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## **Land Resource Appraisal of Kas Plateau Maharashtra**

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**Abstract** - Land resources are used for a variety of purposes such as agriculture, plantation, inhabitation industries, water harvesting and tourism projects. Land management practice refers to the means by which a land use outcome is achieved. The land resource management needs a detailed analysis with respect to physical set up for the optimum use of it. Land resource management is nothing but the managing the use and development of land resources. In this view terrain analysis is an important input in land resource appraisal. The Kas area is an extensive laterite surface. This lateritic plateau area is interrupted with overlying loose material and dense vegetation patches. This area is also spotted with number of depressions and natural lakes. The area is also having reserves of laterite which may be excavated in near future for mineral ore (like bauxite). This area is well known for its plant biodiversity. With this background and the potentials of the area it was thought to carry out the terrain classification and to find out the suitability of the area for the different purposes. This study is carried out to understand the present land use and to find out land resource potentials land cover pattern and with help of land capability classification

**Keywords:** - Resources, Management, Appraisal, Kas Plateau, Biodiversity, Land capability

## I. Introduction

Land resources support all natural cover and also human activities mainly the agriculture. Land resources directly affects the agriculture activity. The agriculture activity directly controls supply food to market. Since 2008 food crisis, food supply uncertainty has driven up competition for land among the countries, food and energy crops growers, and speculative financial investors (Smaller and Mann, 2009), which in turn has affected prices, local availability, and the livelihoods of many. The relative scarcity of potable water, in combination with the dramatic effect of local shortages on agriculture and livelihood, has put water risks and opportunities amongst the top sustainability issues (Ernst and Young, 2012; McNally, 2015; PWC, 2011). The land resource management needs a detailed analysis with respect to physical set up for the optimum use of it. Land resource management is nothing but Land the managing the use and development of land resources. Land resources are used for a variety of purposes such as agriculture, plantation, water harvesting and tourism projects. Land management practice refers to the means by which a land use outcome is achieved. Some land management practices, such as disposal practices, tillage and rotation systems, may be discriminated by characteristic land cover patterns and linked to particular land uses. Commodity usually refers to an agricultural or mining product that can be processed. Commodity information may relate to land use and land cover. Tenure refers to the form of an interest in land. Some forms of tenure (such as pastoral or mineral leases or nature conservation reserves) relate directly to land use and land management (Robert, Michele and Jodie 2006). In this view terrain analysis is an important input in land resource appraisal. The Kas plateau area is an extensive laterite surface. This lateritic plateau area is interrupted with overlying loose material and dense vegetation patches. This area is also spotted with number of depressions and natural lakes. The area is also having reserves of laterite which may be excavated in near future for mineral ore (like bauxite). This area is well known for its plant biodiversity. With this background and the potentials of the area it was thought to carry out the terrain classification and to find out the suitability of the area for the different purposes. This study is carried out to understand the present land use and land cover pattern and with help of land capability classification, it is possible to identify possible potential land usage in this region. The result of the study revealed that the area is inappropriately used for different purposes.

## II. Study area

Study area of Kas plateau is the northern part of the lateritic plateau in Satara District of Maharashtra. The plateau extends from Venna valley in the north through the east-west segment of Koyana valley in the south. The westward limit of the plateau is bounded by North-south segment of Koyana valley. The altitude in the area ranges from 700 m to 1200 m above sea level (Figure 1).

### III. Methodology

The methodology is divided in following four steps

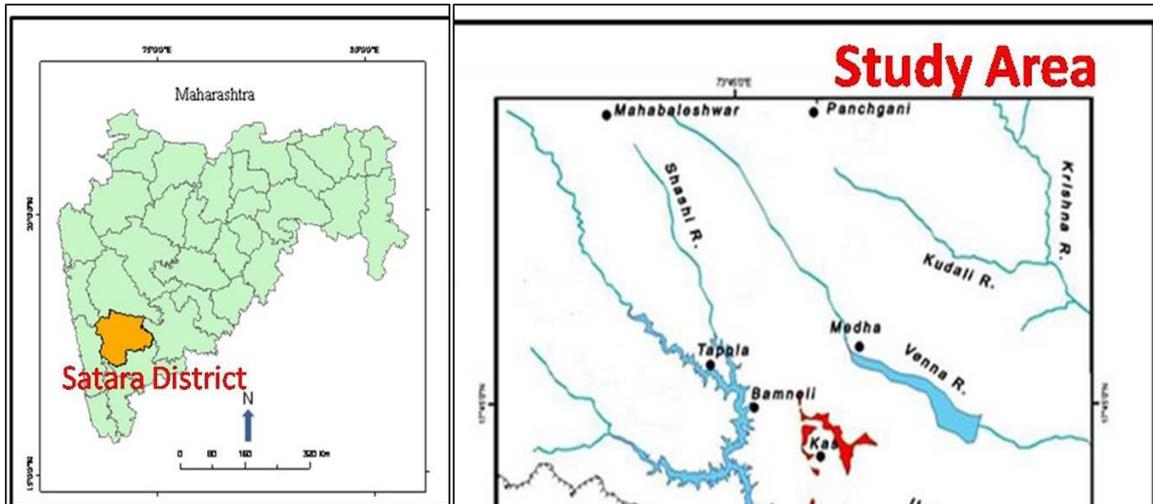


Figure: 1 Study area

**a. Preliminary work:** Includes preparation of basemap and thematic map to ascertain and delineate study area and for the field survey plans.

1. The base map has prepared using SOI toposheets of 1: 50,000 scale.
2. Thematic maps such as distribution of settlements are also extracted from SOI maps and some recent settlements are identified and mapped from the google earth images.

**b. Field survey:** Field survey has been carried out to collect the details of terrain and GCPs. Simultaneously soil / material samples are also collected to identify soil type. GPS survey has been conducted to collect the ground control points (GCPs). These GCPs are used to identify the ground features on the satellite images to be extracted as a geographic feature to prepare a thematic map.

**c. Laboratory work:** It included the arrangement and analysis of data collected in the field. The data further processed through image processing and GIS softwares. The data collected from the field as well as generated in the laboratory is attached to the geographic features using GIS.

**d. MAP:** The result of terrain analysis is represented through different thematic maps.

#### Land resources appraisal

For rational, sustainable land use knowledge about the concern area is required. Based on this knowledge, decisions or plans for sustainable development is designed. These decisions or plans should be based on comprehensive and quantified assessments of potentials and development possibilities of the land resources, taking into account the biophysical, environmental, socio-economic factors, as well as the space and time dimensions of sustained land

use. The outputs from such assessments are required by a growing variety of clients: land use planners, ecologists, environmentalists, economists, researchers, politicians, agriculture economist and land users, corresponding to various areas of applications.

In order to understand the existing land use land cover (LULC) pattern of the study area, a classification algorithm was carried out using the IRS LISS-III satellite image. To determine the training sets and subsequently to determine the accuracy of the classified image extensive field visits, visual interpretation of Survey of India topographic maps and Google Earth images was carried out. Supervised classification technique with maximum likelihood criteria was adopted.

### **Land Cover in the Study Area**

The total area considered for land cover land use study measures 367.84 sq. km. This consists of the plateau region as well as the area along the margins of the plateau where lateritic material is spread. Land cover includes exposed rock, natural vegetation, water bodies, and manmade features (Figure 2).

#### **Exposed rock**

Exposed rocks are observed in the form of crust which is without any type of covers like dense vegetation, soil or water. This covers the maximum area of the plateau surface. It includes the areas of exposed rocky surface, boulder fields and subsided areas of plateau margin and valley slopes. Area covered by exposed rock is about 95.43 sq. km.

#### **Natural Vegetation**

Natural Vegetation cover in study area is divided in two parts, one that is observed on the plateau top and second, which is observed along the cliff base or plateau margin. These forest covers comprise mostly of similar plant varieties. From the satellite image interpretation and field observations, it is clear that, the forest cover on the cliff base is healthier and well grown. On the plateau top forest cover is observed on the central parts of overburdens, depressions, along the cracks and flow line. Vegetation associated with flow lines or cracks are more or less in linear form. Certainly the vegetation along these linear forms has much less density and tree growth is stunted. The vegetation growing along the cracks and flow line as well as margins of depressions are due to the availability of some amount of moisture at such locations. In case of thicker overburdens growth of plants is good. There are number of patches with woody vegetal growth and trees attained the height of 3 to 4 meters with the trunk perimeter of 1 to 1.5 meters.

Vegetation on the thicker overburden and on the margins of plateau is almost same. Besides the thick vegetation, overburden margins and overburdens with shallow soil cover also support the scanty stands and bushes where the grass cover is also observed. On the plateau surface about 1.91 sq. km. area covered by thick woody vegetation these are not included area of disperse and linear vegetation. Along the margins 139.72 sq. km. area covered with thick woody vegetation.

Grass covers are mainly observed around the overburdens. These are also present on the plateau wherever thin soil cover is present. The grass growing on the plateau is short grass which indicates the control on the growth. This grass cover is mainly used for the grazing activity. During summers these grasses dried up and in rainy season these grass areas get covered with variety of small flowers. It seems that the plateau surface is covered with full of colourful flowers. Besides the flowers we can also observe different varieties of butterfly in monsoon and post monsoon seasons. Area covered by grass cover is about 11.86 sq. km.

#### **Water body**

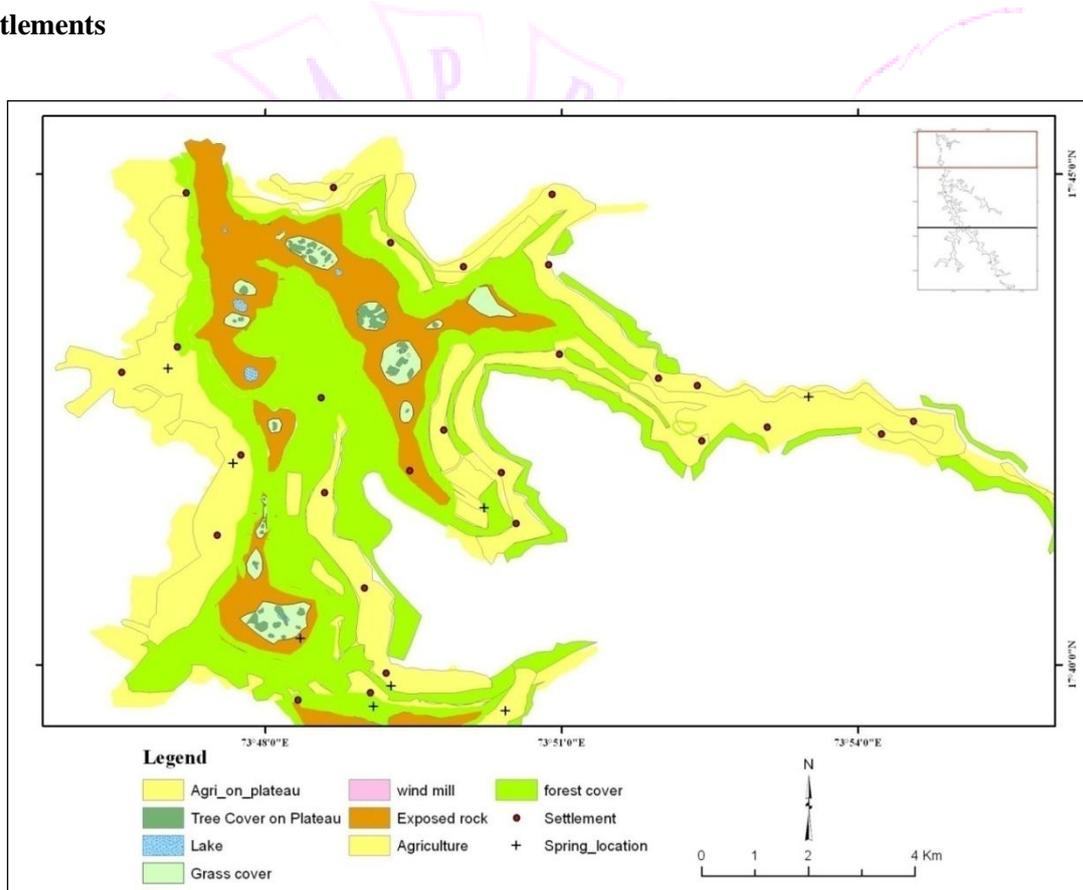
It includes natural depressions with seasonal water storage and small manmade reservoirs on the plateau top. These water bodies are made perennial with human efforts. By using rainwater harvesting measures, natural depressions are also converted to small water bodies by local people. Area covered by Water body is very less and depression area is about 0.67 sq. km.

**Over burden/Soil cover**

Kas plateau covered with a thick layer of soil/overburden in the form of patches with a good vegetation growth. These patches are to be seen in the entire study area. The patches are varying in thickness. These patches are also showing variation in the constituent material. The material is varying in size from coarse sand to fine sand. Generally, it is observed that, in the central part of these patches thickness of soil cover is more than 2 meters. It is also observed that the thickness of soil from the central part of the patches is decreasing towards the peripheral parts. This is resembled in the growth of vegetation also. In the central part of the patches, vegetation is reasonably thick and tall whereas it goes on thinning towards periphery.

The material is washed from the plateau surfaces are accumulated in the depressions and lakes. Thickness of the material is around 60 to 70 centimetres. The material observed in the depression is of clayey type. Most of these depressions and lakes are surrounded by thorny bushes or scrubs and at some lakes it is found that there is good growth of trees. The total area covered by soil patches is about 15.77 sq. km.

**Settlements**



## Figure 2 Present land use land cover

All the settlements in this area are rural settlements. The distribution of all these settlements is mainly controlled by topography of the region. It is observed that, the villages are located on the plateau margin where slopes are suitable and there are sufficiently wide patches of land for cultivation. Besides this, these settlements are wet point settlements meaning that these villages are located near the springs which are originating at an altitude of 900 to 1100 meters.

### Agriculture

In case of northern and middle parts of the plateau, agriculture is practiced only on the margin slopes (benches) and not on the plateau top while in the southern part, agriculture is practiced on margins as well as on plateau top. On plateau top, agriculture is practiced on the overburden area and in large depressions, which are partially used for runoff/rain water harvesting and partially for the agriculture. Agriculture practice is done on the benches observed in entire study area and on some areas of the stripped surfaces. Area covered by agriculture practice on plateau is about 1.59 sq.km. and area of agriculture on benches and stripped surface is 100.89sq.km.

### Land Capability Classification

Land capability classification is done for proper utilization of land resources. Capability classification is nothing but interpretative grouping of soils. It is based on the inherent characteristics of soil; land features and environmental factors which control the land use. According to this classification lands under different capabilities are classified into I to VIII classes. Further these classes are grouped into two sets that is land suitable for cultivation, (includes class I to Class IV lands) and land not suitable for cultivation (includes class V to class VIII lands).

#### 1. Land suitable for cultivation

Classes I to IV have landscape and climate suited to arable cropping. They are separated from each other on the basis of soil texture, soil depth, permeable and internal drainage, nutrient availability, slopes, soil salinity, alkalinity, and toxicity and climatic factors etc.

Class I lands are free from hazards. They are nearly level with more than 90 cm deep, well drained easily workable soil with medium fertility. They are very good cultivable land.

Class II lands are suitable for cultivation with moderate restrictions. The soil conservation practices such as contour tillage, strip cropping, simple terrace system, use of cover and green manure crops are used for such type of land. These are also suitable for pasture and forestry.

Class III lands are of the serious hazard lands. They may have moderately steep slopes, shallow soil, prone to severe erosion hazards, very poor or rapid drainage, very sandy or gravelly or clayey soil. They are suitable for cultivation with severe to moderate restrictions. To overcome these hazards; contour tillage, strip cropping in narrow strip, terrace and outlets, diversion ditches, cover crops and mulching are practiced.

Class IV lands are suitable only for occasional or limited cultivation. They have very much restriction for agriculture. These lands are prone to more severe hazards than class III lands. Maintenance of such type of lands needs special measures which are difficult and too costly.

#### 2. Land not suitable for cultivation

Classes V to VIII have landscape and climate not suited for cultivation. They are separated from each other on the basis of same factors which use for separation of class I to IV.

Class V lands have more or less same characteristics as lands except for one or more limitations of stoniness or wetness or adverse climatic conditions. They are suitable for forest, grazing and production of wild hay.

Class VI lands have susceptibility to sever erosion by water and wind, steep slopes and very shallow soils. These lands are suitable for grazing and forestry with moderate restrictions. Practices like contour furrows, fencing, ridges and water separation/diversion are useful.

Class VII lands are very shallow with steep slopes, rough stony or very severely eroded, infested with gullies or highly susceptible to wind erosion. They have severe restrictions for use and need extreme care. These lands are suitable for grazing and forestry with severe restrictions.

Class VIII lands are absolutely barren and unfit for economic use. These include lands which are rocky, swampy, marshy, lakes and ponds that are permanently wet, sand dunes in desert, very deep gullies affected by severe salinity etc. These lands are not suitable for cultivation or pasture or forestry. They are only suitable for wildlife, recreation.

#### IV. Terrain Analysis

For the land capability, terrain analysis is carried out and based on the landform details like altitude, relative relief, slope area in percentage are calculated (Table 1.). With the help of the terrain analysis study, area is classified into plateau top, plateau margins, boulder line, bench and stripped Surface.

**Plateau top:** -Altitude of the northern plateau is ranging between 1180 to 1264 metres above sea level that means the relative relief of the northern plateau is 84 metres. Average slope of the plateau surface area is less than 4° but because of the break in slope and deepening of the channels, near margins the slopes range between 4° and 18°. Area covered by plateau is 33.17%.

**Plateau margins:** - Plateau margins ranges between 1180 to 1260 metres above sea level and relative relief is 80 metres. The slope angle for all the margins is more than 50°. Area covered by plateau margins is 22.10%.

**Boulder line:** - Boulder line ranges from 1160 to 1240 metres above sea level with relative relief of 80 metres and covered 5.28% area.

Landform type		Altitude	Relative relief	Slope	Area in %
Plateau top	Northern	1180-1264	84	< 4° towards margins 4-18 °	33.17
Plateau margins	Northern	1180-1260	80	> 50°	22.10
Boulder line	Northern	1160-1240	80	>50°	5.28
Bench	Northern	1000-1200	200	<12° but max. area is covered in 4-8°	34.33
Stripped Surface	Northern	1040-1160	120	<12°	5.12

**Table1. Terrain analysis**

**Benches:** -Wherever the benches occur on the slopes, they are between,1000 to 1200 metre above sea level with 200 metres relative relief. Slope benches cover 34.33% of area.

**Stripped Surface:** - The stripped surfaces observed at an altitude range between 1040 to 1160 metres above sea level with relative reliefs 120metre. The slope angle for all the stripped surfaces is less than 12° and it covered 5.12 % of the total area.

With the help of above analysis, it is clear that in the study area maximum area that is 88.08% covered by landforms such as plateau (33.17%), benches (34.33%) and plateau margins (22.10%). Boulder line (5.28%) and stripped surface (5.12%) covered very less area that is 11.92%.

## V. Conclusions

Among the major landform types plateau surface is classified in land capability class such as class I for overburden, class II for overburden and depressions, and class III is also for overburden and depressions. About 102 sq. km. of plateau area is categorized as capability class – VIII. On the basis of Tideman's (1996) classification, these classes of plateau region are of two extreme capabilities. Class's of overburden and depressions are suitable for agriculture in general while class of plateau area is absolutely barren, not even suitable for grassland and forest. It is only suitable for wildlife, recreation and watershed protection.

Plateau margin is classified in three classes of VI, VII and VIII. Class VI is suitable for grazing and forestry with moderate restrictions. Class VII is cover with area which needed severe restrictions for use and need extreme care. Class VIII of plateau margins and deep gullies is absolutely barren, not even suitable for grassland and forest; it is only suitable for wildlife, recreation and watershed protection.

Plateau areas such as boulder field, benches and stripped surfaces are grouped in class IV, V and VI respectively. Among these, only class IV is suitable for cultivation if treated properly. Class V and VI are not suitable for cultivation. About 93 sq. km. area of plateau margins is of boulders and deep gullies. This area is not suitable for any kind of activities except recreation and wild life. Class VI lands have susceptibility to sever erosion by water and wind, steep slopes and very shallow soils. These lands are suitable for grazing and forestry with moderate restrictions. Practiced like contour furrows, fencing, ridges and water harvesting are useful.

Boulder fields are measured only 6.4 sq. km. and categorized in class VII of land capability classification. The area of boulder fields is suitable only after very careful usage. The area of benches is covering about 101 sq. km. This falls in the class IV category of land capability.

The area under stripped surface is only of 23 sq. km. This is bare, uncovered area and classified in class VI. The land in class V has more limitations of stoniness or wetness or adverse climatic conditions. They are suitable for forest, grazing and production of wild hay.

## VI. Suggestions

The study area that is Kas plateau region is declared as world natural heritage site. Tourists visit this area during late monsoon season to watch the flowering plants of this area. Considering the popularity and number of visitors in this area land usage should be done very carefully so that, the flowering plants are not affected and the people should be able to know the nature in better way without harming it.

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