is to understand the causes and pattern of LULC change and dynamics affecting the structure and function of the earth system **(Rindfuss et al., 2004).**

There is high variability in time and space in biophysical environments, socioeconomic activities and cultural contexts that are associated with LULC change. Identifying the causes of LULC change requires an understanding of how people make land use decisions and how various factors interact in specific contexts to influence decision making. LULC change is always caused by multiple interacting factors originating from different levels of organization of the coupled human environment systems **(Lambin et al., 2003).** Single factor explanations of the LULC change may be misleading, because the driving forces of change generally act in combination with each other and the interactions are contigent on place, time and level of analysis. Driving forces of LULC change have been grouped into a number of broad categories by different authors are summed up as follows:

Biophysical factors

These are the endogenous driving forces possessed by land itself. These include the quantity, nature, availability and characteristics of land resources, which set definite limits on use of the land **(Reid et al., 2000; Hubacek and Vazquez, 2002; Gregor and Anette, 2002; Verburg et al., 2004; Baker et al., 2005).**Different combinations of physical and geographical elements induce differences in the spatio-temporal pattern of LULC change. Although at a short-term scale, human activities, rather than natural forces, have become major forces in shaping the environment. Biophysical factors control the trends and processes of LULC change under the big environmental background **(Liu et al., 2001; Dorner et al., 2002; Dawes et al., 2004 Ewert et al., 2005)**. The prior studies have focused primarily on biophysical attributes (e.g altitude, slope or soil type etc.), given biophysical factors being main driving forces of LULC change in the early period of

human history **(Kok 2004; Pedrotti et al., 2005).**the factors including topography, climate, water availability and soil properties provide the best explanation for large scale LULC variations. Steep slopes and small scale topographical feature highly influence the spatial balance between pastures and natural land cover. Topographical barriers often constitute edges between pastures and natural land and affect the spatial structure of natural habitats. Thus for most of human history, land transformation has been caused mainly by the shift cultivation determined by biophysical factors.

Demographic factors

Both increase and decrease of a given population has a large impact on land use. Demographic change does not only imply the shift from high to low rates of fertility and mortality, but it is also associated with the development of households and features of their life cycle. The family or a life cycle features relate mainly to labour availability at the level of households. Population is a fundamental driving force because each individual minimally requires living space, shelter, food and water, regardless of the social and technical actions that determine how these needs are met. The growth of urban aspirations, the urban-rural population distribution and the impact of rapidly growing cities on ecosystem goods and services are likely to become dominant factors in LULC change, be it in major urban or pre-urban areas or in remote hinterland or watershed areas **(Fox et al., 1995).**

Technological factors

The available technology decides the economic supply of land. Technology can influence environmental change by finding new ways to discover and exploit natural resources or by changing the volume of resources required per unit of output. Technologies may increase or decrease the impact of human activity on the environment, depending on the other driving forces, which determine which technologies are developed and used. Technological developments, such as biotechnology and crop and pest management alter the usefulness and availability of land and might therefore change the demand for a certain area. Tall buildings and stereo transport have become possible with the development of new material architectural technology which has naturally reduced land transformation **(Kim and Sohn, 2002; Geurs Van Wee, 2004).**

Economic factors

Economic factors and policies define a range of variables that have a direct impact on the decision making by land managers, e.g. ., input and output prices, taxes, subsidies, production and transportation costs, capital flows and investments, credit access, trade and technology **(Barbier, 1997).** Economic behaviour is an integrated result of biophysical, institutional and technological factors. Economic growth necessarily stresses the environment, but the amount of stress from a given amount of economic growth depends, among other things, on the pattern of goods and services produced, the population and resource base for agricultural development, forms of national political organization and development policies. Higher real incomes usually mean higher purchasing power. This increase in purchasing power is usually reflected in increasing demands for non-food items such as cars, houses, household goods, recreation and travel.

Institutional factors

To explain LULC changes, it is also important to understand institutions (political, legal, economic and traditional) and their interactions with individual decision making. Access to land, labour, capital, technology and information is structured (and is frequently constrained) by local and national policies and institutions. Land managers have varying capabilities to participate in and to define these institutions. Land is as much a social product as it is a physical reality. The importance of policies in driving LULC change is gaining recognition in the contemporary in the contemporary literature. Governmental structure and policies can have significant environmental consequences, both intentional and inadvertent. Institutional factors provide the rules of the game in society, establishing the human devised constraints and unconscious habits that shape human interactions. Many LULC changes are due to ill-defined policies and weak institutional enforcement, as exemplified by the recent master plan of pahalgam which proposed unsustainable land uses and turned out to be a controversial document. With increasingly interconnected market forces and the rise of international environmental conventions, the impact of institutional drivers moves from the local to the global level. Land degradation is more prominent when macro policies, either capitalist or socialist, undermine local adaptation

strategies. In particular, perverse subsidies for road construction, agricultural production, forestry and so forth are thought to be one of the biggest impediments to environmental sustainability. **(Myers and kent)**

Cultural factors

Numerous cultural factors also influence decision making on land use. Land managers have various motivations, collective memories and personal histories. Their attitudes, values, beliefs and individual perceptions influence land use decisions_ for instance through their perception and attitude toward risk. Land use decisions have intended and unintended consequences on ecosystem; these depend on the knowledge, information and management skills available to land managers.

Globalization

Researchers have recently argued that cross cutting the local and national pathways of LULC change are the many processes of globalization that amplify or attenuate the driving forces by removing regional barriers, weakening national connections and increasing the interdependency among people and between nations. Globalization as such is not a driver of LULC change but is a process that underlies the other driving forces. International institutions (including organizations within the U.N system and nongovernmental organizations) can be instrumental in promoting and funding policies aimed at combating environmental degradation, setting political agendas, building consensus and creating constraints and incentives for sustainable land management **(Lambin et al 2002).**

Role of Remote sensing and GIS in Land use change detection

Studies have shown that there remain only few landscapes on the earth which are still in their natural state. Due to anthropogenic activities, the earth surface is being significantly altered and man's presence on the earth and his use of land has had a profound effect on the natural environment, thus resulting in an observable pattern in the land use and land cover over time.

Land use and land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use and land cover and possibilities of their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population.

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. Advancement in the concepts of vegetation mapping has greatly increased research on land use land cover change, thus providing an accurate evaluation of the spread and health of the world's forests, grasslands, and making agricultural resources an important priority. Viewing the earth from space is now crucial to the understanding of the influence of man's activities on his natural resource base over time. In situations of rapid and often unrecorded land use changes, observations of the earth from space provide objective information of human utilization of natural landscapes. Over the past years, data from the earth sensing satellites has become vital in mapping the earth's features and infrastructures, managing natural resources and studying environmental changes. Remote sensing is very important tool for mapping of land use and land cover for micro, meso and macro level planning. Remote sensing systems have the capability for repetitive coverage, which is very helpful in change detection studies. For ensuring planned development and monitoring the land utilization patterns, preparation of land use and land cover map is necessary. This research demonstrates the ability of GIS and remote sensing in capturing spatial and temporal data. Attempt was made to capture as accurate as possible the land use land cover classes as they change through time.

Remote sensing and geographic information system are now providing new tools for advanced ecosystem management. The collection of remote sensed data facilitates the synoptic analyses of earth- system function, patterning, and change at local, regional and global scales over time. Such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity **(Wilkie and Finn, 1996).** GIS and remote sensing data provide a general extensive

synoptic coverage of large areas. Thus these technologies provide a system for regularly monitoring the changes occurring in the area with a view to better planning.

Recently, remote sensing with multi-temporal high resolution satellite data has become a strong tool for monitoring aspects such as vegetation cover, soil degradation, and urban expansion and more generally for most types of LULC changes. In contrast to ground based terrestrial data acquisition, valuable knowledge can be gained in a relatively short time and cost effective way. The importance of mapping land use classes and monitoring their changes with time has been widely recognized in the scientific community. Remote sensing and GIS are important tools for studying land use patterns and their dynamics. Land use changes are invariably associated with the mining of natural resources. Studying changes in land use pattern using remotely sensed data is based on the comparison of time sequential data. Change detection using satellite can allow for timely and consistent estimates of changes in land trends over larger areas and has the additional advantage of ease of data capture into a GIS (Prakash and Gupta, 1998).

Nature and location of change in land use and land cover

An important aspect of change detection is to determine what is actually changing to what i.e. which land use class is changing to other. This information will reveal both the desirable and undesirable changes and classes that are "relatively" stable over time. This information will also serve as a tool in management decisions. This process involves a pixel to pixel comparison of the study year images through overlay. In terms of location of change, the emphasis is on built-up and agricultural land.

Land cover has gone under continuous change for millennia. This change has occurred through the use of fire for game hunting and clearance of patches of land for agriculture and livestock production, since the advent of plant and animal domestication. Thus is because human's production demands cannot be fulfilled without modification and or conversion of land covers. In the past two centuries, the impact of human activities on land has grown enormously because of population increase, technological development and the requirements thereafter, altering entire

landscapes, and ultimately impacting the biodiversity, nutrient and hydrological cycles as well as climate **(De Sherbinin, 2002),** especially in the developing world. These diverse roles have been recognized in a large number of research publications and international conferences, symposia, and workshops devoted to the subject over the past few years.

According to DE Sherbinin (2002), land use is the term that is used to describe human uses of land, or immediate actions modifying or converting the land cover. On the other hand, land cover refers to the natural vegetative types that characterize a particular area. Land use change is the proximate cause of land cover change. The driving forces to this activity could be economic, technological, demographic, scenic and other factors. Hence, land use and land cover dynamics is a result of complex interactions between several biophysical and socio-economic conditions which may occur at various temporal and spatial scales **(Reid et al., 2000)**

Among others, the three international conferences on human and the environment **(Stockholm, 1972)** and the United Nations conference on environment Development (UNCED) (Rio, 1992) and the world summit for sustainable Development(Johannesburg, 2002), called for substantive studies of land-use and land cover changes and since then has become a global issue. This is because the effects of land-use and land-cover are directly related to the livelihoods of people. According to Pimental (1993), as cited in Bewket (2003), for almost all food requirements, people of the world totally depend on land resources, except for only 3% of the food which is coming from aquatic resources. Therefore, this important resource needs careful management for the sake of sustained ability to feeding the world population. Even though, natural processes may also contribute to changes in land cover, the major driving force is human induced land uses **(Allen and Barnes, 1985)**. In order to understand the various implications of land cover change, understanding of land- use change is essential. Different human driving forces mediated by the socio- economic setting and influenced by the existing environmental conditions, lead to an intended land use of an existing land cover through the manipulation of the biophysical conditions of the land **(Turner et al., 1995)**

The fact that human beings are the major contributors to land cover changes and are the ones experiencing the consequences of these changes, it will be of paramount

importance to understand the interaction between humans and the terrestrial environment. This need becomes more imperative as changes in land use become more rapid the livelihoods of societies land use differs from land because of the intentional role of people to adapt the natural land cover to their benefit. The land use connotation entails interference by humans and an underlying intention to turn the natural land resources into a beneficial output. It entails both the manner in which the biophysical attributes of the land are manipulated, and the intent underlying that manipulation, namely, the purpose for which the land is used.

According to the FAO concept land use defines the human activities which are directly related to land, making use of its resources, or having an impact on them. In that context the emphasis is on the function or purpose for which the land is used and particular reference is made to "the management of land to human needs." The term includes both rural and urban or industrial uses. Land use automatically involves the concepts of optimizing the land use potential, land evaluation for example, land use planning.

Rapid and extensive modifications of land use /land cover due to accelerated human activities have been a major cause of global environmental change in the past three centuries, although evidence for land covered alteration dates back many thousand years. Over the past 200-300 years, humans have been dominant drivers of landscape transformations **(Vitousek et al., 1997).** During the past 20 years, humans changed these landscapes to meet the growing demand for food, fodder, timber, fiber and fuel more rapidly and extensively than in any comparable period of time (Millennium Ecosystem Assessment, 2005). Changes in land use/ land cover have occurred to such an extent that it has significantly affected the functioning of biosphere, being one of the most important causes of biodiversity loss as well as climate change. This change is one of the primary causes of soil degradation and has a major impact on the provision of ecosystem services to people. Although, this phenomenon is global in nature and is neither region specific nor country specific. But the nature and magnitude varies from one part of the globe to other, from developed to developing and under developed part of the world. It varies from plains to deserts and mountains. Land use/ land cover change in mountainous areas have wider ramifications. The ecosystem is fragile and it is more susceptible to the negative impacts of this change. Deforestation bad agricultural practices, unplanned growth of settlements and developmental activities have wide ranging effects in mountainous regions. Kashmir valley is

known for its beauty throughout the world. This valley has snow clad mountains, diverse landscapes cascading rivers and streams etc. But this vale has been experiencing environmental deterioration since last several decades. The lush green forests which dotted the landscapes have started dwindling because of the unprecedented anthropogenic impact. The land use/ land cover pattern has changed over the period of time. The forest cover has decreased not only in extent but also in terms of density. **(Kango and Qadri, 1984; Ahmed, 2009).** This land has been brought under agriculture, agriculture plantation, settlement and horticulture uses. Globally, remote sensing and GIS technologies are being applied to carry out change detection studies for land use/ land cover analysis especially in mountainous regions where there are other constraints besides accessibility.

The present study/ has been carried out to identify the existing land use/ land cover analysis of district Pulwama.

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