

Original Article

Analysis of Urban Green Space Using Geospatial Techniques: Case Study in Asansol Municipal Corporation Area

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Received Date: 10 July 2021

Revised Date: 13 August 2021

Accepted Date: 25 August 2021

Abstract - Urban green spaces are urban areas which were occurred that natural and partially natural ecosystems were transformed urban spaces by anthropogenic influences. Urban green space provide the connection between urban and nature. Urban green spaces are increasingly acclaimed as central elements in the promotion of environmental sustainability and quality of life in cities. Green spaces provide environmental benefits, such as the mitigation of heat island effects, the reduction of pollutants in the air, promotion of biodiversity and noise reduction. They are also important in cities due to social benefits, by providing ample recreational opportunities, by supporting social interaction and integration and by contributing to the improvement of mental and physical health. Asansol is an integral part of the Damodar river valley region and also one of the most important urban industrial zones of Eastern India. In recent years the large scale urbanization, industrialization and associated environmental alteration and its impact on biodiversity pose a threat to human existence through basic necessities, recreation and the ecological functions. Remote sensing data are now very much useful for getting authentic and periodical data of any part of our planet. In the study Landsat image of 2016 was used as data base for the analysis of forest and water cover of the study area. By using the technique of unsupervised classification land use map has been prepared. In order to go deep analysis of forest cover NDVI and water cover NDWI has also been prepared for this region. Through this paper we are trying to find some causes of increasing urban population and also increasing the rate of vertical residential development and its effect on urban environment, and last of all to find the proper way of urban environment management by the use of modern technology.

Keywords - Urbanization, Industrialization, Biodiversity, Landsat image, NDVI, NDWI, Green belt, Green Space.

I. INTRODUCTION

A large proportion of the population now lives in cities and metropolitan area. The environmental challenges caused by city boundary as well. Urban expansion also degrades and destroys natural habitats in the city. But nature is essential for human health and well-being in high stress urban environments. Exposure to green spaces and the observation of nature provide well-being and psychological relief from urban stress. Urban nature offers important opportunities for nature education, providing outdoor labs and play areas. Nature provides an important place in the cultural landscape through its scarcity, ranging across all strata of Indian society.

Urban nature does not occur as separate and discrete entities. There is a great deal of interaction between the trees, birds, insects and other plants and animals that live in cities, along with the physical components of the environment such as air, water and soil. The massive scale of urbanization in India will pose undoubted challenges for the country's environment, ecology, society and sustainability.

The current focus on smart city as a solution for urban sustainability challenges in India is driven by a management of technology for the efficient management of economic growth.

A. Rationale behind the Selection of Study Area:

The study area is an integral part of the Damodar river valley resources region and is one of the most important urban industrial zones of Eastern India. The study area is an industrial cross-section which naturally pollutes the area more compared to other cities. In recent years the large scale urbanization, industrialization and associated environmental



alteration and its impact on biodiversity pose a threat to human existence through basic necessities, recreation and the ecological functions. It is evident that pollution from various sources particularly from industries has negative impact on environment. Selection for this topic was to know how much area are polluted due to growth of urbanization. The study areas are situated in Paschim Bardhaman.

Satellite Remote Sensing has become an important tool for monitoring and management of natural resources and the environment. Remotely sensed data are widely used in Land use/Land cover classification. Land cover relates to the discernible Earth surface expressions, such as vegetation, soil, water or anthropogenic features and thus describes the Earth's physical state in terms of the natural environment and the man-made structures (Xavier Baulies and Gerard Szejwach, 1998).

According to Chorley, B(1968), the integrated approach to research methods in geomorphology and environment includes field observation, laboratory observation, official observation and theoretical work (Sing, 1998, p.21).

The paper namely "Benefits of Urban Green Space" by Dr. K. D. Ridder published by January 2003 help to understand and evaluate a cities potential in terms of green space enhancement, to develop planning scenarios for the effective implementation.

The paper namely "Urban forests and Open Green Space lessons for Jaipur, Rajasthan, India" by V.S.Singh, D.N.Pandey and P.Chaudhry published in the year of 2010, discuss about multifunctional landscapes to enhance urban resilience and human well-being.

The paper namely "Urban Greenery Status of some Indian cities" by P.Chaudhry, K.Barga and B.Singh published in April 2011, discuss the conditions of urban greenery in some of the Indian urban places.

The paper namely "Analysis of Urban Green Space distribution and better organization of Space and Place it: Case study of the region Two of IZEN City, IRAN" by I.Ebrahimzadeh, S.Maleki and D.Hatami published in 2013. These papers mainly discuss about increasing urbanization increased environmental pollution and green spaces play a important role in maintained the ecological balanced.

The paper namely "The importance of planning for Green Spaces" by E.J.Cilliers published in May 20, 2015 discuss about the necessity of Green Spaces. This paper explored the importance of planning for green spaces and to the sustainable development approach.

The paper namely 'From Garden City to Eco-Urbanism: The quest for sustainable neighbourhood development' by A. Aharifi Published in 24 July 2015, helps to understand how successful movement have been in addressing the requirements of sustainable development. Literatures on five selection movements are Garden City, Neighbourhood unit, Neo traditionalism and Eco- Urbanism.

The paper namely 'Expansion and upcoming problems of Asansol city in West Bengal' by Mr. S. Mandal published by April, 2016 volume v number II, discuss about population growth and population density in Asansol region. The problems related to city growth discussed about may be removed by proper planning of the city area and its region.

The Book "Nature in the City" by H.Nagendra published in 2016. These books discuss the past, present and future nature or green belt condition of Bengaluru.

The paper namely 'Sustainable urban Green space management practice' by H.Q.Yoong, K.Y.Lim, L.K.Lee, N.A.Zakaria, K.Y.Foo published in January, 2017, help to understand sustainable development is required for urban green space development and management practice.

The paper namely 'The environmental benefits of urban open Green spaces' by M. Rakhshandehro, M.J.M. Yusof, R. Arabi, M.Parva and A.Noehian published in June, 2017, discuss about the benefits of urban green and open spaces contribute for human and social wellbeing. The paper namely 'Indicators for ecosystem services in urban green space management' by J.Ludha published in August, 2017, discuss the specific indicators for ecosystem services at a green space. The papers also describe how to develop the management of an urban green space by biofriendly services.

The article namely 'The Future of sustainable Urbanism: Society-Based, Complexity-Led and Landscape-Driven' by R.Roggema published in 15 August 2017, discusses the question: where to with sustainable urbanism? And also reviews of recent literature in the field of eco-cities.

The article 'Preferences for Urban Green Space characteristics: A comparative study in Three Portuguese cities' by H. Madureira, F. Nunes, J.V. Oliveira and T. Madureia published in 1st February 2018, help to understand the urban residents preferred public green space characteristics and investigate whither similarities and differences can be highlighted in three different Portuguese cities.

The paper 'Urban Green Space and Its Impact on Human Health' by J.M.Fluehr, T.Mckeon and C.C.Branas published in 3rd March 2018, discuss about the possibility of health improvement by green space development.

The paper namely "Urban Open Space in the 21st century" by C.W.Thompson discuss the human needs and the broader ecological framework of urban open space structures and also discuss recognising 'loosfit' landscapes which allow opportunities for the socially marginalised and the ecologically shifting with a dynamic framework.

The current focus on smart city as a solution for urban sustainability challenges in India is driven by a management of technology for the efficient management of economic growth. The objective of this research to nature of pollution due to growth of urbanization.

So, it is very important to understand the importance of urban nature in the city and better protection, inclusive will be essential for urban sustainability.

II. PROFILE OF ASANSOL MUNICIPAL CORPORATION

Asansol, West Bengal, India is located at India country in the cities place category with the gps coordinates of 23°40'26.1984"N and 86°57'8.6148"E. Asansol is the part of the Chotanagpur plateau which consists of the Meta sedimentary rocks of Precambrian age, Gondwana sedimentary rocks, Rajmahal basalts and upper tertiary sediments. In general, the topography resembles a promontory jutting out from the hill range of Chotanagpur plateau.

Total geographical area of Asansol Municipal Corporation is 125 km² and it is the smallest city by area in the district. Population density of the city is 4503 persons per km². There are 50 wards in the city, among them Asansol Ward No 28 is the most populous ward with population of about 33 thousand and Asansol Ward No 13 is the least populous ward with population of 3026.

As per provisional reports of Census India, population of Asansol in 2011 is 563,917; of which male and female are 292,387 and 271,530 respectively. Although Asansol city has population of 563,917; its urban / metropolitan population is 1,243,414 of which 646,052 are males and 597,362 are females. Population of the city has increased by 18.6% in last 10 years. In 2001 census total population here were about 4.8 lakh. In 1901 census total population in Asansol area is very low. In this year population is 30747.

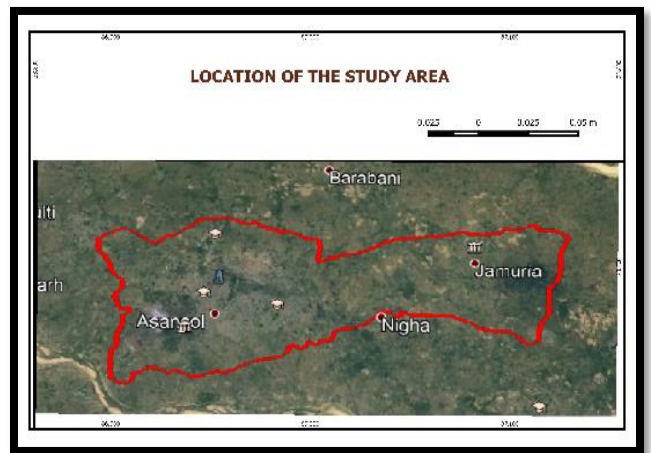
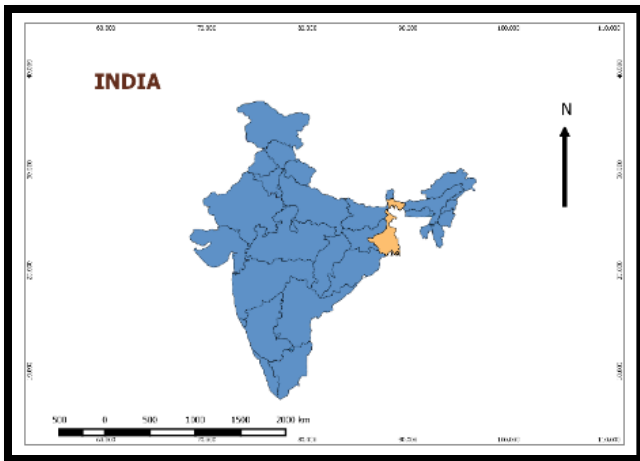
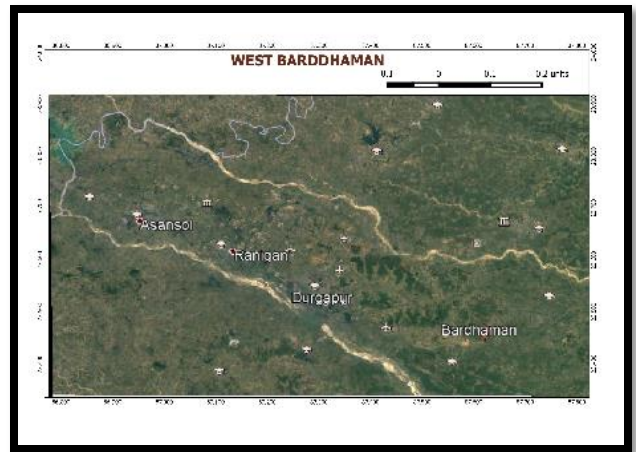
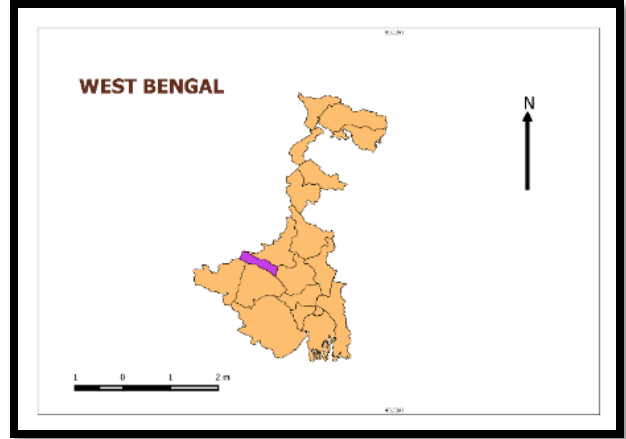


Figure.1: Location of the Study Area

III. OBJECTIVES

Every field study of physical geography and social geography has one or more objectives to reach the predefined goals. The objectives are-

- 1) Mapping and analysis of Land use/Land cover of Asansol Municipal Corporation.

- 2) To identify the change of spatial growth of the study area.
- 3) To identify the green space of the study area.
- 4) To find out man nature interaction or nature connected to the people.
- 5) To identify people awareness for conservation of nature.

IV. DATABASE AND METHODS

For the study Landsat image (LISS III) were acquired for the year of 2016. Also used District Census Handbook 2011 for collection of population data in Asansol Municipal Corporation area.

A. Field Observation: Field observation includes qualitative as well as quantitative methods of data acquisition. Data are obtained from extensive field observation in the form of numerical and informative source. I was to visit the study area to derive the quantitative and qualitative data and ground truth verification.

B. Software and Instrument used:

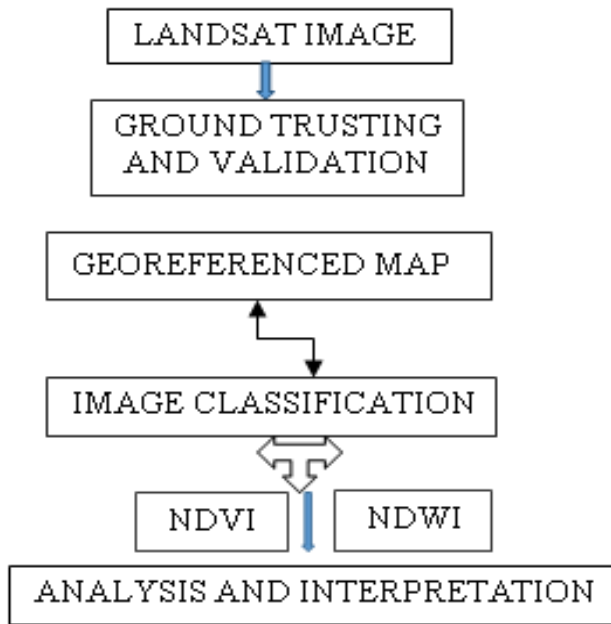


Figure.2: Graphical Representation of Methodology of the Study

V. OPERATIONAL DEFINITION

A. Urban Green Space:

Urban green spaces are urban areas which were occurred that natural and e ecosystem. Urban green space provide the connection between urban and nature. Besides, urban green areas provide lots of ecological benefits which were established especially needs of urban people. In order to meet social and psychological needs of citizens satisfactorily, green spaces in the city should be easily accessible and in adequately optimal in quality and quantity. Green spaces need to be uniformly distributed throughout the city area. Urban green spaces play a key role in improving the

liveability of our town and cities. Green spaces are areas that have contiguous vegetated areas and spaces, such as artificially created city parks, natural vegetation and land areas such as botanical gardens. Green spaces also include school grounds and sports fields. A network of green spaces which supply life support functions including food, fiber, air to breathe. The Green infrastructure approach seeks to use regulatory or planning policy mechanisms to safe-guard natural areas.

B. Unsupervised Classification:

Unsupervised classification is a method which examines a large number of unknown pixels and divides into a number of classed based on natural groupings present in the image values. Unlike supervised classification, unsupervised classification does not require analyst specified training data. The basic premise is that values within a given cover type should be close together in the measurement space (i.e. have similar gray levels), whereas data in different classes should be comparatively well separated (i.e. have very different gray levels).

C. Normalized Difference Vegetation Index (NDVI):

Normalized difference vegetation index (NDVI) is a ratio used to determine the density of vegetation in an area based on visible and near-infra-red (NIR) sunlight reflected by plants (Hassan Ahmadi, Asima Nusrath 2010). The NDVI algorithm subtracts the red reflectance values from the near-infrared and divides it by the sum of near-infrared and red bands. $NDVI = (NIR - RED) / (NIR + RED)$. Theoretically, NDVI values are represented as a ratio ranging in value from -1 to 1 but in practice extreme negative values represent water, values around zero represent bare soil and values over 6 represent dense green vegetation. High positive values of NDVI correspond to dense vegetation cover that is actively growing, where negative values are usually associated with bare soil, snow, clouds or non-vegetated surfaces.

D. Normalized Difference Water Index (NDWI):

The Normalized Difference Water Index (NDWI) (Gao, 1996) is a satellite-derived index from the Near-Infrared (NIR) and Short Wave Infrared (SWIR) channels. The SWIR reflectance reflects changes in both the vegetation water content and the spongy mesophyll structure in vegetation canopies, while the NIR reflectance is affected by leaf internal structure and leaf dry matter content but not by water content. The NDWI is a remote sensing based indicator sensitive to the change in the water content of leaves (Gao, 1996). NDWI is computed using the near infrared (NIR – MODIS band 2) and the short wave infrared (SWIR – MODIS band 6) reflectance’s. The formula is $NDWI = (NIR - SWIR) / (NIR + SWIR)$.

VI. RESULT AND ANALYSIS

A. SPATIAL GROWTH OF THE STUDY AREA:

The spatial detail and accuracy of urban expansion forecasting methods currently in use must be improved in order to help policy-makers to prepare for future socio-economic, environmental and health changes associated with urban growth and expansion.

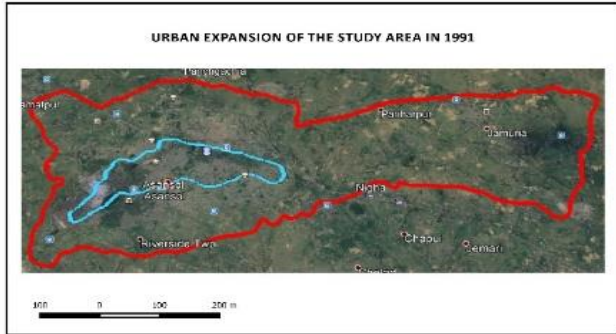


Figure.3 Urban Expansion 1991

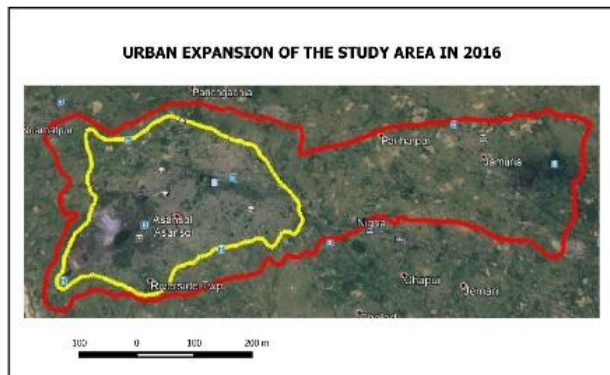


Figure.4 Urban Expansion 2001



Figure.5 Urban Expansion 2016

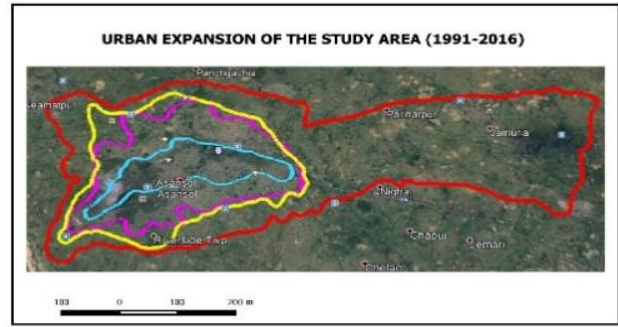


Figure.6 Urban Expansion (1991-2016)

Asansol cities grow faster than other cities because of many reasons. The first is that the population growth of cities is economically important in itself. Coal industries, educational institutes, hospital, shopping mall and others different built up area are situated in Asansol. The spatial distribution of settlement also provides key insights into the emerging settlement pattern. More settlements are located on the western side of Salanpur and Barabani C.D Block, large number of them is connected around Chittaranjan and Hindustan Cables Township.

In 2001 census total population is 30747, which increased metropolitan population is 1,243,414 in the year of 2011. Asansol saw large amounts of urban expansion between (1991-2016). The region had 73.23 square kilometers of urban land in 2000; reaching 127.87 square kilometers in 2016.

Table.1 Respondents with various educational levels admitted on values of urban green space in environmental development

Educational level	Number of respondents	Number of respondents agreed on urban green space value	Number of respondents agreed on urban green space value in percentage
Illiterate	20	12	60.00
Elementary	22	15	68.18
Higher Secondary	34	24	70.58
Graduate & above	24	21	87.50
Total	100	72	72.00

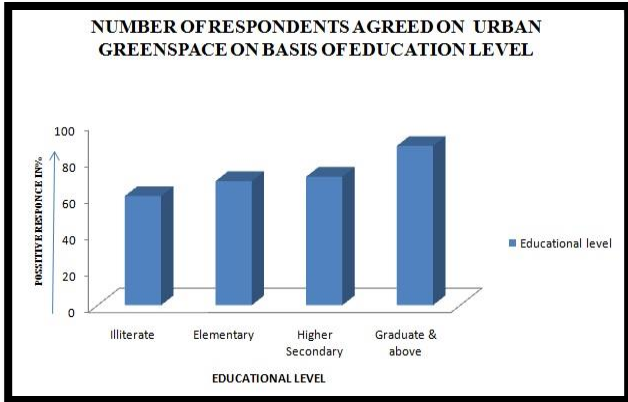


Figure.7: Number of respondents agreed on urban green space in basis of Education

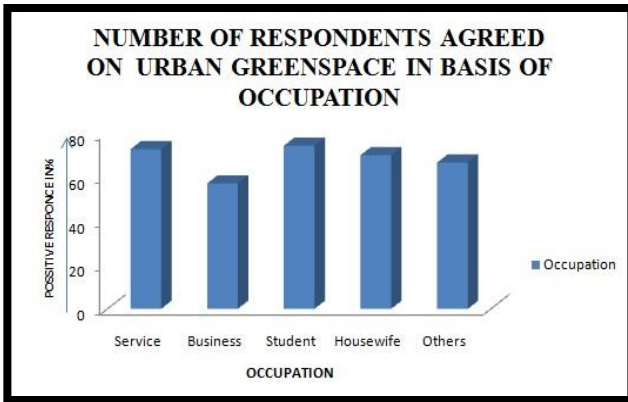


Figure.8: Number of respondents agreed on urban green space in basis of Occupation

B. PEOPLE’S RESPONSE TO CHANGING GREEN AREAS

Among the respondents with different educational attainments, 60% illiterate people agreed on green space values whereas 87.50% respondents with bachelor or higher degrees admitted higher green space values in environmental development. It was observed that (table.1) people with more education level had higher positive perceptions about the values of green space in environmental development of urban area.

Table.2 shows that different occupational groups those were interviewed, 72.72% of service holders, 57.14% of businessmen, 74.28% of students and 70% of housewife’s agreed on green space values on environmental development. It was observed that there was no significance difference of views among the different occupational groups.

Occupation	Number of respondents	Number of respondents those agree on urban green space value	Number of respondents agreed on urban green space value in percentage
Service	22	16	72.72
Business	21	12	57.14
Student	35	26	74.28
Housewife	10	7	70.00
Others	12	8	66.67
Total	100	69	69.00

Table.2: Respondents with different occupations admitted values of urban green space in environmental development

C. LAND USE/LAND COVER MAP OF THE STUDY AREA

The area under different land categories is given in the table no.3. Generally 7 land categories have been found in that area as it is not so much densely forested area. Most of the area is covered by built up area. Among the total area (127.87sq km), most of the area (39.51294 sq km) is under built up area like settlement and transport area. Among them 17.80815 sq km is open forest, 11.20846 sq.km is agricultural land and 19.24676 sq km is dense forest. Here 12.16529 sq km land area is barren land and 17.16007 sq km area is moist fallow land. Only 9.82249 sq km area is covered by water bodies.

Table.3: Area of Different Land Categories

Classes	Area sq.km
Water Bodies	9.82249
Settlement & Transport	39.51294
Open Forest	17.80815
Barren Land	12.16529
Agricultural Land	11.20846
Dense Forest	19.24676
Moist Fallow land	17.16007

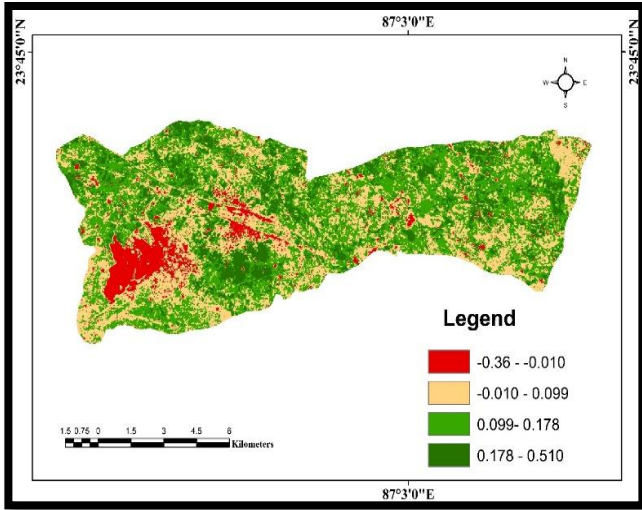


Figure.9: Land Use Land Cover Map of the Study Area

D. NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI)

Figure 10 shows that the range of NDVI is from -0.36 to 0.510 in the above mentioned year. It is clear from figure 8 that the range from -0.36 to -0.010 of that area is reaming without vegetation cover which is indicated by red colour and the range from -0.010 to 0.099 which is indicated by cream yellow colour. Rest of the area is covered with vegetation. The range from 0.099 to 0.178 has indicated the open forest area. The range from 0.178 to 0.510 of that area is covered with high vegetation cover like dense forest area. This classification depicts that 60% of the area is covered with vegetation cover with NDVI value of more than 0.099.

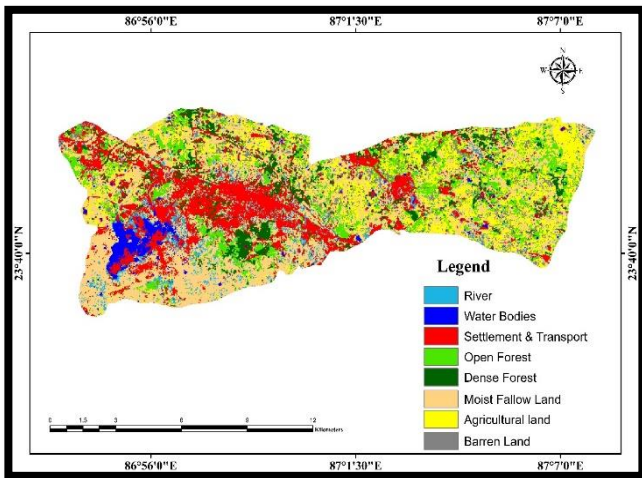


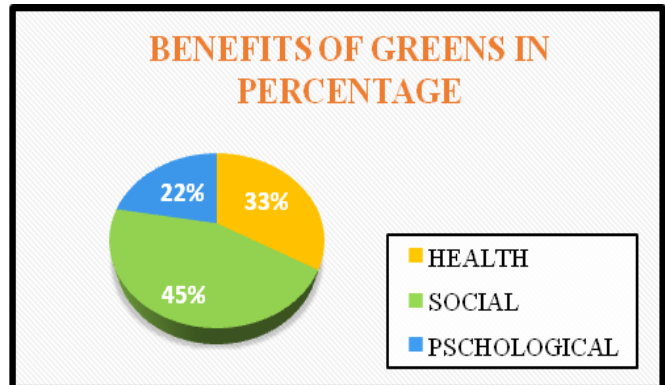
Figure.10: Normalized Difference Vegetation Index (NDVI)

E. GROWTH OF URBAN SPACE IN ASANSOL

The spatial and temporal dynamics of cities are complex and controlled by various driving forces, such as the regional economy, population movements, the policy environment and socio-cultural processes. Asansol cities grow faster than other cities because of many reasons. The first is that the population growth of cities is economically important in itself. Extremely large investments in building new housing and infrastructure must be made to accommodate the demographic growth of cities. Coal industries, educational institutes, hospital, shopping mall and others different built up area are situated in Asansol.

F. PEOPLE’S RESPONSE TO BENEFITS OF GREENS

As per survey report its very clear that 45% is social benefit, 33% health benefit and 22% is psychological benefit. Discussing with people, which is understood that to keep the environment healthy, it is very important to protect or conservation green space. Scientists assert that green spaces increase our ability to concentrate, both on the tasks at hand and on our subconsciously-viewed surroundings. Vegetated roadsides may also serve a social benefit by reducing fatigue, anger, aggression, fear and stress of automobile drivers. It has a positive effect on children for increased ability to concentrate.



G. INCREASING URBAN PROBLEMS

The urban environment is a coexistence of natural elements and the built up environment. Here natural environment is alter for human dwelling and activity, including buildings, infrastructure and urban open spaces. The attribute of urban environment is effected by its geographical location; the various kind of human activities for development; the mismanagement of waste emissions and ecological ruining. The urban environment is also affected by the socio-cultural components of the native such as the values, behaviour, beliefs, knowledge, traits, customs, traditions etc. The ensuing chapter pertains to the study of urban problems which have cropped up in the urban industrial landscape of Asansol Municipal Corporation area.

H. URBAN SPRAWL

Urban sprawl or real expansion of the cities, both in population and geographical area, of rapidly growing cities is the root cause of urban problems. In most cities the economic base is incapable of dealing with the problems created by their excessive size. Massive immigration from rural areas as well as from small towns into big cities has taken place almost consistently; thereby adding to the size of cities. During 1991-2001, well over million people migrated to cities. This is due to the fact that such large cities act as magnets and attract large number of immigrants by dint of their employment opportunities and modern way of life. Such hyper urbanisation leads to projected cities sizes of which defy imagination.

I. TRANSPORT

With traffic bottleneck and traffic congestion, almost all cities and towns of India are suffering from acute form of transport problem. Transport problems increase and become more complex as the town grows in size. With its growth, the town performs varied and complex functions and more people travel to work or shop. As the town becomes larger, even people living within the built-up area have to travel by car or bus to cross the town and outsiders naturally bring their cars or travel by public transport. Wherever, trade is important, commercial vehicles such as vans and trucks will make problem of traffic more complicated.

J. TRASH DISPOSAL

As Indian cities grow in number and size the problem of trash disposal is assuming alarming proportions. Huge quantities of garbage produced by our cities pose a serious health problem. Most cities do not have proper arrangements for garbage disposal and the existing landfills are full to the brim. These landfills are hotbeds of disease and innumerable poisons leaking into their surroundings. Wastes putrefy in the open inviting disease carrying flies and rats and a filthy, poisonous liquid, called leachate, which leaks out from below and contaminates ground water. People who live near the rotting garbage and raw sewage fall easy victims to several diseases like dysentery, malaria, plague, jaundice, diarrhoea, typhoid, etc.

Other factors are included in pollution, urban crimes, slums, unemployment, overcrowding etc.

VII. FINDINGS & AUTHORS SUGGESTION

- Importance of urban sustainability for a good urban green space management practice and its conservation.
- The spatial and temporal dynamics of Asansol cities are complex and controlled by various driving forces, such as the regional economy, population movements, the policy environment and socio-cultural processes.

- Land use land cover change in Asansol, growth of built up area and decreased water bodies and forest or vegetation area.
- Introduce the green belt project for controlling urban sprawl and control environment health as well as it's a place of recreation.
- Land use land cover change in Asansol, growth of built up area and decreased water bodies and forest or vegetation area.

We are trying to find some causes of increasing urban population and also increasing the rate of vertical residential development and its effect on urban environment, and last of all to find the proper way of urban environment management by the use of modern technology. Government and people awareness about the conservation and protection of the natural environment at Asansol and its surrounding areas should be the prime concern.

VIII. CONCLUSION

Due to excessive population growth and related cardinal problems such as pollution resulting from escalate production and accumulation of waste and mismanagement of it urgently needed maintain and expand urban green space. The area is under transport and settlement cover but there are some patches of vegetative area like open forest, dense forest and agricultural land for cultivation. It is obviously that more a large amount of area is engaged by urban built up area. These papers suggest that the value of green spaces should be firstly identified. Secondly quantified and measured in order to be prioritized and comparable to urban developments and other development priorities such as housing provision and commercial developments. Therefore, the modus-operandi of central and state governments and mandarins should pay more attention in developing urban green spaces by involving Local peoples, NGOs and Voluntary organizations.

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