RESEARCH FRONT

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IMPORTANCE OF LAND USE PLANNING IN WATERSHEDDEVELOPMENT: A CASE STUDY OF KOYNA WATERSHED

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ABSTRACT

Watershed development has been a key focus area in India 1980s onwards. An integrated and holistic approach of watershed development has brought out excellent results in terms of improvementin the conditions of natural resources like soil and ground water. Land use is an important component of watershed and gets highest priority in planning development measures in watershed management. Land use if planned sensibly can change the land scape of the region and have greater impact on socio-economic fabric of the region by providing better opportunities of income to the local population. However, the great deal of people's participation is needed to make these measures work out well. The paper gives an overview about importance of land use studies in watershed management and its impact with reference to Koyna Watershed in Satara district of western Maharashtra.

Key Words: Land Use, Watershed Development, Koyna Watershed, Wasteland Management, Land Capability Index.

INTRODUCTION

Land use is the fundamental element of development hence land use planning becomes a tool to direct development efforts to sustainability. The changing interaction between man and nature has guided the land use planning philosophies, concepts, and methodologies over the past centuries. Land use planning concepts have evolved from single purpose approach to more complex multipurpose approach. The initial concepts were targeting at sectoral needs like agriculture, industries and urban development. The later evolvement at the conceptual level is more towards the implementing integrated and holistic development approach. This evolution in land use planning has come through the awareness that land use planning provides a platform to identify and develop land use planning management options on the basis of need to manage resources and watershed ecosystems with development objectives.

As the developmental objectives becomes more and more complex land use planning has to deal with complex and multi-dimensional interactions. In the spatial dimension, three scales are generally recognized as requiring the formulation of different but related set of goals for land use planning A) National or multinational scale, B) Basin or regional scale, C) Local or micro watershed scale.

These scales are set apart on the basis of priority issues which require to be dealt with at each level e.g. at national level the priority issues might include economic and social expectations, environmental aspirations and regional development pattern. At the basin scale watershed management might be oriented towards ecosystem stability and biodiversity objectives and finally at local level issues may be more related specific management options. Land use planning should adopt both a proactive and preventive approach towards integrated development objectives at all levels.

Alarming population growth, along with resulting agricultural development and expansion of urban areas contributes to steady increase in pressure on land as a resource. Increasing demand on this limited natural resource leads to the over exploitation and degradation of land environment.

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Fundamental natural resources such as land, forests, water when utilized to provide employment and yield sustenance to communities, may not be developed and managed in an environmentally sustainable manner. Since most of the suitable land for agriculture is already being used, agricultural expansion is now happening in marginal and fragile lands which are prone to degradation.

Most common consequences of poor land use in upland watersheds is soil erosion due to deforestation, cultivation and destruction of native vegetation. Steeply sloping forest lands, when cleared vegetation, is highly prone to erosion. Extent of soil erosion can hamper the agriculture productivity beyond recovery. Eroded material may be transported down slope into rivers and streams leading to siltation of channels.

In recent years there has been an increasing recognition of the need for new approaches to the management of land and water resources.

Integrated watershed development involves the adoption of a coherent management system for land, water and vegetation that helps to achieve to sustainable use of natural resources within a watershed. The land resources of soil, water and vegetation cannot be managed for quality and sustainability in isolation from each other or from watershed environment. The natural balance of these resources can be easily disrupted by changes in land use or by mismanagement and bad planning of land use.

IMPORTANCE OF LAND USE PLANNING IN WATERSHED MANAGEMENT

Land being a limited resource has to be optimally used. In most of the situations it is observed that land is either over utilized or underutilized. The balance between usages of land for various activities has to be maintained in order to have a healthy watershed. The existing land degradation in any watershed needs attention in order to make land available for activities planned for watershed development.

A lot of watershed management activities depends on the current land use pattern in the watershed. Watershed Management also addresses the issue of land degradation. Integrated watershed management involves coordinated efforts to manage land resources in a way to maximize the long term productivity of land while still maintaining the quality of watershed environment. In the view of this definition of land resources can be further expanded to include all relevant features of geology, geomorphology, landforms, climate, hydrology, vegetation and fauna.

Integrated watershed management approach requires an assessment of the suitability of existing forms of land use and suggesting more improved or beneficial forms of land use. Decision related to watershed management are therefore dependent on assessment of potential of land resources for various types of uses and introduction of modified or improved forms of land use. The assessment of the potential of the land is called land evaluation. It compares the requirement of land use with the resources offered by land. It aims to predict consequences of land use change as a basis for planning. Land evaluation depends on land resources, land use and economics. Information about the other components like topology, landforms, geology, geomorphology, soils, climate, hydrology and vegetation cover can facilitate decisions related to land use planning.

Land evaluation is critical in land use planning and an important feature of Integrated Watershed Management practice. Effective land use planning can be undertaken on the basis of detailed assessment of the land and evaluation of its potential for alternative uses and best uses, such planning is essential for effective watershed management which is concerned with the prediction of the environmental effects of various land use.

1 Land Evaluation

The assessment of land potential is called land evaluation.

Land evaluation compares quality of available resources of land and requirements of different land use. A comprehensive inventory of existing qualities of land resources is necessary for this comparison. Information about possible land use from includes pros and

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cons of possible land use from variety of sources. To compare the best possible land uses for decision making economic data related to cost and benefits of each of the land use and their consequences are also required.

Inventory of existing resources include information related to topography, landform, geology, geomorphology, soil types climate, hydrology, vegetation, wild life & existing land use. A soil survey is of prime importance to land use planning.

Information about resource requirement of various forms of land use can be obtained from variety of technological & scientific sources. Soil science, agronomy, forestry, ecology, civil & agricultural engineering are basic sources of such information.

The outcome of land evaluation does not necessarily be expressed in monetary terms. It can vet qualitative or quantitative in physical terms as well. A qualitative outcome will defined each land use for a specific land unit as “highly suitable”, “marginally suitable” or “not suitable”. However qualitative outcome may not be precise and it is appropriate for broad scale, under developed or sparsely settled areas. The advantages of this approach is expression and comparison of wide range of cost and benefits considering environmental, social & economical aspect, this is also useful where decision makers have limited expertise and want only a brad classification.

A quantitative physical evaluation provides numerical estimates of inputs and outputs associated with various alternatives. Inputs may include resources, labor or capital. Output will be in quantitative expression of land use products e.g. tons of grains produced. This approach is useful for doing cost benefit analysis between various alternatives. It expresses environmental as well as social cost and benefit for all land use alternatives. Environmental cost and benefits are expressed in terms of water and air quality parameter, tons of soil lost by erosion, area of vegetation cleared etc. economic cost and benefits can be expressed in number of jobs generated. The major disadvantage of this approach is difficulty in ranking the alternative land uses. Since the outputs are not comparable on the basis of quantities alone. It is difficult to suggest or choose between land uses e.g. number of jobs generated cannot be compared with tons of soil lost. Quantitative physical evaluation should be considered as first step to detail economic analysis.

A detailed economic evaluation will require a comprehensive cost and benefit analysis associated with all existing and potential land use which can be comparable in terms of monetary, social and economic benefits and loss. The detailed economic evaluation should also consider time based value of money and other benefits while ranking the land use.

Land capability classification is one of the technique that is used for land evaluation at farm level. This technique focuses mainly on sustainable agriculture and soil conservation. This technique has also been modified and applied for purpose of urban development planning. This is a readily applicable technique for integrated catchment development planning.

There is also an alternative approach to this technique which do not only assess the capability of land for various purposes but suitability of land for specific land use purpose. This approach is now being widely used to assess suitability of land for new forms of land development & choose preferred changes in land use.

2 Land Capability classification

The land use capability classification is defined as a systematic arrangement if different kinds of land according to this properties that determine its capacity for long term sustained production. Capability is used in the sense of suitability for productive use by taking into account the physical limitations of land (Land Use capability survey handbook – A New Zeeland handbook for classification of land)

Originally developed by United States Development of agriculture (USDA) for farm planning purposes particularly in soil erosion prone areas, it is now widely used, often in modified or extended form for land evaluation. It is useful tool for integrated watershed

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management as it promotes sound farming practices that helps in conservation of natural resources. It is also useful in broader scale catchment land management planning.

LAND USE CLASSIFICATION IN KOYNA WATERSHED

Koyna watershed falls in Satara district of Maharashtra. Koyna is an important tributary of Krishna River and the largest tributary in the Satara district. The study area lies between the 17° 01' 55.71" N latitude and17° 17' 23.83" N latitude and 73° 01' 39.10" E longitude and 73° 39' 53.26" E longitude.

The land use data used here is acquired from MRSAC (Maharashtra State Remote Sensing Agency). The data was then classified into land uses & land cover types observed in the study area. The following table gives a broad level classification of land use and land cover present in the area.

Land Use/Land Cover	Area in KM	% of Total Area
Agriculture	1010784	40%
Built Up	43427	2%
Forest	802361	32%
Wasteland	478149	19%
Waterbodies	188341	7%

Agriculture occupies the highest position in terms of percentage of area covered with 40% area showing agriculture as a land use. This is followed by forest with 32%. The area is one of the greatest biodiversity site identified in the world due to the presence of dense rain forest. The third highest land cover is waste land contributing to 19% of the area. This is the potential growth areas that can be targeted to watershed management program. Waterbodies and built up are contributes to 7% and 2% respectively.

The details of the above classification can be found below table:

Land Use/Land Cover	Sum of AREA in KM	% of Total Area
Agricultural Land-Crop Land-Kharif Crop	453656	18%
Agricultural Land-Crop Land-Kharif Crop(Sugarcane)	173790	7%
Agricultural Land-Crop Land-Rabi Crop	49147	2%
Agricultural Land-Crop Land-Two crop area	288641	11%
Agricultural Land-Crop Land-Zaid Crop	769	0%
Agricultural Land-Fallow-Current Fallow	44782	2%
Built Up-Built Up (Rural)-Built Up area (Rural)	33671	1%
Built Up-Built Up (Urban)-Residential	2787	0%
Built Up-Built Up (Urban)-Vegetated Area	6968	0%
Forest-Deciduous (Dry/Moist/Thorn)-Dense/Closed	181962	7%
Forest-Deciduous (Dry/Moist/Thorn)-Open	73964	3%
Forest-Evergreen / Semi Evergreen-Dense/Closed	239574	9%
Forest-Evergreen / Semi Evergreen-Open	112159	4%
Forest-Forest Blank	23280	1%
Forest-Scrub Forest	50848	2%
Forest-Tree Clad Area- Dense	93480	4%
Forest-Tree Clad Area- Open	27094	1%
Wastelands-Barren Rocky/Stony waste	22216	1%
Wastelands-Scrub land-Dense scrub	204422	8%

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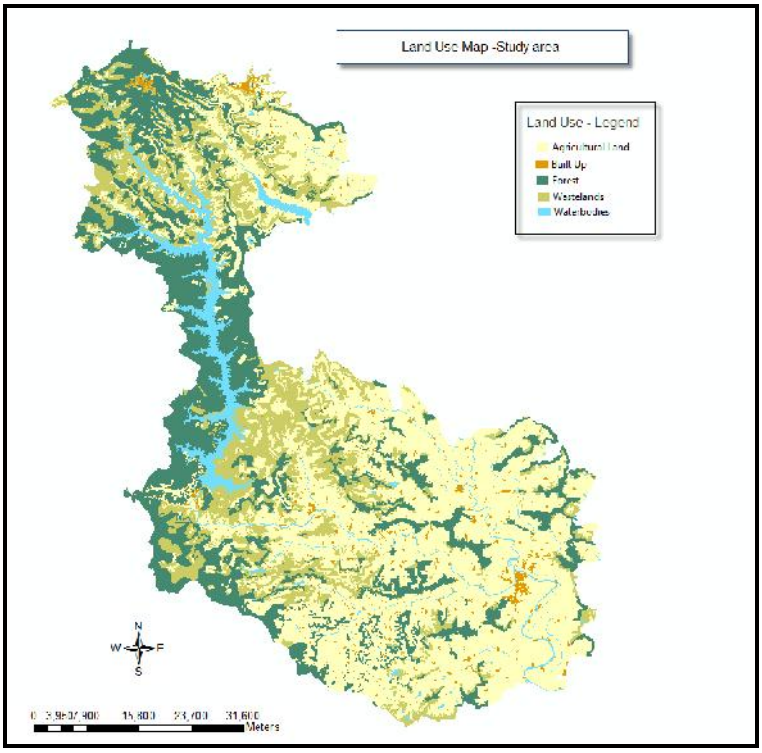
Wastelands-Scrub land-Open scrub	251511	10%
Waterbodies-Canal/Drain-Lined	20043	1%
Waterbodies-Reservoir/Tanks-Dry-Kharif extent	30879	1%
Waterbodies-Reservoir/Tanks-Dry-Rabi extent	24247	1%
Waterbodies-Reservoir/Tanks-Dry-Zaid extent	70534	3%
Waterbodies-River/Stream-Perennial	42638	2%

MAP OF LAND USE AND LAND COVER OF STUDY AREA



SUGGESTED LAND USE STRATEGY

Since a larger percentage of the watershed is occupied with wastelandbeside agriculture, any watershed development programme planned in the region should focus on management of waste land and how it can be better utilized for other purposes.

Wastelands are land which is unfit for production. It includes overgrazed and draught struck pastures, eroded soils, hilly slopes, eroded valleys, barren land as well as waterlogged land.

Wasteland which can be treated to be used to its potential are called culturable wastelands. These are generally the wastelands which are not being utilized to the potential and mismanaged due to various reasons, e.g. marshy lands and barren lands. Unculturable wastelands are the areas which cannot becultivated and reclaimed e.g. steep slopes.

In the Koyna watershed, it is important to see how much percentage of total wastelands fall under unculturable wasteland. Since most of wastelands along the crest are steep hilly slopes, they may be unculturable. For the wasteland on the downstream area following measures can be taken to reclaim the wastelands.

1 Afforestation

To reclaim the wastelands which are culturable, afforestation can be taken up as an immediate measure of action. Reforestation in the areas where forest existed and was destroyed due to excessive cutting, over grazing or fire is also necessary to control the further degradation of soils.

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2 Surface cover and Mulching

Providing surface cover to soil either in the form of crop residue or mulching will restrict the soil moisture from evaporating and will also provide necessary nutrients to soil. This will also restrict the soil erosion.

3 Strip farming and terracing

These very useful techniques to control the downhill erosion of soil. Strip farming includes planting different kinds of crops alternatively on hill slope. In terracing the hill slopes are shaped in form of levelled terraces to hold soil and water. They also restrict the flow of water downhill thus restricting the soil erosion. Edge of the terraces are planted with plant species which can hold soil.

4 Cropping pattern

Changing the cropping pattern by mixed cropping, alternatively cropping the plants and crop rotation is also an important measure to replenish the soil with deprived nutrients.

CONCLUSION

The land use studies thus can prove an effective tool in devising a plan for watershed management. It can not only change the land scape of the region but also help in improving the quality of other allied aspects of watershed like soil and ground water. Measures taken to balance the land use in an area can restrict the soil erosion and improve the level of ground water by reducing run off. Effective land use planning is necessary for success of watershed development programs.

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