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Integrated Approach for Land Resource Management: A Case Study of Kathan Watershed, Chhatarpur District, Madhya Pradesh, India Using Digital Classification Technique

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ABSTRACT :
This paper focuses on the conceptual integration of land resource management within the context of an action research program, where land is growing consensus that an effective way to control land degradation and enhance the long term sustainability of agricultural and rural communities through locality based land planning and management at the watershed scale. Advancement in remote sensing, geographical information system and physical simulation make it possible to develop user-friendly study of land resources for economic development, it has been recognized as an essential component of developmental planning. Appraisal of resources and diagnosis of problems involved in management of the availability of these resources is particularly important in areas of scarce resources. Land use bears a close correspondence with terrain characteristics especially in the tropical countries. There is a direct impact of relief, geology, soil fertility status and micro climatic conditions in laying out the land use pattern. An attempt has been made to prepare an action plan for the strategic management and planning of land resources of the study area with integration of different thematic maps. The present study help is the management and development of Kathan watershed. The lack of planning in forest management and cropping pattern is the main concern of the watershed. By integrated various thematic maps is GIS platform such as geomorphology, lithology, soil, drainage, slope, land use/ land cover and groundwater potential map along with meteorological data of the study area, generated action or non-action plan map.

Keywords: Land Recourse Management, LISS-III, Satellite imagery, Unsupervised Classification Technique.

INTRODUCTION

Land is precious source of natural resources; land is important factor of production. The introduction of sustainable development has an impact on land use/ land cover, playing an important role in natural resource management. Land is the prime and a vital resource for man. Since, the beginning of human existence, man has directed his activities with reference to earth resource, and he know how to use these resource for own benefit. The proper utilization and management of land is a matter of utmost concern to the people, improper use of land has created so many problems like land degradation, Soil erosion resulted decline in other productivity. Therefore, optimum utilization and strategic management of land resources, according to its capability in a planned is essential. Land and water both are basic elements of our life; land resource management is the process, managing the use and development in both urban and rural setting of land resources. In today's life, due to population explosion there is a massive demand of land for resources is imperative to understand the consequences of man-made initiatives and natural effected of environmental land cover things each and everything and there developing planning.

The urban land is compound system of human and nature. It is also high dense geographical synthesis of population, environmental and social economic resource. Report is described, unplanned industrialization, urbanization and its consequence adversely affect the regional environment. So the two words– land use/ land covers have important significance in regard to land. Land cover implies the physical a natural state of the earth's surface. On the other hand land use is the manner in which human beings activities. This urban development is strictly depends upon land use/ land cover of the area. It is important to distinguish the difference between land cover and land use, and the information, that can be ascertained from each. Remotely sensed data provides valuable and spatial information on natural resources and physical terrain

parameters (Chowdary *et al* 2009). The main research is to apply image processing and pattern recognition to LANDSAT-TM and IRS LISS III satellite image data to drive various land development and management. Erdas Imagine 9.3 software was used for image processing. The classification scheme being using modeled after the India geological Survey system for use with remote sensing data (NRSC 1989, land use/land cover classification system).Geo informatics use in the land resource management has proved to be an indispensable management. The main aims of the study are as follow below-

- Making land resource management system for sustainable development at micro watershed level.
- To identify the prioritized area for land use/ land cover management.
- To develop a local specific micro watershed action plan and non-action plan considering land and forest resources for optimal utilization.
- To suggested the agricultural land development, scrub afforestation land development, water bodies or their channels development measure for micro watershed on a their weather climate land terrain all effect basic.
- To identify the integrated of groundwater potential area.

STUDY AREA

The total geographical area of Kathan watershed is 1341km^2, this is the part of Chhatarpur district (figure no 1). Chhatarpur district is located in the northern part of Madhya Pradesh and covers an area of 8687 km^2, it comes under SOI toposheets no.54L/16, 54P/2, 54P/3, 54P/4, 54P/6, 54P/7 and 54P/8. It is surrounded by the districts of Panna in the east, Damoh and Sagar in the south, Tikamgarh in the west and Banda, Hamirpur and Jhansi districts of U.P. in the northeast, north and northwest, respectively. The area is well connected with the adjoining townships and district headquarters with a network of roads. The nearest railhead is Mohaba town, located about 54 km northeast of Chhatarpur. The tributaries of Dhasan and Ken rivers drain the district. World famous Khajuraho temples are located in this district. The study area watershed code is 2C2C1.

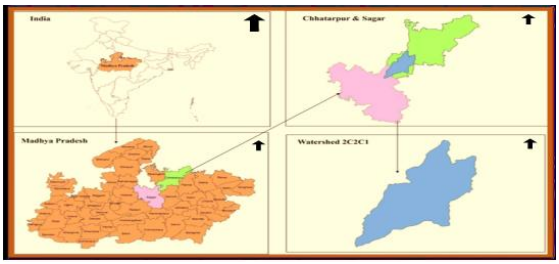

Fig. 1: Location map of the study area

The major part of the district is occupied by Bundelkhand Gneissic, Complex comprising a variety of medium to coarse grained granites, migmatites, gneisses etc. They also contain minor enclaves of schist, philtres, banded hematite quartzite and met basics. The Bundelkhand Gneissic, Complex is traversed by a large number of NE-SW and NW-SE trending quartz reefs and NW-SE trending dolerite dykes, pegmatite's and quartz veins. These rocks are overlain by ENE-WSW trending sedimentary sequence of Bijawar Group of rocks in the south-central part of the district.

METHODOLOGY

The research in land use resource was undertaking by well programmed and integrated approach set up methodology for data collection, identifications, selection and evaluation of well data, which includes;

- Data collection.
- Digital image processing (pre-processing, image enhancement, image classification).
- Land use/Land cover classification using unsupervised classification.
- Visual interpretation of satellite data and preparation of various thematic maps.
- Generated of digital database from thematic maps.
- Weight overlay process.
- Data integration and preparing action plan.
- Result validation

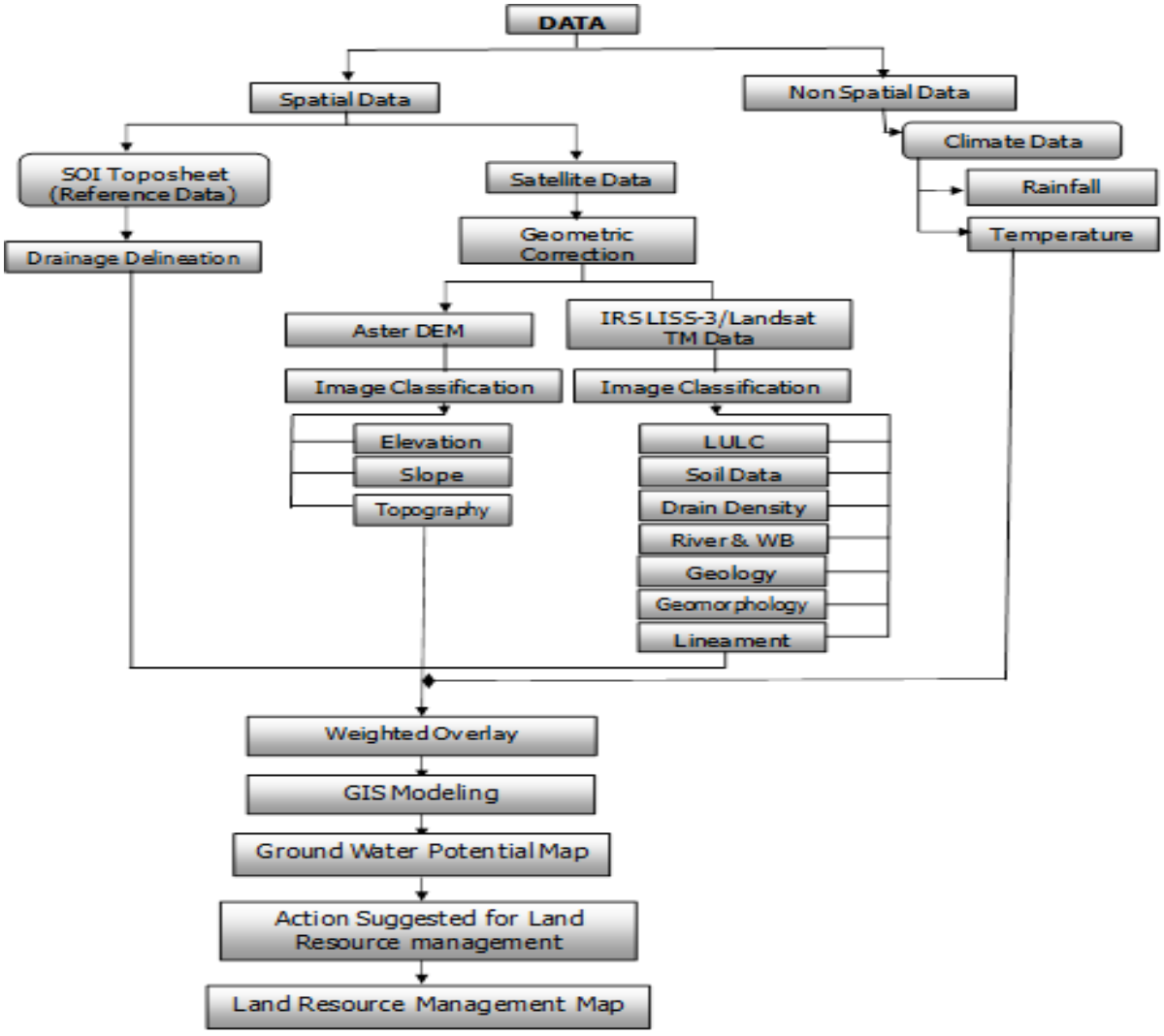

Fig. 2: Flow chart of Methodology

RESULT & DISCUSSION ABOUT LAND RESOURCE MANAGEMENT

In this chapter covers all the aspect of land resource management such as agriculture land management, Wasteland management and forestland management of the Kathan watershed. In the present study an integrated approach has been adopted to evaluate every parcel of lands for adoption of a suitable land use management practice. Capability of GIS is utilized adopting with equal weighted and table criteria approach, for integration of thematic information and generation of land resource management plan. Lithology, geomorphology, land use / land cover, soil, slope, land capability and groundwater potential have been considered for land resource management. Their land resource management was making based on lithology, geomorphology, land use/land cover, soil, slope, land capability, and groundwater potential. These combinations have been grouped in a tabulated from and suitable action it's suggested for each group of combination. Land resource management is divided in three parts i.e.

- Agriculture land management
- Waste land management
- Forest land management

Land Use	Land Cap	Geomorphology	Slope	GWP	Lithology	Soil
Action Suggested : Double Cropping						
Kharif Crop Rabi Crop	IIe, IIIe	IFV,BPP	S_L	Excellent to very good	Sandstone	Fine loamy, loamy,
Kharif Crop Rabi Crop	IIIw	IFV,BPP,	S_L,S_G	Excellent to very good and very good to good	Sandstone	Fine loamy Coarse loamy
Action Suggested : Agro - Horticulture						
Double Crop	VIIes	BPP-M,BPP-S	S_L,S_G	Moderate to poor and poor to nil	Sandstone	Loamy Skeletal,
Fallow Land	IIe,IIIe,I IIw	IFV, BPP –M	S_L	Excellent to very good and very good to good	Alluvial , sandstone	Fine Loamy, Coarse Loamy
Kharif Crop	IIIe,IVes, Vie,VIIes	IFV, BPP-M, BPP-BP	S_L,S_G	Excellent to very good and very good to good	Alluvial , sandstone	Fine Loamy, Loamy Skeletal,
Action Suggested : Agro – Forestry						
Fallow land	IIe,IIIe,I IIw	IFV, BPP	S_L,S_G	Moderate to poor and poor to nil	Alluvial , sandstone	Fine loamy, loamy,
Kharif Crop	IIe	BPP-M, BPP-S.,	S_L,S_G	Moderate to poor	Alluvial , sandstone	Fine loamy, loamy,
Rabi Crop	IIIe			Moderate to poor and poor to nil	Alluvial , sandstone	Fine loamy, loamy, Loamy Skeletal
Kharif Crop Kharif crop	IIIe, IIIw, Vie	BPP-M, BPP-S BP, LR	S_L,S_G, S_{MS} S_L,S_G, S_{MS}	Moderate to poor and poor to nil poor to nil	sandstone	Fine loamy, Loamy Skeletal
Action Suggested : Dry Land Horticulture						
Kharif Crop	VIIes	BPP-S, BP, LR	S_L,S_G	Moderate to poor	Sandstone	Loamy, skeletal
1. Action Suggested : Farm Forestry						
Fallow Land	Vie, VIIes	BPP-M,BP	S_L, S_{MS}	Moderate to poor and poor to nil	Sandstone	Loamy, skeletal
Kharif Crop	VIIes	BP,DH,LR	S_L,S_G	poor to nil	Sandstone	Loamy, skeletal
Action Suggested : Insitu-Soil Conservation						
Double Crop	IIe, IIIe, IIIw, IVes	IFV, BPP-M, BPP-S,BP	S_L,S_G	Moderate to poor and poor to nil	Alluvial , sandstone	Fine loamy, Coarse, Loamy Skeletal
No Action						
Double Crop	IIe, IIIe, IIIw, IVes	IFV,BPP-M, BPP-S,BP	S_L,S_G	Excellent to very good and very good to good	Alluvial , sandstone	Fine loamy, Loamy Skeletal, Coarse Loamy

Table 1 : Agriculture land management

Land Use	Land Cap	Geomorphology	Slope	GWP	Lithology	Soil
Action Suggested : Lay Farming						
Land with scrub and land without scrub	IIe, IIIe, IIIw, IVes	IFV, BPP-M,BPP-S	S_L,S_G	Excellent to very good, very good to good	Alluvium, Sandstone	Fine loamy typic, Fine loamy, coarse loamy, loamy
Action Suggested : Fuel wood Plantation						
Land with scrub and land without scrub	VIIes	CB,BPP-M,BPP-S,BP	S_L	very good to good	Alluvium, Sandstone	Fine loamy skeletal, coarse loamy skeletal
Action Suggested : Pasture Development						
Land with scrub and land without scrub	IIe, IIIe, IIIw, IVes	IFV, BPP-M,BPP-S	S_L	Moderate to poor	Alluvium, Sandstone	Fine loamy typic, coarse loamy, loamy, loamy skeletal

Action Suggested : Silvia-pasture						
Land with scrub and land without scrub	IIe, IIIe, IIIw, IVes,	IFV, BPP-M,BPP-S, BP	S_G,S_{MS},S_S	Moderate to poor, poor to nil	Alluvium, Sandstone	Fine loamy typic, , coarse loamy, loamy, loamy skeletal typic

Table 2: Waste Management

Land Use	Land Cap	Geomorphology	Slope	GWP	Lithology
Action Suggested : Farm Forestry					
Open forest, Scrub forest, Crop land in forest	II,III,IV, VI	IFV, BPP-M,BPP-S, BP	S_L,S_G	Excellent to very good, very good to good	Alluvium, Sandstone, basic Intrusive
Action Suggested : Gap Plantation					
Open forest,	II,III,IV, VI	BPP-M,BPP-S, BP,DH	S_L,	Good to Moderate, Moderate to poor, poor to nil	Sandstone & basic Intrusive
Scrub forest,	II,III,IV, VI	IFV, BPP-M,BPP-S,	S_L,S_G,S_{MS}	Good to Moderate, Moderate to poor, poor to nil	Sandstone & basic Intrusive
Open forest,	VI	BPP-M,BPP-S, BP,DH	S_{MS}	Poor to nil	Sandstone & basic Intrusive
Open forest,	VI,VII	DH, LR	S_S, S_{VS}	Moderate to poor, poor to nil	Sandstone & basic Intrusive
Action Suggested : Afforestation					
Double Crop in forest, Kharif in Forest	II,III,IV	BPP-M,BPP-S, BP,DH	S_L,S_G	Moderate to poor, poor to nil	Sandstone & basic Intrusive
Double Crop in forest, Kharif in Forest	II,III,IV, VI,VII	BPP-M,BPP-S, BP,DH	S_L,S_G,S_{MS}	Moderate to poor, poor to nil	Sandstone & basic Intrusive
Action Suggested : Forest Protection					
Dance Forest	II,III,IV, VI,VII	IFV, BPP-M,BPP-S, BP	S_L,S_G	-	-
No Action					
Dance Forest		IFV, BPP-M,BPP-S, BP,DH	S_L,S_G	-	-

Table 3: Forest land management

AGRICULTURE LANDS MANAGEMENT

Convectional cropping pattern and agricultural practices do not seem adequate during the periods of weather aberrations. Apart from that as per the land capability classification system capability classes I to IV along with gentle and moderate slope, supporting lithology, geomorphology and suitable groundwater condition are found suitable for agricultural practices beyond that they are unsuitable for conventional agricultural use. Kathan watershed comprises 11.59 Km^2 of land, which is under cultivation despite of unsuitable due to social and economic problems. The alternate agriculture or management practices suggested are double cropping, agro- horticulture, agro forestry, dry land, horticulture, farm forestry, in situ soil conversation and areas for peeving the present land use practices i.e. no action.

DOUBLE CROPPING

Agriculture, multiple cropping is the practice of growing two or more crops in the same piece of land during a single growing season. It is a form of polyculture. It can take the form of double-cropping, in which a second crop is planted after the first has been harvested, or relay cropping, in which the second crop is started amidst the first crop before it has been harvested. A related practice, companion

planting, is sometimes used in gardening and intensive cultivation of vegetables and fruits. In our study area Kathan watershed, having deep loamy and very deep fine loamy soils with land capability IIe, IIIe or IIIw, Groundwater condition excellent to very good or very good to good and having level or gentle slope being crop (table no 1). The suitable crops which are practiced in the area are rice, wheat, gram etc.

AGRO- HORTICULTURE

Horticulture is the branch of agriculture that deals with the art, science, technology, and business of growing plants. It includes the cultivation of medicinal plants, fruits, vegetables, nuts, seeds, herbs, sprouts, mushrooms, algae, flowers, seaweeds and non-food crops such as grass and ornamental trees and plants. Agro horticulture is a modified system of farm- forestry of agro forestry. On the study area Kathan watershed which are presently under double crop with loamy skeletal type and lithic soils under land capability VIes and moderate to poor ground water potential along with fallow land and kharif crop areas with very good to good ground water potential and level to guide slope, have been suggested for agro – horticulture purpose (Table no 1).

AGRO- FORESTRY

Agroforestry is an activity that combines production on the same plot of land, from annual agricultural activities (such as crops and pasture) and from delayed long-term production by trees. In the Kathan watershed the area which are presently under kharif crop or fallow land having deep to moderate deep soils with land capability IIe, IIIe,IVw, moderate to poor groundwater potential and having level to gentle slope have been suggested for agro – forestry (table no 1). Area which are moderately deep soil with land capability IIe, IIIe and poor to nil groundwater potential with gentle slope or areas with skeletal soil with land capability.

DRY LAND HORTICULTURE

Growing of fruit crops is one of the many ways of crop diversification in dry lands. Dry land horticulture not only provides higher income to the farmers, but also more stable returns, besides utilizing the off-season precipitation. Land use Kathan watershed which are presently either fallow or under kharif crop having loamy skeletal soil with land capability VIIes, and moderate to poor and poor to nil groundwater potential and level to moderate slope have been suggested for dry land horticulture The suggested for dry land horticulture, (Table no 1).

FARM FORESTRY

Farm forestry is the commitment of resources by farmers, alone or in partnerships, towards the establishment or management of forests on their land. Farm forestry and agroforestry are about choice farmers choosing to commit their resources to the development and management of forests for, amongst other things, commercial return The study area in the Kathan watershed which is presented under kharif crop or fallow land with land capability Vie and VIIes and groundwater condition moderate to poor or poor to nil level to gentle slope has been suggested (Table no 1).

IN –SITU SOIL CONVERSATION

In situ soil conversation is the practices used for soils which are suitable for agricultural as per the land capability is concerned but there is some limitation with soil such as erosion process, wetness limitation or soil depth limitation. The study area Kathan watershed are practicing double crop in some areas where land capability is IIe, IIIe, IIIw and IVes and with moderate to poor groundwater conditions having level to gentle slope. Such area have been chosen for in-situ soil conversation (Table 1).

NO ACTION

Area which are already utilized optimally as per their conditions and capability are being left as no action required , only the present land use system should be maintained. Land units of the Kathan watershed which are presently under double crop having deep, fine loamy soils with land capability IIe, IIIe, IIIw, Ive and excellent to very good an good to good groundwater potential having level to gentle slope are found to be optionally utilized and therefore no action is suggested.

WASTE LAND MANAGEMENT

According to Integrated Wasteland Development Programmed, Wasteland is a degraded land which can be brought under vegetative cover, with reasonable effort, and which is currently underutilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. Watershed development refers to the conservation regeneration and the judicious use of all the resources – natural (like land, water plants, and animals) and human within the watershed area. Watershed Management tries to bring about the best possible balance in the environment between natural resources on the one side and man and animals on the other. Since it is the man which is primarily responsible for degradation of environment, regeneration and conservation can only be possible by promoting awakening and participation among the people who inhabit the watersheds. The Kathan watershed comprises of

19.27 Km^2 of area of under wasteland category of land use / land cover classification. All of those wastelands are cultural in nature and using suitable management techniques these can be reclaimed to be used for bio-mass production. Different wasteland for various actions as per their respective prevailing conditions (Fig. 3).

LAY FARMING

Ley farming is an agricultural system where the field is alternately seeded for grain and left fallow. Another name for the method is "alternate husbandry". In ley farming, the field is alternately used for grain or other cash crops for a number of years and "laid down to ley" i.e. left fallow, used for growing hay or used for pasture for another number of years. After that during the fallow/pasture period the soil is filled with roots of grasses and other plants. In Kathan watershed the areas which are presently under land with or without scrub developed over moderate to buried Pedi plain (Shallow), buried pediment (s), buried pediment (I) and in filled valley having level to gentle slope and excellent to very good , very good to good ground water condition are suggested for lay farming (Table no 2). Different varieties of grass and legume are used for ley farming.

FUEL WOOD PLANTATION

Tree plantations can be a source of fuel wood - wood or wood waste - for electricity generation or methanol production. Fuel wood can be a greenhouse neutral, renewable energy source - the wood used to produce biofuels or to generate electricity. Mallee and other eucalypts are suitable for fuel wood plantations. Establishing fuel wood plantations on land cleared for other uses can benefit biodiversity. In the Kathan watershed areas which are presently under land with scrub or land without scrub having VIIes land capability with very good to good, good to moderate groundwater potential and level slope are suggested for fuel wood plantation (Table no 2). The map show in Fig. 3.

Pasture Development

Pasture lands in the narrow sense are enclosed tracts of farmland, grazed by domesticated livestock, such as horses, cattle, sheep or swine. The vegetation of tended pasture, forage, consists mainly of grasses, with an interspersion of legumes and other forbs (non-grass herbaceous plants). Pasture lands in the narrow sense are distinguished from rangelands by being managed through more intensive agricultural practices of seeding, irrigation, and the use of fertilizers, while rangelands grow primarily native vegetation, managed with extensive practices like controlled burning and regulated intensity of grazing. In the Kathan watershed areas presently under land with scrub and land without scrub with moderately deep to skeletal soils and moderate to poor ground water potential having level slope developed over infield valleys , buried Pedi plain, buried Pedi plain moderate , buried pediment have found suitable for pasture development (Table no. 2). Area can be show on (Fig.3).

SILVIA-PASTURE

Silvia-pasture combines trees with forage and livestock production. The trees are managed for high-value saw logs and, at the same time, provide shade and shelter for livestock and forage, reducing stress and sometimes increasing forage production. Silvia-pasture is the practice of combining forestry and grazing of domesticated animals in a mutually beneficial way. Advantages of a properly managed Silvia-pasture operation are enhanced soil protection and increased long-term income due to the simultaneous production of trees and grazing animals .Wasteland units of the Kathan watershed are presently under land with or without scrub having methodology deep soils any type of land capability up to class VI, moderate to poor and poor to nil groundwater potential having moderate to steep slopes are suggested for Silvia-pasture using development (table no 2). The highest slope areas are suggested for protection using contour bundling. The map show on (Fig. 3).

FOREST LAND MANAGEMENT

A forest is a large area of land covered with trees or other woody vegetation. Hundreds of more precise definitions of forest are used throughout the world, incorporating factors such as tree density, tree height, land use, legal standing and ecological function. Land provides an environment for agricultural production, but it also is an essential condition for improved environmental management, including source/sink functions for greenhouse gasses, recycling of nutrients, amelioration and filtering of pollutants, and transmission and purification of water as part of the hydrologic cycle. The objective of sustainable land management (SLM)is to harmonize the complimentary goals of providing environmental, economic, and social opportunities for the benefit of present and future generations, while maintaining and enhancing the quality of the land (soil, water and air) resource (Smyth and Dumanski, 1993). Sustainable land management is the use of land to meet changing human needs (agriculture, forestry, conservation), while ensuring long-term socioeconomic and ecological functions of the land. (Fig. 3).

NURSERY DEVELOPMENT

A nursery is a place where plants are propagated and grown to usable size. They include retail nurseries which sell to the general public, wholesale nurseries which sell only to businesses such as other nurseries and to commercial gardeners, and private nurseries which supply the needs of institutions or private estates. Some nurseries specialize in one phase of the process: Propagation, growing out, or retail sale; or in one type of plant: e.g., groundcovers, shade plants, or rock garden plants. Some produce bulk stock, whether seedlings or grafted, of particular varieties for purposes such as fruit trees for orchards, or timber trees for forestry. Forest land units presently under open forest, scrub forest, crop lands in forest having excellent to very good, very good to good groundwater potential and level to gentle slope are suggested for nursery development (Table no 3).

GAP PLANTATION

Gap plantation is the plantation of suitable tress in gaps development in the forest due to tree cutting and degradation of forests. It is a modified afforestation technique applied to open forest areas. To achieve the best result of this system it is necessary to select plants which are similar to exiting naturally grown species. Such areas should be protected from grazing and other encroachment. Land units of Kathan watershed which are presently under open forest or scrub forest with good to moderate , moderate to poor and poor to nil groundwater condition having level to gentle slopes are suggested for gap plantation (Table no 3).

AFFORESTATION

Afforestation is the establishment of a forest or stand of trees in an area where there was no forest. Reforestation is the reestablishment of forest cover, either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting). Afforestation is the planting of trees to create a forest on non-forest land. It is different from *reforestation*, which is replanting trees where a forest has been depleted. In the Kathan watershed area the land units which are under forest blank or cropland in forest with level to gentle slope and very good to good groundwater conditions are suggested for afforestation (Table no 3).

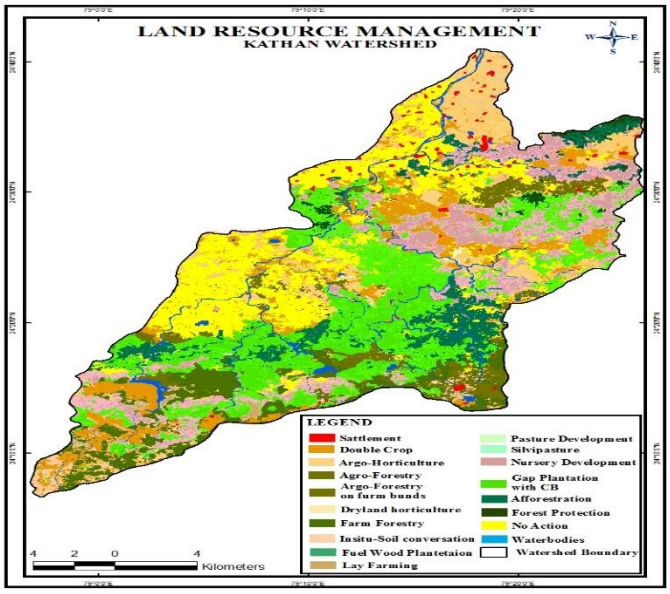

Fig. 3 Land Resource Management

CONCLUSION

The rising pressure on land resource due to the increasing human population, remote sensing and GIS can be used to manage these precious limited resources in effective and efficient manner. The paper study has shown that the micro watershed of Chhatarpur district Madhya Pradesh, is extremely under threat due to improper land use practices and anthropogenic activates. Based on the analysis there is a need to adopt new tools, techniques and technology for proper use and conversation practices for resource use. The LANDSAT- TM imagery is found more reliable for land use and land cover mapping and could be used effectively for in order to submit the land, ecological and environmental resources information for the development and management of the study. Digital interpretation of LANDSAT – TM imagery with 30m resolution proved to be effectively to determining detailed assessment of land use and land cover classes. The unsupervised classification for the land use/ land cover mapping and accuracy assessment provided satisfactory result. Thus remote sensing have been found to be very effectively and economical tool for resources management.

RECOMMENDATION

Remote sensing data are powerful tools to improve our understanding of groundwater system and land resource management or planning suggested. They provide continues detailed terrain information and fallow the mapping of feature significant or their thematic layers to groundwater development therefore it is important to Land resource management, incorporate them in the data collection stage of Land resource management works. Land resource management suggested or planning purpose there slope gentle or level condition,

geomorphology major condition , lithology major class are most important data analysis and found understand all climate by change every think than suggested or planning on the area.

Despite various satellite data with different spectral and spatial resolution coupled with digital image processing technique help to produce detailed maps, ground verification is crucial to increase the accuracy of the interpretation result. The result obtained from this study should be supported by subsurface data obtained from geographical study. Since, geology, geomorphology and lineament mainly control the distribution occurrence and flow of groundwater, analysis of these parameters of these parameters should be supported by high – resolution terrain data and satellite imagery.

Since, land use / land cover map or their classes are seen in the attributes table, there open others features of that area or analysis where every criteria are properly match, those criteria we are described in land resource management chapter, then attributes by attributes or class by class change or help by satellite or some information based on Google map.

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