Overview Article:

Indian environment includes 45,000 species of wild plants and over 75,000 species of wild animals, together comprising about 6.5 per cent of the world's known wildlife. Our generation have caused severe social and environmental consequences like global warming, habitat destruction, pollution resulting into deprivation of this ecosystem. Anthropogenic climate change is the major problem before all the countries today which is a derivative of rapid urbanization all over the world. The wildlife including plants and animals has been threatened to extinction in last few decades because of habitat loss and degradation. Therefore, it is necessary to create awareness about the environment and educate people about environment enhancement and conservation.

Introduction to Kaas Plateau:

Western Ghats is a mountain chain older than that of Himalayas and epitomize geomorphic landscapes of vast importance and unique biophysical and ecological processes. The site's forest ecosystem influence the Indian monsoon weather pattern and is one of the best examples of the monsoon system in the planet. It is approximately 25 km from Satara city (District: Satara, State: Maharashtra, Country: India). The total area of Kaas Plateau is 1800 ha. It is a lateritic plateau at the height of around 1,213 m above mean sea level. Kaas being known as 'Valley of Flowers of Maharashtra' is a hot-spot of biodiversity due to its unique ecosystem and high degree of endemism of varieties like herbs, shrubs, other flora and fauna. This area has been attracting the attention of tourists, botanists and environmentalists over a last few decades.

In 1860s, Pratapsingh Maharaj built a lake called 'Kaas Lake' to provide water for Satara city. Till today Satara city gets supply of water through this lake. As the flowers on Kaas bloom only from June to September, people were not aware of this serene paradise. It was first discovered by Dr Manohar Auti He visited India after completing his Royal Navy training from London in 1947. He was fond of trekking and adventure, he decided to trek from Satara to Mahableshwar via Kaas. Satara city has a historical importance as it was the seat of power of the Marathas and this route existed since Shahu Maharaj's (Precedent of Shivaji Maharaj) tenure as it was the shortest route to Pratap gad (Near Mahableshwar). So for quite a long time people used to trek to Mahableshwar through Kaas. At that time Kaas was unexplored and extremely tranquil abode. While travelling to Mahableshwar, Dr Auti set up a trek at the plateau, he while exploring the place came across this paradise on earth. He found a blanket of flowers all around his tent and discovered Royal Bengal tigers roaming around. It was a treasure of opulent biodiversity at that time! As most of his life he was in London, he has described Kaas plateau next to Scotland.

Laterite plateau of kaas – the evolution and its composition

Kaas Plateau falls under the Sahyadri Subcluster of the Western Ghats and lies in the buffer zone of Koyna Tiger Reserve. The Western Ghats are an imposing north-south range of hills around 1600 km long, forming a western edge of Deccan Plateau. The Western Ghats are composed of tall steep hills in the north interspersed with scattered low hills. The northern Western Ghats have flat table top hills which are rocky scrub lands. These plateaus are scientifically known as Rocky Outcrops and have been formed during the breakup of supercontinent of Gondwana some 150 million years ago. This results in the formation of abrupt cliff at the western coast of India known as the Western Ghats escarpment. The crest of northern

Western Ghats is on an average 1000 m but reaches up to 1400 m in some areas. These rocky plateaus are the result of the multiphase rift that affected western India during the Mesozoic times. These have placed important restraints upon this morphotectonic progression and upon the associated erosional, depositional and subterranean weathering effects that have added to the long-term development of the Western Ghats escarpment. The portion between the Western Ghats and the Arabian Sea is known as Konkan-Malabar region, bounded to the east by the Western Ghats escarpment. The coastal lowlands that heads the Western Ghats are significant for occurrence of a shallowly dipping, intermittent belt of dissevered laterite-capped 'Table lands.' These table lands exemplify the fragments of a once widespread, semi-continuous laterite belt that initially stretched along the length of western peninsular India.

Kaas Plateau is one of these table lands which is composed entirely of Deccan flood basalts. Basalt is the igneous rock shaped from cooling of Deccan Trap lava which forms the base rock of western part of the state of Maharashtra. The Deccan traps are mostly arranged in flat layers giving rise to flat plateaus. The basalt has weathered to laterite on the hill tops but the laterite cover has eroded in most places and remains only as caps on the summits of the Western Ghats escarpments. Laterite is a creation of intense biochemical enduring in a leaching environment and successive or concurrent induration. It is categorized by 'Rock Outcrops.' Outcrop in geological terms is a part of naturally formed bedrock or other landforms protruding through the soil level. Locally, these rocky outcrops are known as 'Sadas.' Rock outcrops has been used for landforms like cliffs, isolated rocky hills, inselbergs, ferricretes etc. Special microclimatic conditions are formed due to extreme climatic conditions like high exposure to sun, shallow soil depths, water stress which influences unique plant communities. The rocky plateaus are further classified into two types: Ferricretes and Basalt Meso.

1. Ferricretes- are indurated platforms of laterites with wide and flat to moderate oblique flat tops and ends marked by harsh cliffs. There are 2 types of ferricretes. They are often commonly known as 'tablelands.' The Ferricretes are further differentiated on the basis of altitude.
    a. High Level Ferricretes: These plateaus are the ones which are found at an altitude of 800 m to 1400 m in the districts of Satara, Sangli, Kolhapur and Belgaum. Kaas Plateau is an example of High Level Ferricretes.
    b. Low Level Ferricretes: These plateaus occur in Konkan plains between 50 m to 200 m in the districts of Raigad, Ratnagiri and Sindhudurg districts as well as Karnataka and Kerala coastal regions.
2. Basalt Meso: These are basalt outcrops where upper portion of the laterite have eroded and the underlying basalt rock is exposed which depends on the degree of weathering. These basalt meso are found on the forts of Maharashtra and occur in areas of Pune, Akola, Ahmedanagar and Nashik districts. They are commonly known as 'katal' or 'kharam' Marathi. These areas are unsuitable for agriculture.

Floristic and Faunal Diversity:

Kaas plateau is home to about 1,500 types of plants – 156 botanical families, 680 genera, 1452 species, 400 medicinal plants, and about 33 endangered varieties. More than 450 species of wild flowers bloom in and after monsoon season and most of them are endemic herbs. It is a unique example signifying

ecological and biological processes in the evolution and at the same time forecast the development of terrestrial and freshwater ecosystem of plants and animals around. The rocky terrain creates crevices in rocks which hold small amounts of soil. At places, the uneven surfaces also creates small puddles which act as a harbour which forms a habitat for distinctive marshy flora. This accounts for a typical species of plants of herbaceous nature i.e. plants without woody parts.

Plants here have species strategies to sustain in extreme environmental situations. They are tolerant to wide temperature fluctuations and poor nutrient content in soil. The laterite soil is poor in nitrogen and phosphorus content. Most species seen here need high humidity and abundant water for survival and therefore, depend on the monsoon. Just after the first monsoon showers the plants break out of their dormancy and the dry grass plateau turns lush green and soon spreads out a beautiful carpet of vivid flowers across. The plateau seems to change the colour every week depending on the dominant flowering variety.

The flora of Kaas are majorly insect pollinators and attracts specific insects and pollinators forming a delicate and intricate network of interdependency and food linkage. The laterite plateau acts as sponge and provides water resources to agriculture and the villages around.

The flora of Kaas is observed in every shade of colour and seems to change the colour every week depending on the dominant flowering species. Some plant species have distinguishing features. For example, *Utricularia* or locally called 'Seeteche Asava' (Seeta's tears) has an interesting small bladder around their roots. Minute insects are attracted to the bladder and get trapped, thereby providing the plant with precious nitrogen and phosphorus. Another species called *'Ceropegia'* (Kandil Pushpa) which has a long stem and bowl-shaped petals which looks like a traditional lamp (Kandil). In between 2 petals there is a small gap which facilitates the insects to enter inside. It attracts some insects as hostage and release them only after pollination and fertilization. There are 20 of these species found in Western Ghats, out of which 6 species are found on Kaas. There are species like *'Habenaria*' (Ground Orchids), *'Senecio grahamii'* (yellow sonki), *'Smithia'* (Mickey Mouse shaped plant), *'Aponogetan satarensis'* (purple Y-tura) which are endemic to Kaas Plateau.

Some flowers bloom annually and others take their turn after 4 to 7 years. The species called Topli karvi grow after every 7-8 years and found in abundance in lines of edges of forest and cliff and has 46 species found in Western Ghats. Insectivorous plants like *Drosera* and *Utricularia* are native to Kaas.

Along with plants, some animals are also adapted to the habitat. Mammals, beetles, ground dwelling ants, spiders, scorpions, grasshoppers, reptiles etc. are found on Kaas plateau. The seasonal pools are home to Tadpole Shrimp, Fairly Shrimp and Clam Shrimps. Freshwater shrimps lay eggs during monsoon, but these eggs remain desiccated throughout dry period. They can produce new offspring soon after the area floods with rainwater. Many of the insects that live on plateaus, and small geckos and frogs also show certain behavioral adaptations to be able to survive in rocky areas.

The smaller invertebrate fauna usually use boulders on plateaus for shelter during extreme conditions. Frogs spawn in the ephemeral pools. The fauna found on Kaas usually take shelter under the boulders to protect itself from harsh sun or hide from the predators like raptors. Deep large caves are found under the plateau which are the roasting sites for bats.

Microhabitats found on Kaas Plateau

It is recorded that there are 17 microhabitats found on Kaas Plateau which is the main reason for the floral diversity. The main reason for the floristic diversity found on Kaas is the presence of diverse microhabitats which is found here.

Microhabitats vary from each other with respect to soil, slope, moisture, nutrients and even temperature. All these affect the flora and fauna. For example, boulders are stones that lie on top of a plateau. In summer season, the rocks are exposed to sun and are very hot, but underneath the boulders, it's a lot cooler and quite many animals take shelter there. If soil layer is thin, only ephemeral or annual species of herbs can grow in that. But if the soil layer is deeper, say more than 10 cms, then larger shrubs can take root there. Researchers have described around 17 different microhabitats on Kaas plateau. Each offers a unique growing environment for species and hence each has its own unique plant community. The dryer rocky parts, crevices actually hold lot of nutrients, which accumulate over several years. Such crevices area ideal for growth of geophytes which have underground bulbs or rhizomes. They are also safe sites and the soil in crevices will not be easily disturbed by wind or trampling.

Exposed rock faces are the most challenging for plant growth. But lichens and blue green algae and mosses manage to grow there. They are resistant to drying and heat and can take a hold on rock and even use its nutrients to grow.

Quite opposite to these are the ponds on Kaas. These retain water for months after monsoon and have clay soil. So only the truly aquatic plants like *Nympoides, Persicaria* can grow there. They are also good growth sites for freshwater shrimps, fish and frogs.

The most unique amongst these are the gently sloping rocky surfaces. In monsoon, rainwater only seeps through the vegetation. These are ideal growing conditions for 'ephemeral flush vegetation' which has tiny annuals which thrive for only a few weeks of monsoon. Insectivorous *Utricularia* species, grow in such conditions. They have tiny bladders on roots that trap insects. Seeping water helps them in trapping microfauna in the rainwater. The soil on plateaus is poor in nutrients, but adaption for eating insects and other microfauna provides necessary nutrients to Utricularia. Same is true for other insect eating species of Drosera that grow on plateaus. Eriocaulons are another group that grow in EFV. They are tiny annuals – almost like grass, they produce large amount of nectar that supports insects on the plateaus.

There is one more endemic aquatic species in rock pools on Kaas. It is called Eriocaulon tuberiferum. Unlike other Ericaulons, it grows in water pools. It has tiny tubers underground, which help it to remain dormant in the soil. The water pools all dry up immediately when the rain stops, but the plant can remain in the soil throughout the hot dry period. Most species that grow on rocky plateaus show such special adaptations to survive in the extreme weather conditions and challenging habitats on plateaus.

Kaas and People

Unlike the other natural heritage sites in the Western Ghats, Kaas was not a wildlife sanctuary or a national park. Part of Kaas plateau is RF- a reserved forest, which is under administration of forest department.

However, traditionally it was the grazing land of villages mainly by Ekiv and Kaas. The plateau was never suitable for agriculture. It does not even have grass or water throughout the year.

Hence villagers could only graze cattle there for a few days in the monsoon. But partial use of the land on Kaas has exposed more of the shallow soil habitats making it suitable for carpets of impatiens, eriocaulons and utricularia. Smaller wild herbivores and village cattle continue to graze of the plateau. Their numbers are very small and this kind of grazing actually regulates the growth of grasses and that is why we are able to see the mass blooming flower carpets on Kaas.

The trees and shrubs on the plateau were used as fuelwood to some extent and the larger boulders were used for making roads or build houses at times. The deeper ponds are useful sources of water for village cattles during the winter times. There are some old places of deities, sthans- on the plateau which villagers sometimes visit. But for most part of the year, the plateau is hardly used by people, perhaps only as a shortcut route from one village to another.

The knowledgeable people in the villages did know of some medicinal plants that grow on the plateaus, and they have local names for some of the more obvious of the plateau plants. So direct use of the plateau for fodder or water was always very limited. This is the reason that endemic and special biodiversity continued to remain in this area, despite being in a human dominated landscape.

The Journey of Kaas for UNESCO entitlement:

The proposal for entire area of the Western Ghats was submitted for the entitlement for UNESCO World Heritage list. But as the area and population of different flora and fauna in Western Ghats is vast, it was impossible to conserve the whole area. flagship species were collected and ultimately 39 biodiversity hotspots were declared in the UNESCO World Heritage list. The first northern site being Kaas plateau. The Western Ghats being India's hottest biodiversity hotspot and was inscribed in the World Heritage list during 36th Session of World Heritage Committee meeting held at St. Petersburg, Russia in June 2012. Other sites include tiger reserves, national parks, wildlife sanctuaries and reserved forest from the state of Maharashtra, Karnataka, Kerala and Tamil Nadu. There are 4 sites in Maharashtra out of which Kaas plateau was nominated in the Heritage list due its vast aesthetic beauty and richness in genetic environment and ecology.

The efforts for its inscription in the list was started in 2005. The proposal was deferred back thrice stating that the awareness of local communities was lacking in the proposal. The dialogue with local communities was the key criteria for its inscription for the UNESCO World Heritage Tag. To meet this criterion, a seminar entitled 'SAVE KAAS – SAVE HERITAGE' was organized jointly by 2 NGOs, they were Ranwata of Satara and TERRE Policy Centre Pune in Satara city on April 1, 2012. 200 participants including 18 speakers and 35 experts were present. National and Internationals organizations like UNESCO, IUCN, Bombay Natural History Society, Commission of Biodiversity of Government of Maharashtra, Biome Conservation Group, Bombay Environmental Action Group, Forest Department officials from Satara and Maharashtra participated. Dr Ram Boojh of UNESCO New Delhi office and Dr Rajendra Shende, former Director UNEP participated in this seminar and provided guidance for Sustainable Development of Kaas Plateau. The main objective of this seminar was to launch the process of conservation of the plateau as a natural heritage and leverage the surrounding local villages to attain sustainable development of the entire

region. Conservation efforts for the plateau were in progress since a long time but this seminar became an eye opener towards community engagement by having a dialogue with the stakeholders involved in this region.

This seminar was utilized as a kick-start action plan for community involvement for conservation of Kaas Plateau. It included panel discussion on the issues related to threats and opportunities, capacity building regarding knowledge and importance of Kaas plateau, methods to safeguard the rich heritage. Till 2012, Kaas plateau was not defined in terms of its boundary, area and ownership. It was then decided to build a scientific data for Kaas Plateau and achieve advocacy with the government. Educating the local communities and controlling the tourist traffic are some of the recommendations given by the expert panel during this seminar.

The outcome of this seminar was then presented by Dr Shende to World Heritage Committee meeting held at St. Petersberg, Russia in June 2012. One to one dialogue was established with different experts and representatives from 23 countries qualified for voting rights at the United Nations. Out of 23 countries, 19 countries voted for Conservation proposal for Kaas Plateau and was then declared as one of the biodiversity hotspot in Western Ghats under sector 7 i.e., 'The area which characterized by superlative natural phenomenon or areas of exceptional natural beauty and aesthetic importance.' It was declared in this conference that the ever-increasing tourism to such a sensitive habitat shall be focused on environment conservation and education and nature appreciation. The legal status of Kaas plateau was not defined till 2012, which was another urgent task to be carried out considering the environment, ecology and livelihood issues of the local communities. It was made cleared in the conference that the inhabitants of the villages surrounding the areas should be the foremost beneficiaries of conservation and management actions for the plateau.

How Kaas became a global tourist destination:

The popularity of Kaas increased due to the vast media coverage of Topli karvi, a unique species of plants which bloom once in 7 years and spread a blanket of purple flowers. This attracted lakhs of tourists in the year of 2008. The sudden mass tourism on the plateau created tremendous pressures on the site. The irresponsible tourists and lack of awareness about the delicate plant species resulted into destruction of such a rich habitat. The proximity of the plateau from the mega cities like Mumbai, Pune and Kolhapur and easy accessibility by road ways are the other major reasons for the mass tourism at Kaas. On the one hand, popularity of Kaas plateau spread worldwide and on the other hand there were attempts to enroll it in UNESCO World Heritage site. In 2012, it was declared as UNESCO World Natural Heritage site to honor its rich biodiversity. Due to its entitlement in UNESCO World Natural Heritage sites and mass media coverage, the tourist numbers which were insignificant until 2005, have peaked in last five years to more than 2.5 lakhs tourist per season. Most of the tourism during that time was not regulated, leading to enormous destruction of plants species from 2008 to 2012. After its declaration in UNESCO, there were attempts made by Forest department with the help of experts, different NGOs, researchers to conserve this rich habitat and regulate the ever increasing tourist flow.

There was a study carried out by Prerna Agarwal for Rufford Foundation which assess the impact of human trampling on the plant species. So (0.5 x 1) m patches of vegetation were selected and 5 trampling

treatment were considered. The first was 0 (controlled), 25 passes (25 people walk on vegetation), 75 passes, 200 passes and 500 passes. It was observed that the vegetation is damaged immediately after the trampling in most of the plots but it's highest in 500 treatment plots were the patch turned into a brown soil patch. But the tourist count at Kaas is in lakhs. So the damage caused due to human trampling is unimaginable. There are 2 conditions when damage caused by human trampling is maximum. One when damage is occurred during flowering and reproductive periods for plants and second is during the monsoon season. Both these conditions are true for Kaas plateau. People visit the plateau when the plants are blooming which is just after the first showers of monsoon which makes the conditions wet. Thus, trampling caused by the tourists is maximum during that time.

Conservation Measures:

In 2012, to restrict the tourists going onto the blanket of flowers, chain link fencing along the main roads was constructed. This guided the tourists' movement as well as prevent the vehicles movement on the vegetation. The total area of Kaas plateau was divided into 3 sectors. Sector A is a restricted zone, Sector B is No Access zone and Sector C is open for the tourist.

Major Threats to Kaas:

Topographic maps of the region often mark these rocky plateaus as 'rocky scrub' or 'stone waste'. These wasteland statuses have been easily exploited for acquiring rocky plateaus for mining, wind farms and infrastructural projects. Grazing, human trampling, tourism, quarrying, private developments in the surrounding areas are some of the major threats to Kaas plateau. The rocky plateaus like Kaas have tolerance to grazing by wild herbivores such as hares, barking deer, sambhar, guar etc. But as tourism has tremendously increased at Kaas, it has been tremendously exposed to human trampling. As per Prerna Agarwal's study, the carrying capacity of the plateau is 1500 people per hectare which have increased to lakhs due to increase in tourism activity.

Even before the actual declaration of Kaas as natural heritage site, there were efforts from the tourism industry to promote it for domestic tourism. As long as the use of the area was mainly by local people and the number of users were restricted, the biodiversity remained unharmed. But just before and after the declaration of the Natural Heritage Site, there was a sudden promotion of this destination to the tourists. The tourist number started increasing since around 2009 and after 2012 they increased to thousands. It was very unorganized, very exploitative tourism. Tourists trampled all over the flowers, even rolled over them, they plucked the rarest of flowers for amusement. Photographers were at times quite destructive as for one of the picture they did not mind clearing the vegetation around the rare plant or even plucking it. Some people used to drive through the flowering plants, to create shapes or write their names on the grounds. The fragile vegetation started eroding. Trampling destroys the lichens on rocks, disturbs the soil and affects the animal behavior too. Some parts became barren. The nesting of the larks were also affected.

Along with this there was a lot of littering. The tourists littered on the very spot they had come to visit for beauty. Plastic, wasted food could be seen everywhere. Chocolate wrappers, chewing gums, gutkha packets were all strewn across the plateau.

The impact was even seen beyond the actual plateau. Many natural areas surrounding the plateau also started degrading, as parking lots, hotels, eateries were built to cater to the tourists. The landscape as whole is changing due to increasing land sales. In last 6 to 7 years, the number of weeds species have increased which is one of the important concern in protection of this plateau. When the fence was built, gravel came from outside the plateau. The number of vehicles bring in foreign soil. Trampling disturbed the natural soil. So weeds like Alternanthera, Gomphrena, Celsia are observed on the plateau. In the past they were always seen around the villages, but never on the plateau. But today they can be seen growing on Kaas. It is entirely due to disturbance on large scale.

On the other hand the development pressure around Kaas are inevitable. The land prices around Kaas Plateau have tremendously increased after declaration of Kaas as UNESCO World Heritage site. So, there is a need to achieve a balance between Biodiversity conservation and development. It can be achieved when the management actions focus on conserving biodiversity rather than ensuring planning tourism growth alone. A clear conservation centered management plan should lay guidelines on how to destroy the invasive weeds. It should also look at how to restore the forest patches and boulders which are important for various micro fauna. Population studies of endemic plants and animals will give us clues to how well our management is working. The management activity will be futile if it is just limited to a few hectares of land and should be incorporated in the Regional Plan of Satara to achieve holistic development.