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Land use Land Cover and Vegetation Analysis of Gujarat Science City Campus, Ahmedabad, Gujarat

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ABSTRACT

This paper illustrates the Land use Land cover detection and floral diversity of Gujarat science city campus, Ahmedabad, Gujarat, India. It is one of the science centers of the Gujarat state managed by the State Government. The initiation of this science center is to acknowledge students towards the science field. Arc GIS is used to detect the vegetation patches and analysis of Land use Land cover of the study area. The Unsupervised classification has been performed to analyze the study area. High-resolution satellite image used for identifying the land use/ land cover classes. Out of which, the major area is covered by vegetation and constructed area. The major part is occupied by vegetation. The plant survey carried out in January 2020. The flora of campus consists of 73 species which belongs to 44 genera and 32 families. Herbs and shrubs were dominant as compared to the trees. Herbs were recorded with 15 species, while shrubs with 32 species, climbers with 10 species and trees with 11 species. These species were cultivated for ornamentation of the campus.

KEYWORDS: *Floral diversity; GIS; Land use Land cover; Satellite Image; Species*

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INTRODUCTION

This paper deals with the species diversity and land use pattern of Gujarat Science City campus. A Geographical information system is a computerized tool designed for the management and use of spatial data (Hasmadi M.I. *et al.*, 2010). Remote sensing and GIS frequently used by researchers for plants mapping or vegetation mapping and Land use Land cover detection as well as investigation of before and after the state of earth's surface. Remote sensing and GIS provide effective means to study the vegetation cover change, Satellite data brings the information of the target area at any given time; these data can be reused and re-assessed for the change detection in a selected area. Remote sensing and GIS forms an easy way to analyzes Land use Land cover change.

Species distribution and abundance patterns influenced plant species diversity of any geographical region (Day and Monk 1974). Campus gain the attention of students as well as people through its unique design, different sculpture, and Life Science Park. Ornamentation of campus attracts the people. The diversity of plant species is different from one geographic region to another. The vegetation of campus contributes to the greenery of Ahmedabad city. The vegetation of the campus plays an advanced role in species richness of urban areas due to increased urbanization in Ahmedabad city. Minakshi Goswami and Khire M.V. 2016 reported various changes in the land use pattern of the city. The built-up area of Ahmedabad city was increases by 33% to 53 %, and vegetation area decreased by 33% to 27% from 1999 to 2011. P Mohammad et al., 2019 analyzed LULC of Ahmedabad city, they divided the city into two zones; urban zone and the rural zone. And for the better representation, they form various classes of LULC such as Cropland, Herbaceous cover, Mosaic natural vegetation, Shrubland and Grassland, Built-up area; based on how the land is used. Herbaceous cover of the urban zone is only 1.12 km^2 means 0.53%. In rural zone, herbaceous cover is 0.71km^2 and in percentage, it is 0.16%. 0.42 km^2 area is occupied by Mosaic natural vegetation which includes tree, shrub, herbaceous cover as well as cropland. It is 0.20% in the urban zone. The Mosaic natural vegetation covers 3.42 km^2, 0.80% area in the rural zone. Shrubland is 0.02 km^2, in the urban zone, and in the rural zone, it is 0.25 km^2, 0.06% area covered by shrubs. Grassland is up to 1.24 km^2, 0.59% in an urban area. In the rural zone, it is 0.01 km^2 only. The Built-up area in the urban zone is 191.25 km^2, up to 90.63% which covers the major land of urban zone. In rural zone, it is 35.06 km^2

The vegetation of a particular area can play a key role as an environmental indicator. Urban green space fragmentize and isolating from rural green areas due to the urban sprawl, furthermore the natural biological diversity of urban areas negatively affected by an unplanned change in land use and land cover (Vare and Rekola 2007). Vegetation acts as an

acoustic screen between noise- sources and receivers but also prevent noise by generating pleasant sounds. This positive impact play role of benefits to humans mental and physical health as well as children's growth and their educational results (Gonzalez- oreja JA *et al.,* 2010, Nijland HA *et al.,* 2003, Kaplan R, 2001, Taylor AF 2002, Van Renterghen T *et al.,* 2012) Urban greenery decorates natural or artificial scenery, it helps human to reduced stress by providing pleasant visual quality. An investigation reveals that green views increased the capacity of recovery of an ill person (Ulrich RS 1984, Van den Berg AE *et al.,* 2010) and also increased concentration ability. Emili Redon et, al., 2020 explore the "bigLeaf" approach of the interaction soil-Biosphere-Atmosphere (ISBA) model deals with energy exchange between atmosphere and vegetation, they reported that the canopy trees and mass of vegetation can reduce the temperature and maintain the- the town energy balance. Urban greenery or vegetation not only makes human comfort but also provides economic benefits via decreasing energy and health care costs. Natural vegetation is difficult to maintain in the era of globalization due to urban sprawl. Cultivated gardens and green areas are bringing the taxonomic richness and increase the greenery of Ahmedabad city.

Objectives

1. To detect vegetation patches through remote sensing.
2. To quantification of Land use Land cover of study area through iso cluster unsupervised classification.
3. To list out the plants of the study area by ground survey.

Material and Method

Study area

The Gujarat Science City is a government's initiative to educate students in the science field. The campus situated between 23.0800˚ N and 72.4936˚ E. Study area is approx. 6.495 km^2. Half of the area is without any infrastructure due to the reason campus is maximum covered by vegetation. In the future, it is expected that there would be a change on campus. It is the most visited place in Ahmedabad city. The campus is designed by proper planning and management. Science City has cultivated plants, ornamental plants, and as well as it has a broad area of natural vegetation and common plants which are seen in Ahmedabad so in this place we can observe all types of plants and its habitats. The Science city is far away from central Ahmedabad, it is situated near Sardar Patel ring road, which can consider as the boundary of the city. The study aims to estimate, both natural and planned (by humans) state of the earth's surface. This science center has both sites, planned as well as a natural state of the land surface. Due to this reason this site was chosen.

Figure 1: Map of India

Figure 2: satellite image of Ahmedabad city and study area

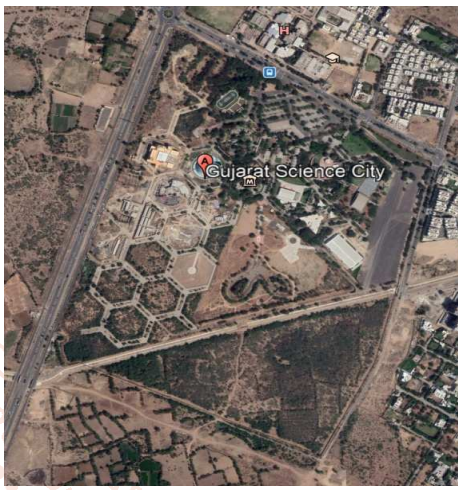


Figure 3: Location of Gujarat science city

LULC (Land use Land cover) classification through Remote sensing and GIS techniques

1. Satellite image of the study area with high resolution was taken for January 2020 from Google earth pro.
2. The Image was georeferenced by using QGIS 3.4.11.
3. Isocluster unsupervised classification was carried out using ArcGIS 10.4 for Land use Land cover analysis and Scales and apt legends were used to generate Land use Land cover map.
4. For the removal of software-based error, it was checked with a ground survey.

Field survey

The Field survey was carried out in January 2020 for the formulation of a plant checklist. The survey was carried out around the campus the study area is around 6.495 km^2. The Plant checklist included plants that are inside the campus. For the better understanding plants were noted down with its common name, habits such as a tree, herb, or shrub. The photographs of plants were taken for identification with leaves, bark, and flower parts (if available). With the comparison of Filed note information of plant species were used as basic data for plant identification. Plant identification was done with the help of taxonomic experts of the university and institutions, and with the help of literature (Cooke, A.T. 1903, 1985, Shah, 1978) available in the library of the Botany Department, Gujarat University, The Serenity Library, Ahmedabad.

Result and Discussion

Image analysis

Remote sensing and GIS are appropriate techniques for the determination of land use land cover change on the earth's surface. Satellite data has been used for the identification of

global land use land change since 1972 due to its constant availability of images (Hansen and Loveland 2012). This image represents the Iso cluster unsupervised classification. This image illustrates different land-use patterns of the study area. Different colors in the image represent different classes such as open area represents by blue colour, green color shows vegetation area, olive green represents the constructed area and land covered with lawn highlighted by sky blue color. Vegetation covers include small herbs, shrubs as well as trees, cultivated plants (garden plants) also some natural plants. The Constructed area consists of various buildings, roads, and different parks of science center such as life science park, dinosaur park, butterfly park, aquatic gallery, earth dome. Study area classified into four classes: the open area, the vegetation area, the constructed area, and lawn area (land covered with lawn). Unsupervised classification is self-organization data analyses, this method of classification dose not require the primary knowledge of land cover type before classification (J.B campbela *et al.,* 2011, R.O. *et al.,* duda 2009). This method was proceeded by forming maximum clusters. The software identified the pixel itself and generated the cluster, similar clusters form one group. In this image, the land without vegetation and construction considered as open area.

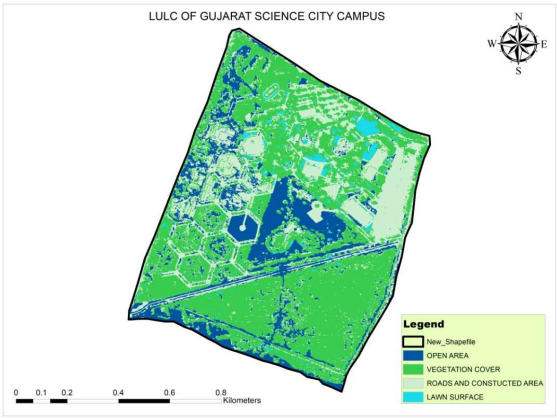
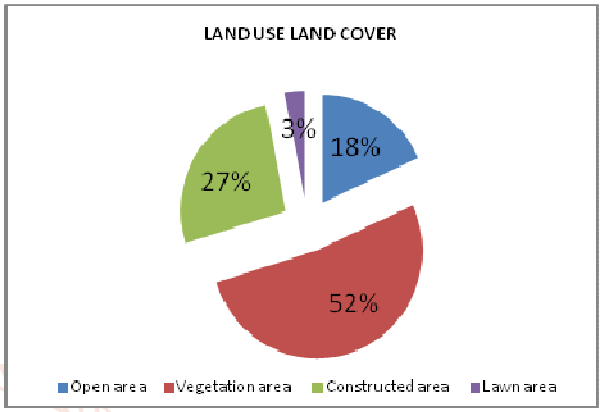


Figure 4: unsupervised classification of study area

Land use Land cover analysis

Graph 1 represents land-use patterns of the study area in percentage. This graph concludes four classes which are calculated in percentage, the open area is 18% represented by blue color. The vegetation area is in red up to 52%, the constructed area shown by green color is 27% and the lawn area represented by purple colour is about 3%. Maximum area covered by vegetation and minimum area covered by a lawn of gardens. The information of Land use land cover patterns will help in the future for the formulation and further development of the campus.



Graph 1: Represents Land use Land cover in parentage

Plant list

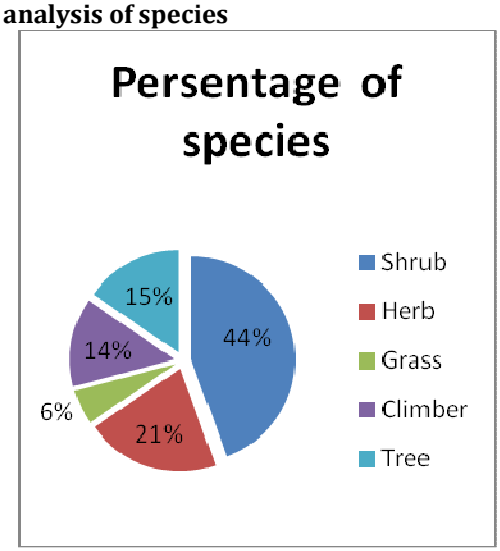
The List of surveyed plant species of campus indicated a total of 73 species including herb, shrub, grass, climber, sedges, and tree belongs to 44 genera and 32 families

Table 1: List of plants, Local name (Gujarati), Families, Habit.

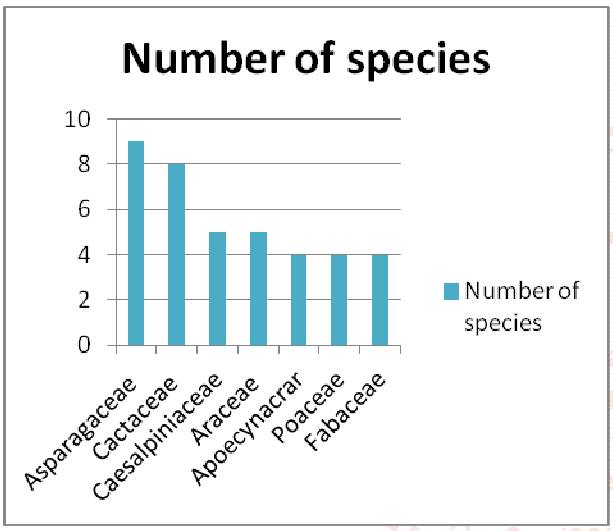
Botanical name	Family	Habit
Agave Americana	Agavaceae	Shrub
Agave capensis gentry	Agavaceae	Shrub
Agave joe hoak	Asparagaceae	Shrub
Agave sisalana perrive	Agavaceae	Shrub
Agave angustifolia var. angustifolia	Asparagaceae	Shrub
Agave desmettiana Jacobi	Asparagaceae	Shrub
Agave victoriae reginae T. Moore	Asparagaceae	Shrub
Agave xylonacantha sal m- Dyck	Asparagaceae	Shrub
Agenolaema marantifolia Blume	Araceae	Herb
Agenolaema simplex Blume	Araceae	Herb
Allamanda blanchetii A DC	Apocynaceae	Shrub
Allamanda cathartica L.	Apocynaceae	Shrub
Allopteropsis cimicina (L.) Stapf	Poaceae	Grass
Alluaudia procera (Drake) Drake	Didiereaceae	Shrub
Aloe barbadense Mill	Liliaceae	Herb
Aloe vera (L.) Burm.f.	Asparagaceae	Herb
Aloe perryi Baker	Asparagaceae	Shrub
Aloe aristata Haw.	Xanthorrhoeaceae	Herb
Alysicarpus spp	Fabaceae	Herb
Aralia chinensis L	Araliaceae	Shrub

Aralia racemosa L	Araliaceae	Shrub
Aralia fruticosa Sesse & Moc.	Araliaceae	Shrub
Araucaria columnaris (Forsk.) Hook	Araucariaceae	Tree
Bahunia acuminata L.	Caesalpiniaceae	Tree
Bauhinia tomentosa L	Caesalpiniaceae	Tree
Caladium bicolor (Aiton) Vent	Araceae	Herb
Caladium esculentum Vent	Araceae	Herb
Caladium hertulanum Bridsey	Araceae	Herb
Cannabis sativa L.	Cannabaceae	Herb
Carallum crenulata wall.	Asclepiadaceae	Shrub
Cardiospermum halicacabum L.	Sapindaceae	Climber
Careya arborea Roxb.	Lecythidaceae	Tree
Cassia grandis L	Caesalpiniaceae	Tree
Cassia javanica L	Caesalpiniaceae	Tree
Cassia roxburghii DC	Caesalpiniaceae	Tree
Cereus jamacaru DC.	Cactaceae	Shrub
Cissus quadrangularis L	Vitacea	Climber
Desmodium gangeticum (L) DC	Fabaceae	Shrub
Desmodium scorpiurus (Sw.)Desv.	Fabaceae	Climber
Dioscoriea alata L	Dioscorieaceae	Climber
Elytrophorous spicatus (Wild.)A. Camus	Poaceae	Grass
Eriocaulon eleanorae Fyson	Eriocaulaceae	Herb
Ficus elastica Roxb. Ex Honem	Moraceae	Tree
Fimbristylis spp	Cyperaceae	Sedge
Jacaranda mimosifolia D. Don	Bignoniaceae	Tree
Mallotus philippensis (Lam.)Mull. Arg.	Eurphorbiaceae	Tree
Mammilaria longimam ma DC.	Cactaceae	Shrub
Murdania nudiflora L	Commelinaceae	Herb
Operculina turpethum(L.)Silva Manso	Convolvulaceae	Climber
Opuntia elatior Mill	Cactaceae	Shrub
Opuntia ficus	Cactaceae	Shrub
Opuntia cylindrical (Lam.)DC.	Cactaceae	Shrub
Opuntia falcate Ekman & Werderm.	Cactaceae	Shrub
Opuntia Microdasys (Leh m.)Pfeiff	Cactaceae	Shrub
Opuntia tunicate (Lehm.)Pfeiff.	Cactaceae	Shrub
Oryza rufipogon Griff	Poaceae	Grass
Pachypodium spp	Apocynaceae	Shrub
Pachypodium lamerei Dr ake	Apocynacea	Shrub
Panacratium triflorum Roxb	Amaryllidaceae	Herb
Pandanaus odorifera (Forssk.) Kuntze	Pandanaceae	Shrub
Passifloria foetida L	Passifloraceae	Climber
Pennisetum spp	Poaceae	Grass
Pentas lanceolata(Forssk.)Deflers	Rubiaceae	Shrub
Pentatropis capensis(L.f.)Bullock	Asclepiadaceae	Climber
Pergularia daemia (Forssk)Chiov	Asclepiadaceae	Climber
Phyllanthus virgatus G.Forst.	Euphorbiceaes	Herb
Piper longum L	Piperaceae	Climber
Piper betle L.	Piperaceae	Climber
Platycladus orienalis (L.)Franco	Cupressaceae	Tree
Yucca aloifolia L inn	Agavaceae	Shrub
Yucca pineahele	Asparagaceae	Shrub
Yucca silverae	Asparagaceae	Shrub
Zornia gibbosa Span.	Fabaceae	Herb

Graph analysis of species



Graph 2: Species in percentage



Graph 3: Species in number

- Graph 2 represents the species in percentage. 44% are shrubs, 21 % herbs, 15% trees, 14% are climbers and only 6 % are grasses.
- Graph 3 represents species in numbers with families, Asparagaceae with 9 species, Cactaceae 8, Caesalpiniaceae 5, Araceae 5, Apoecynaceae 4, Poaceae 4, and Fabaceae 4. These families are dominant.

The major plants are cultivated on this campus as compared to natural plants. This is the state's most visited science center. Plants are cultivated for ornamentation of campus. Due to this reason, herbs and shrubs are more dominant as compared to trees. Herbs and shrubs are variously used for the beautification of the campus. Vegetation contributes in the removal of air pollutants from the atmosphere via dry deposition and by influencing the smog (O_3) process for the improvement of air quality (Bolund, P *et al.,* 1999, Akbari *et al.,* 2001, konopacki *et al.,* 2000, Nowak *et al.,* 1998, Thrones J 2010). the area of leaf surface directly linked with air temperature and air quality, urban trees and other plants of the urban area helps to improve it via reducing air temperature and reduced energy demands for buildings (Akbari *et al.,* 2001) and act as environment filter due to its absorbing capacity of gaseous pollutants on the area of leaf surface (Nowak *et al,.* 1998). The vegetation of urban regions can impact on carbon dioxide sequestration and climate change mitigation. The municipality can increase carbon sinks and decreasing co_2 emission by proper Management and planning of land use (Jo. *et al.,* 2001). Pollinators and wild pollinators receive essential resources such as habitat for nesting and food (flower with nectar and pollen) from urban vegetation (Holland *et al.,* 2016).

CONCLUSION

Drastic use of land and uncontrolled urban growth resulted in a threat to the vegetation of the particular area. It produces destruction of the environment, geological resources, and biological resources. This impact can be examined by using geospatial applications; remote sensing (RS) and geographical information system (GIS). Plants, animals, and insects of urban areas depend on urban habitat for food and shelter, food, especially insects and birds. Urban vegetation captures and filters the PM pollutants from the atmosphere and decreased the disperation of PM pollutants from air (Chen He *et al.,* 2020) additionally trees with large crown with mass of branches and leaves able to decreases the turbulent kinetic energy downwind of trees. Urban vegetation also decreases the NO_2 by absorbing it, it is also explored that concentration pf pollutants are lower under trees canopies as compare to in open area (Setala *et al.,* 2013). Urban vegetation habitat can provide condition like natural habitat (Gilbert 1989), which is beneficial for urban biodiversity conservation. It provides shade which can buffer solar radiation, maintain the temperature and moisture during the day as well as block the heat flow during the night. The development and conservation of urban greenery or vegetation, natural and cultivated both are necessary. It is appropriate for human health and also economically beneficial. Ahmedabad city is the rapidly growing city of Gujarat state. Urban sprawl is the major threat to species diversity Particularly in Ahmedabad city. The Strategic process of urban and infrastructure development requires the selection of suitable sites, new approaches, planning, operations, networks, and urban project management. Gardens, parks, institutional campuses are the sources of the greenery in Ahmedabad city. It is a primary need to maintain and develop them.

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