

LAND CAPABILITY BASED LAND USE RECOMMENDATION FOR A WORLD HERITAGE SITE OF KAS PLATEAU, MAHARASHTRA

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Abstract: The areas which are with high potentials of various land uses are need to be assessed very carefully. This study is carried out on the Kas plateau which is recently declared as world heritage site. This is an extensive high level laterite surface. This is the most important area with respect to landforms, biodiversity, tourism and a proposed site of tiger reserve project. This extensive lateritic plateau area is interrupted with overlying loose material and patches of dense vegetation. In the entire area, slope ranges from less than 40 to 660. Along the plateau margins, slopes range between 270 to 660. Land use land cover analysis of this area is carried out by using IRS LISS-III image acquired on 13th March 2006 to understand the present pattern of land use and land cover. Based on the land use and land cover analysis it can be suggested that about one third of total area, mainly the top surface of the lateritic plateau should not disturb and should be treated as area for the wild life and recreation, and it can be used for eco-tourism activity. One third of the area should be used for cultivation and pasture while remaining area should be used for forest as well as for the pasture. Besides this, certain precautionary measures also suggested for the better practice of land resource management. Present study emphasises the need of detailed assessment of land use and land cover of this area. It is also essential to know the terrain characteristics and geomorphological set up in detail before changing the present land use and cover. Based on the analysis of the land surface, land capability classification was done to identify the proper land uses.

Keyword: Heritage Site , Land Capability , Kas Plateau , recommendation.

INTRODUCTION

The study area is termed as Kas Plateau after the village Kas situated on the the plateau. The plateau extends from Venna valley in the north to Urmodi valley in the south. The westward limit of the plateau is bounded by N-S segment of Koyana valley (fig.1). The plateau area lies between 17°40' N. to 17°45' N. latitude, while the longitudinal extension is from 73°45' E. to 74°0' E. The altitude in the area ranges from 700 m to 1200 m above sea level.

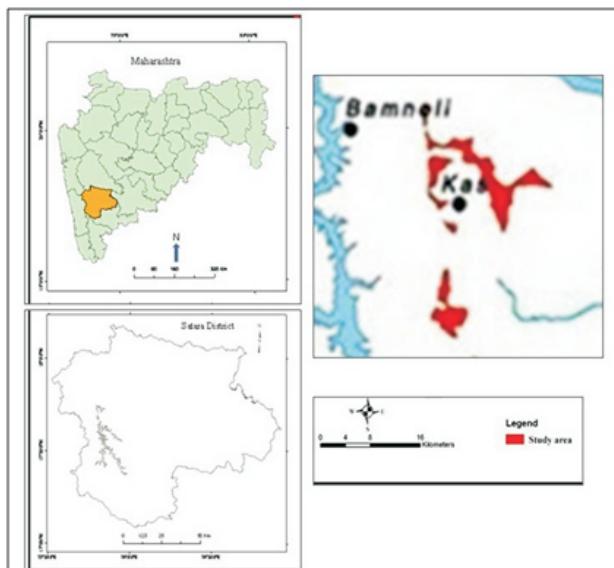


Figure: 1 Location map of the Study area

The Kas plateau is an extensive surface of laterite.

This is separated from the Western Ghat escarpment by the upper Koyana valley running in N-S direction. The average distance between the Ghat scarp and the Western edge of the plateau is about 20 km. The plateau forms the source region of Urmodi River, tributary of River Krishna. This lateritic plateau area is interrupted with overlying loose material and dense vegetation patches. This area is also spotted with number of natural lakes and depressions. This area is declared as new Mahabaleshwar, an alternate tourism destination. Some part of this plateau area is also declared as the part of proposed tiger reserve of Koyana-Chandoli sanctuary. Recently this area is declared as world heritage site.

Study of land use and land cover analysis of this area will be an essential input in further studies of this area. The present study area is one the most popular areas for carrying out field studies of Earth Sciences and Life Sciences.

LAND CAPABILITY CLASSIFICATION

Land capability classification is done for proper utilization of land resources; it is useful for land resource management. Capability classification is the 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 Tideman (1996) classification lands under different capabilities are classified into I to VIII classes (Table 1). 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).

Table 1 Land use and land capability classes

Group	Class	Characteristics	Capability
Land suitable for Cultivation	I	Deeper than 90 cm. Free from hazards, nearly leveled, suitable	Without any special measure suitable for intense cultivation.
	II	Moderately deep soil (45 to 90 cm.) with heavy texture, imperfect or rapid drainage, gentle slope, moderate erosion	Moderately low soil fertility. Used for cultivation with moderate restrictions and also used for pasture and forestry
	III	Moderate soil depth (22.5 to 45 cm), moderately steep slope, severe erosion hazards, very poor or rapid drainage, very sandy or gravelly or clayey soil.	Low inherent fertility, without special measures farming may be difficult.
	IV	Shallow depth (7.5 to 22.5 cm) Hazards are more severe than class 3 land. Unfavorable soil depth, slope, erosion and drainage.	These lands suitable only for occasional or limited cultivation.
Land not suitable for Cultivation	V	Very deep, lands are having same characteristics as class-I land except for one or more limitation of stoniness or wetness of adverse climatic conditions.	Suitable for grazing and production of wild hay.
	VI	Very shallow soil (< 7.5 m.), susceptible to severe erosion by water and wind, steep slopes.	Suitable for grazing and forestry with moderate restrictions.
	VII	Very shallow (< 7.5 m.), with very steep slopes, rough, stony or very severely eroded, infested with gullies or highly susceptible to wind erosion.	Severe restriction for use and need extreme care.
	VIII	Lands which are rocky, swampy, marshy, lakes and ponds that are permanently wet, sand dunes in desert, very deep gullies are in this class.	Absolutely barren, not even suitable for grassland and forest. Only suitable for wildlife, recreation and watershed protection.

Source: Tideman (1996)

Methodology and Material

For land use and land cover analysis; slope and geomorphic analysis were done. For land capability classification detail field work was carried out. With the help of field data and observation slope analysis and geomorphic analysis were carried out. According to Thawaites (2006) and Arnot and Grant (1981) in land use land cover analysis terrain analysis is very important. With the help of all these analysis land capability classification was done.

Slope Analysis in the study area

For the slope analysis slope maps were generated by using ASTER-GDEM (fig.2). For that based on the landform distribution in the study area the details like altitude, relative relief slope and area in percentage are observed (Table 2). It is found that an altitude of the Kas plateau is ranging from 1180 to 1264 metres. It is also observed that the relative relief of the plateau is only 84 metres. An average slope of this part of study area is less than 4° but the slopes towards margins range between 4° and 18° this is because of the break in slope at the margins. It is also attributed to the deepening channels near the margins. Area covered by plateau surface is 33.17%.

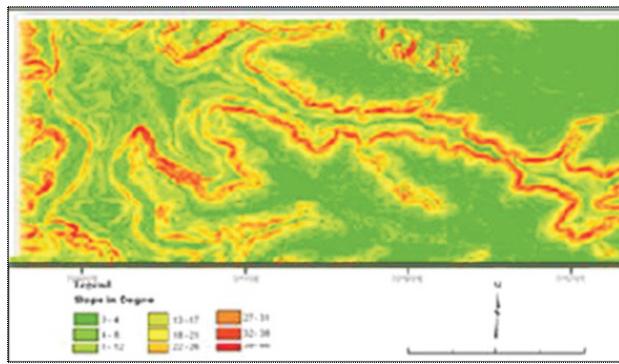


Figure: 2 Slope map of the study area Based on ASTER-DAM

Geomorphic Analysis of the area:

Geomorphic features such as plateau margins are observed in the study area which lies within the range of 1180 to 1260 m. and relative relief is 80 m. The slope angle for all the margins is more than 50°. Area covered by plateau

margins is 22.50%.

Table 2 Geomorphic analysis

Landform type	Altitude	Relative relief	Slope	Area in %
Plateau	1180-1264	84	< 4° towards margins 4-18°	33.17
Plateau margins	1180-1260	80	> 50°	22.50
Boulder line	1160-1240	80	>50°	5.28
Bench	1000-1200	200	<12° but max. area is covered in 4-8°	32.41
Strip Surface	1040-1160	120	<12°	6.64

The range of Boulder line area is 1160 to 1240 m. and relative relief is 80. Slope angle for Boulder line area is more than 50°. Area covered by Boulder line is 5.28% only. The benches in the area are observed in the range of 1000 to 1200 metre altitude and relative relief is 200. The slope angle for benches is in between 0° - 12°. Area covered by benches is 32.41%. The stripped surfaces lie in the range of 1040 to 1160 m. Relative relief of plateau is 120. The slope angle for all the stripped surfaces is less than 12°. Area covered by stripped surfaces is 6.64%

With the help of above information it is clear that the maximum area covered by landforms such as plateau surface (33.17%), benches (32.41%) and plateau margins (22.50%). Boulder line (5.28%) and stripped surface (6.64%) covered very less area that is 11.92%.

Land use and capability classes

With the help of above information and field visits land capability classification is done. According to land capability classification land capability map of the study area was prepared (fig. 3). In land capability classification, the area was classified into two major groups; one, land suitable for cultivation, Second, land not suitable for cultivation. In land capability classification overburden (with soil thickness more than 2meter) classify under class-I and consider as very good land for cultivation. Overburden with low soil thickness and base of the large depression areas are classified under class-II, while area immediately surrounding overburden and base of the large depressions are classified under class-III. Bench and thin soil cover areas, transition area between overburden and exposed rock are classified under class-IV. These lands, which classify under class II, III and IV were useful for cultivation with some precautions. Plateau margin areas like deep gullies, and water bodies are classified under class V and can be use as grazing land. In class VI depression rims, stripped surface, margin area on the plateau and gullies on plateau are classed. Margin areas of the plateau and boulder line are classified under class VII. Where as in class VIII exposed rock surfaces, margin areas of the plateau and deep gullies are classed (Table 3). The land which classify under the classes V to VIII were not suitable for cultivation.

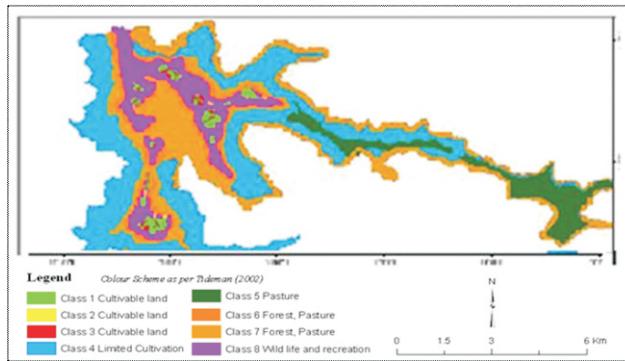


Figure: 3 Land capability map of the plateau.

Land Resource: Recommended land use and precaution for the eight capability classes

Based on slope and geomorphic analysis, land capability classification and on the basis of the classification method suggested by Tideman (1996) further categorization of the study area is done. Using slope parameters and soil limiting factors, such as texture and depth, the area is classified in to different categories (table 4). Thus, based on these parameters and observations in the study area, land capability classes are suggested. The areas suitable for different land capability with special needs or precautions are given in table (4).

Table 3 Land capability classes for the study area.

Major region	Land form type	Land capability classes							
		Class-I	Class-II	Class-III	Class-IV	Class-V	Class-VI	Class-VII	Class-VIII
Plateau	Plateau	Over burden (14.21 sq.km.)	Overburden (0.5 sq.km.)	Depression (0.12 sq.km.)	Overburden (1.05 sq.km.)	Depression (0.55 sq.km.)	.....	.....	Exposed Rock (95.43 sq.km.) Inundated area (4.31 sq.km.) Field (4.31 sq.km.) Water bodies (2.61 sq.km.) Total (102.24 sq.km.)
Margin	immediate Plateau margins	....	....	....	....	....	Plateau margins (18.77 sq.km.)	Plateau margin areas, depressions (3.43 sq.km.)	.....
	Boulder field	....	....	....	....	....	Boulder field (6.4 sq.km.)	....	....
	Bench	....	....	....	Bench (100.9 sq.km.)	....	Transition area between plateau margin and bench (15.07 sq.km.)	....	....
	Stripped Surface	....	....	....	....	Stripped Surface (23.76 sq.km.)	....	....	....

In the study area, the surfaces like, overburden, large depressions and areas immediately surrounding over burden are grouped in the category of cultivable class but due to its ecological importance the top surface of the lateritic plateau should not be disturbed, it should be maintain in present condition. Areas of benches with a thin soil cover are in the category of 'CL' with limited cultivation. These areas require intensive erosion control when in cultivation. It should be used in appropriate season. These areas also need precautions from the hazard of gully erosion. Forest and pasture, type of categorization of land use are suggested in the areas of depression rims, stripped surface, margin area on the plateau, gullies on plateau and boulder line. For these areas proper management of grazing and logging is necessary to maintain sufficient residue and litter on the soil for soil and moisture conservation and fire protection. It is also suggested that areas of exposed rock surfaces, margin areas of the plateau and deep gullies are suitable for wildlife and recreation after some improvement. However, this land capability classification is done after considering the

existing forest cover in all areas. It is also note that the suggested classes or categories do not propose replacement of existing forest cover.

Table 4. Recommended land use and precaution for the capability classes

Land Capability Class	Slope Category	Soil Limiting factors	Soil depths (cm)	Land use (Observed)	Land use (proposed)	Area	Special needs and /or precautions	Area in Sq km	Colour
1	(0°- 1°)	with out	> 90 (d5)	F, P, C	C, F	Overburden	No special difficulty in farming. Usual good farming practice to maintain soil fertility and conserve water.	14.21	Light Green
2	B (1°- 3°)	With out	45-90 (d4)	F, P, C	C, F	Overburden areas and base of the large depression	Protection from erosion. Use conservation irrigation methods.	0.62	Yellow
3	C (3°- 5°)	Very stony or Gravely	22.5-45 (d3)	P, C	C, P (Moderately good)	Areas immediately surrounding and base of the large depression	Special attention to erosion control and conservation irrigation.	1.6	Red
4	D (5°-10°)	Gravely to stony soil	7.5-22.5 (d2)	C, P	C, CL (Limited Cultivation)	Thin soil cover areas, transition area between overburden and depressions	Intensive erosion control when in cultivation.	100.89	Blue
5	E (10°-15°)	Stony or waterless	< 90 (d5)	F, P	P, F	water bodies and plateau margin areas like deep gullies	Proper season of use and rate of grazing. Proper protection of grazing in gullies.	23.76	Dark green
6	(15°-25°)	Rocky	< 7.5 (d1)	F, P	P	Depression rim, steep surface, margin area on the plateau and Gullies	Manage grazing and logging to maintain sufficient residue and litter on the soil and moisture conservation.	33.84	Orange
7	(25°-33°)	Rocky	< 7.5 (d1)	F, P	P	Margin area of the plateau and Boulder line	Carefully manage grazing and logging to maintain enough plant litter and soil moisture conservation. Fire protection.	77.19	Brown
8	(>33°)	Rocky	Very shallow(d1)	WL and R	WL and R	Exposed rock surfaces, margin areas of the plateau and deep gullies	Improve for wildlife and recreation.	105.67	Purple

F (Forest), P (Pasture), CL (Limited Cultivation), WL and R (Suitable for wild life and recreation).

CONCLUSION

The major outcome of this analysis is in the form of land capability map of the study area. Present land use is compared with land capability classification. On the basis of this comparison and the characteristics of this area and recommend particular land uses as per the capability classes. It is suggest that about one third of total area, mainly the top surface of the lateritic plateau should not be disturb and should be treated as an area for the wild life and recreation, and it can be used for eco- tourism activity. One third of the area should be used for limited cultivation and pasture while remaining area should be used for forest as well as for the pasture. For the better practice of land resource management certain precautionary measures also suggested. Present research emphasises the need of thorough appraisal of land use and land cover of this area. It is also essential to know the terrain characteristics and geomorphological set up in detail before changing the present land use and cover.

PROPOSED LAND USE

1. Agro-forestry can be done around existing forest cover and on the overburden or its rim.
2. In the forest areas honey bee keeping (apiculture) can also be proposed so that the floriculture and apiculture can be used to develop eco tourism and to develop nurseries of local plant varieties.
3. In this area surface runoff harvesting can be done with some treatment like bund construction. For this, surface depression can be used to store water.
4. In case of large size depressions, embankment can be constructed to store the water for longer period in the depressions.
5. Local fruits, flowers, medicinal plants or plant produces can be collected by villagers. All these collected material and processing on them can be done in the form of cottage industries at the settlement locations.
6. Some areas should be kept reserved for the use of local people to fulfil their needs like fuel wood. Grazing areas should also be maintained for grazing local cattle.

7. Along with above mentioned activities Eco-Tourism can be developed without alteration of the present landscape.

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