CHAPTER –1

INTRODUCTION

1.1 CONCEPT OF GEOMORPHODYNAMICS

The term Geomorphodynamics is a synthesis of three words of which two are Greek words that is "**geo**" (meaning earth), "**morphe**" (form) and "**dynamics**" (which refers to science that deals with object or matter in movement). In short Geomorphodynamics includes all those dynamic forces (such as gradational, weathering, denudation etc. which are induced by several agents acting on the surface of earth and also endogenetic) which stimulate changes to form i.e., landscape in a given spatial and temporal unit. This is how an attempt has been made to define the term 'Geomorphodynamics' because this term was not encountered in any literature, dictionary or the search engines on the internet.

Geomorphodynamics implies the dynamic nature of 'Geomorpho' that is earth and its form which in general focuses on the interaction of form and process within a given spatial unit. And all this falls within the domain of Geomorphology.

Geomorphology is the study of the present form of the earth and its genesis and is also capable enough to speculate closely if not exactly, its future which is necessarily based on the geological past and the present day processes or forces acting upon it. Geomorphological studies can be undertaken on a variety of scale which can be as large as world geomorphology (macro level) and as small as the study of a landscape at local level (micro level).

Geomorphology is the study of landforms. Traditionally the study has been essentially emphasizing the origin and evolution of landforms. "The study and interpretation of the records left by erosion constitute the larger part of the science of Geomorphology" (N.M Fenneman, 1936)[1], on the other hand geomorphologists like L.B .Leopold, M.G.Wolmen and J.P.Miller (1964) considered the contemporary processes as a thrust area in their approach to the subject.

The geomorphology is the science of landforms and of processes transforming landform. Much of the recent work reflects the adjustment of form and process. Going by the notion of Alistair (1977), another approach to the subject is the interaction at the contact surface between the terrestrial parts of the lithosphere and the liquid & gaseous envelops which surrounds it.

[1] Feeneman, N.M. (1936), "Cyclic and non cyclic aspects of erosion". Bulletin Geological Society of America. Vol-47, Pp-173-186.

There is a difference in the opinion on the geomorphic analysis in between American & the European view. As for example, according to American (A. N. Strahler, 1952), the Dynamic Geomorphology (a method of geomorphic analysis involving treatment of landform and Processes) depends upon the physical properties of form and process i.e., to know the physics of processes operating & also to apply physics in geomorphology. In Europe, the view of dynamic geomorphology as is reflected from the work of Cailleux & Tricart (1973) & other is more confined to the effects of chemical & biological as well mechanical processes on land forms, their approach stressed mainly on where the given process operates & how much it has affected the area.

The objective of such Geomorphological work is to understand the genesis of the present landscape by studying the stages through which it has passed to reach its present form. There are two major paths by which this objective can be approached; firstly, the development of the drainage pattern can be investigated, and secondly, the stages of the denudation chronology can be elucidated as far as possible. But both these approaches are associated with the lack of evidences since both evolve at a glacial pace. Moreover, Geomorphological phenomenon depends on a large number of variables, which is one of the major difficulties in analyzing geomorphic features.

"The genesis of the landforms development can also be understood on the basis of the information derived through its classification and description. The explanation of landscapes may be approached through (a) establishing relationships between landforms and climate (climatic geomorphology approach) or between landforms and structure or rock types (structure-form approach), (b) through seeking landform origin and

development in historical perspective (chronological or historical approach) and (c) through establishing relationships between landforms and processes (process-form approach)", Singh, Savindra (2003)[2].

According to Penck the three elements that must be studied in geomorphology are the exogenetic processes, endogenetic processes and the actual morphological features that depend on their interaction. Penck did not gave due importance to climate. Whereas, geomorphologists like Tricart (1970), P. Birot(1968) in Germany and Peltier (1950) in the United States considered that climate plays an important role in the landscape development. The climatic geomorphologists considered that the different climatic condition effects differently on soil, vegetation, runoff and parameters such as rainfall determines the nature of the operation of processes and resultant landforms.

Ultimately, it can be said that landforms is the subject of primary interest in geomorphology & to study the genesis of landforms, it is indispensable to know about the morphodynamic i.e., process of formation & the process which are at work & are responsible for. Both the approach i.e., trying to infer process from the form & form from the process is well explored by the geomorphologists.

Geomorphodynamics refers to the component or processes in different form, which induces changes on the surface of earth. Here both endogenic dynamics and exogenic dynamics are held responsible, at the same time both tries to show their hegemony, making it very difficult to establish the fact. In geomorphology one may distinguish structural landforms (endogenic) from denudational landforms (exogenic).

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[2] Singh, Savindra & Tiwari, R.C.(1989) ed. "Geomorphology & Environment". Allahabad Geographical Society P-680

Endogenic (from the Greek word '*endon'* meaning within) dynamics includes all those processes originating within the earth. Penck designated all processes which has its origin within the earth as endogenic. The main sources of endogenic energy are (a) Thermal, due to radioactive decay at macro level and chemical exothermic reaction at local level and (b) Gravitation, based on isostatic principle. The most familiar endogenic processes involve earthquake, volcanism, crustal wraping, folding, faulting and metamorphism.

Similarly, all externally generated geodynamics processes are classified (after Penck, 1894) as exogenic. Thus all denudational processes in geomorphology and geology are related to exogenic dynamics. The radiation from the sun being the principle source of exogenic energy helps in the heating and circulation of atmospheric phenomenon. The second major source is gravitational force in relation to heavenly mechanics of the sun, earth, moon and other planets. Such celestial mechanics effects the circulation of oceanic currents and tides. At large, all exogenic dynamics are directly or indirectly dependent on the thermal energy emitted from the sun. Circulation of water (water cycle) and air on the face of earth is guided by the intensity of solar energy.

"Considering several morpho-dynamics, the earliest attempt to comprehend all landforms over a wide area into a general classification seems to have been that of Passarges, S. (1919). His scheme was hierarchical and remains one of the most comprehensive produced. It includes category level; *Types* (coastal, fluvial landforms etc.); Class (forms suffering from aggradations, erosion etc.); Order (identified main

type of process such as tectonic, volcanic etc.); Families (e.g. faulted, fractured) & Kind (degree of family, symmetrical, asymmetrical etc.)" [3].

Thus Geomorphodynamics includes all those forces (such as Gradational, weathering, denudation, salinisation, deflation which are induced by several agents and also endogenetic) which stimulate changes to processes modifying form i.e., landscape in a given spatial and temporal unit.

1.2 CONCEPT OF MORPHO-ECOLOGY

Traditionally, ecological studies have always been emphasizing the organic components while inorganic components like soil, its type, and parent material slope gradient and particle sizes have always been less fascinating.

"Geomorphological processes affect spatial & Temporal changes to the land surface (Thornes & Bundsen, 1977), and consequently influence the distribution and development of soil & ultimately the ecosystem" [4].

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[3] Colin W. Mitchal, (1991), "Terrain Evaluation". Longmans, London (2nd Edition), p-50.

[4] Colin E. Thorn, ed. "Space & Time in Geomorphology". Proceeding of the Binghamton Symposia in Geomorphology, International Series no. 12, Allen & Unwin Publisher, p-25.

The ecology of an area not merely includes the organic elements such as micro & macro flora & fauna but also soil, which is at large the result of Geomorphodynamics and hence Landscape (inorganic) together with the plants and animals (organic) must be held together for the study i.e., morpho-ecology. In any unit of ecosystem there exists a defined relationship between morphology & ecology and thus the term "Morpho-ecological management" is incorporated.

Ecology is the study of the relationship between organisms and their environment. One of its central tasks is to study the symbiotic and complementary relationships, which is achieved through specific interventions either in the physical environment or within themselves. As for example the Halophytes, these plants grow and complete their life cycles in the habitat with high salt content. Such plants are commonly found near seashore and some saline areas away from sea coast. Although these plants grow in the areas that are highly saturated with water yet they cannot take water because of high concentration of salts in the soil. Thus it is not a Physical stress but a physiological stress. Such physiological stress can be seen in the mangroves lying within the salt pans of study area.

Halophytes, which are found growing in muddy swamps of estuaries and inter-tidal zone, are called mangroves. Because of the presence of ample of water in the upper layer of the soil, they have shallow normal roots. In addition to it many stilt root or prop roots develop from aerial branches of stem for efficient anchorage on the muddy or loose sandy soil. The soil of the coastal region is poorly aerated and contains very little oxygen because of water logging. Under such circumstances the roots do not get sufficient aeration and in order to compensate the same, the

halophytes develop special type of negative geotropic roots called as Pneumatophores. Pneumatophore develops on underground roots and project in the air above muddy soil, which helps in gaseous exchange; this is a typical characteristic of mangroves in the clayey soils found in the study area. Similarly, the Xerophytes have adopted to grow in the area with scanty rainfall and underground water with water holding capacity. The present scenario of morpho-ecological adaptations of halophytic and xerophytic plants exhibits there response to the complete domain of physical environment which includes climatic parameters and relief condition surface texture moisture content and water depth during rainy season.

Morpho-Ecology is also described as a new framework, combining morphogenesis (the development of structure or form) and ecology, which is firmly rooted within a geographical and biological paradigm.

"According to Gray (1977), only from the result of field studies together with an understanding of natural developments & effects of human influences, one can decide the best approach to the management of a site"[5].

A species act differently in different morpho-eco-climatic regime. To insure the healthy growth of biome it is necessary to understand the role of each components of the biome starting from relief, soil, its type, texture, profile etc. to live organic matter dwelling on to them.

[5] Singh, Savindra & Tiwari, R.C. (1989) ed. "Geomorphology & Environment". Allahabad Geographical Society P-680