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# EVALUATION AND PLANNING OF URBAN GREEN SPACE NETWORK IN LANDSCAPE PLANNING OF PONNERI, AN EMERGING SMART CITY IN TAMIL NADU

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## ABSTRACT

Global human population and urban development are increasing at unprecedented rates and creating tremendous stress on local, regional and global air and water quality. Some of the major functions of the urban green spaces include reducing air pollution, providing shade and habitat for arboreal birds, producing oxygen, providing shelter against winds, recreational and aesthetic qualities. Cities and peri -urban Settlements must be prepared to meet the challenge of unplanned settlement or slum formation. The move towards smart cities promises to bring greater automation, intelligent routing and transportation, better monitoring and better city management. The development of urban green space networks includes creation of new spatial forms, restoration and maintenance of green patches connectivity as well as protection of existing green spaces. Green space network begins to be recognised as a medium of conserving ecosystem and natural environment in urban area. Several methods have been introduced in regards to formulation of modelling urban green space network. This research paper reviews several methods that are used for modelling green space network in urban planning. Recently, remote sensing and GIS are being used to produce a model of urban green space network which positively afford nature conservation in the city. Various methods of modelling urban green space network which include remote sensing, GIS application through land suitability analysis (LSA) and least cost path analysis and gravity model are used to give some understanding on the role of geo-informatics to be used for future planning. The study has given us appropriate way to understand the living spaces in the proposed smart city and identified the probable locations for the green space network.

**KEYWORDS:** Urban Green Space, Land Suitability Analysis, Remote Sensing, Geo-Informatics, GIS, Smart City

## INTRODUCTION

As global population continues to grow at a steady pace, more and more people are moving to cities every single day. According to the experts the worlds' urban population will double by 2050 which means that we are adding seven more New Delhi cities every single year. As population of India continues to grow, more citizens will move to cities. Experts predict that about 25-30 people will migrate every minute to major Indian cities from rural areas in search of better livelihood and better lifestyles. It is estimated that by the year 2050, the number of people living in Indian cities will touch 843 million. To accommodate the massive urbanisation, India needs to find smarter ways to manage complexities, reduce expenses, increase efficiency and improve the quality of life. Government of India has allocated 70.6 billion for smart cities in budget 2014 – 2015. India has planned 100 new smart cities and will develop modern satellite towns around existing cities under smart city program. According to the Ministry Of Urban Development, Government of India, "Smart City is one which provides for the wellbeing of the people through integration of urban planning systems, efficient service delivery, smart governance, energy management and conservation of resources with underlying use of technology and

instrumentation leading to socio-economic and sustainable development".

Urban green spaces play a vital role in improving urban community's life quality in which it contribute to public health as well as urban environment. Green space is an important part of complex urban ecosystems that give environmental, recreational and economic benefits to the urban dwellers. According to Jim and Chen (2003), urban green spaces can be defined as an outdoor place contain with varied vegetation species and exists mainly as semi-natural area which is accessible public. Urbanization has increasingly threatened the biodiversity and consequently made loss and isolation of habitats. (Kong et al, 2010). The Integration of both remote sensing and GIS application in monitoring and managing land use is of immense use in the management of resources. Thus GIS is a one of the major tool that can be used for modelling a green space network for a proposed smart city.

**Objectives**

- To understand the land use and land cover of Ponneri, the upcoming smart city in Tamil Nadu.
- To study the air pollution levels especially SOx levels of ponneri at every 5m intervals.
- To generate suitability scenarios of the urban green space system by integrating suitability analysis with geographic information system (GIS) technology.

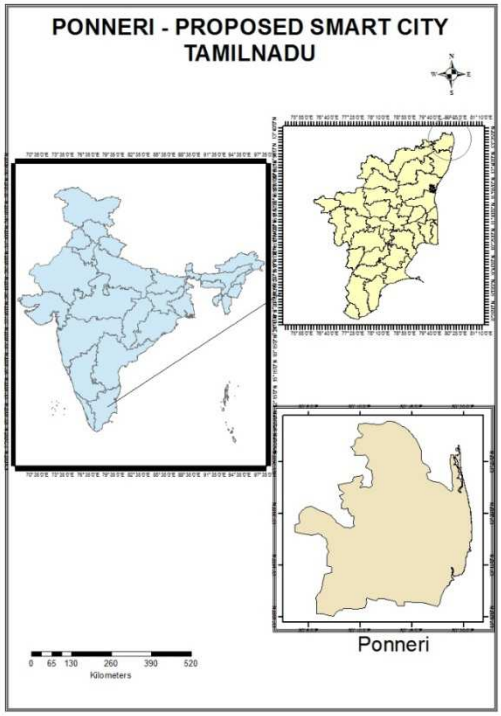


**Figure 1: Study Area: Ponneri**

**Study Area**

**Ponneri** is a town, north of Chennai in Thiruvallur district in the Indian state of Tamil Nadu. It is geographically located between 13.32°N and 80.2°E. PonneFritaluk covers an area of approximately 643.34 sq.kms. According to the 2011 census, the taluk of Ponneri had a population of 385,620 with 193,043 males and 192,577 females. Neighbouring towns are Minjur and Athipattu with development underway on NCTPS power plant project. Ponneri is located near Arani River. Ponneri is located 13km from pattupalli and the pulicat lake from 23km. Nearly 16940 small scale industries, are

successfully running in the district some of them are wood, textile, chemical, engineering, non-metallic and leather industries. The neighbourhood is served by the Ponneri railway station of the Chennai Suburban Railway Network. Ponneri is one among the 3 cities to become smart cities in the country. This will be a great opportunity for real estate investors who are looking for quick appreciation as Ponneri Smart City. Ponneri in Tamil Nadu has attained a fair amount of attention in the Budget to be developed into a smart city. Main reason for the attention from the foreign investors is the strategical location of Ponneri. It is very close to the Chennai metropolitan city and close to the Ennore port which favours both imports and exports. The focus on Ponneri is also due to its strategic location along the Chennai – Bangalore industrial corridor. The town was expected to become a hub for business development since the proposal of the corridor. With a population of over 25,000 people and splattered with industries like Ponneri steel industry and Nelcast Limited, the locality is all set to become a smart city in 'Modified' India.

**Methodology**

To identify the green space network land use and land cover classes of the Ponneri smart city were classified using the 2012 LISS III data. The pollution map was prepared using the air pollution data got from EIA report of NTPL. The emission from the NTPL was taken. The emissions of RPM, SPM, $SO_2$, NOx from the point source was evaluated. The extent of dispersion of pollutants was calculated using Gaussian Plume Dispersion model. From the model, dispersion of pollutants at 1km, 5kms and 10kms distance was calculated. Hence a multiple ring buffer was made at three different distances. The map of industrial zones was prepared and also the water bodies were extracted from the land use/land cover map derived from LISS III data. All these were taken as the basic parameters for carrying out the Weighted Overlay Analysis to identify the ideal places to develop the green space network.

Land Suitability Analysis (LSA) – Identifying suitable site for developing green space. Identifying suitable sites for conserving and developing green spaces is the first important step to ensure their roles and functions. Thus, in order to identify the most suitable site, land suitability analysis (LSA) can be seen as an appropriate tool to be used. In recent years of 2008, land suitability analysis (LSA being initially used for urban green space planning. Accordingly, LSA function as an indicator of identifying and evaluating areas with more suitability for green spaces development. According to Uy (2008), the LSA is supported by spatial analysis functions of GIS application. Jafari (2010) outlined that there must be a wide range of criteria involved in the LSA which firstly name as environmental, followed by social and economic factors. There are four steps involved in the LSA system which includes: spatial data collection, weighting with analytic hierarchy process (AHP), overlapping with GIS analysis and last but not least output evaluation and comparison. Uy (2008) stated that weighting is a very important process in land suitability identification as it precisely affects the output. Additionally, Jafari (2010) in the International Journal of Environmental Science and Development later mentioned that the analytic hierarchy process can be classified as a powerful tool to identify in detail the most suitable site which then helps for defining effective management plan. From the statements above, it can be concluded that the application of Land Suitability Analysis.

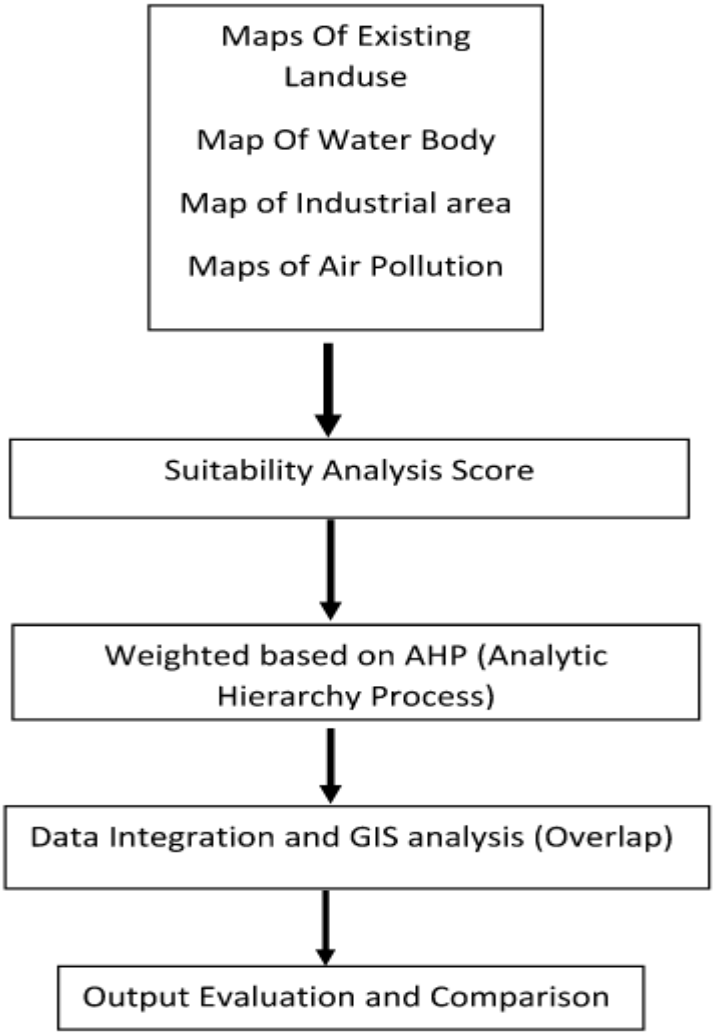


**Figure 2: Methodology**

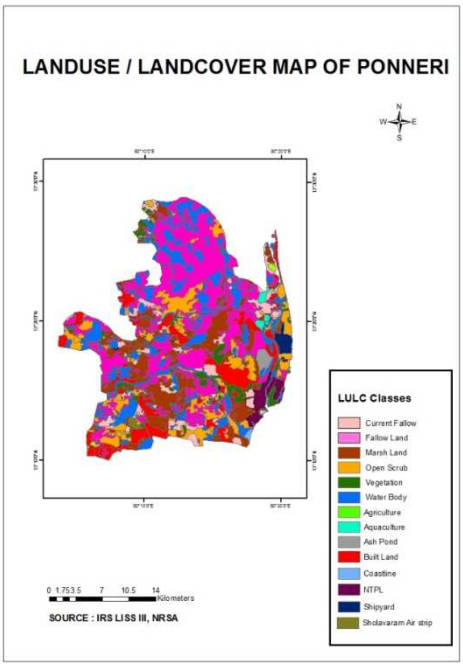


**Figure 3: Land/Landover Map of Ponneri**

## RESULTS AND DISCUSSIONS

Supervised classification of the study area was done in ERDAS IMAGINE 2014. Figure 2 from the classification done the major portion was found to be fallow lands. Water Bodies occupy almost 10% of the land area. The area is primarily covered with fallow lands. North Chennai Power Company is situated in Kalanji Village in Ponneri Taluk. The emission from the power plant has been considered for the study. The concentration of RPM is found to be 31microgms/$m^3$, SPM 82 micromesh/$m^3$, $SO_2$ 9.7microgms/$m^3$ and NOx 10.6 micromesh/$m^3$. The extent of dispersion of the pollutants was found out with the help of Gaussian Dispersion model. The pollution map reveals the extent of spread of the pollutant which has been shown in

**Table 1: Area of Land Use & Land Cover Classes**

| Lulc Classes | Area(In sq. kms) |
|---|---|
| Built Up | 95.36 |
| Water Body | 109.48 |
| Vegetation | 85.21 |
| Fallow Land | 195.63 |
| Marsh Land | 81.15 |
| NTPL | 17.64 |
| Shipyard | 5.88 |
| Open Scrub | 63.21 |
| Aquaculture | 3.51 |
| Air strip | 1.85 |

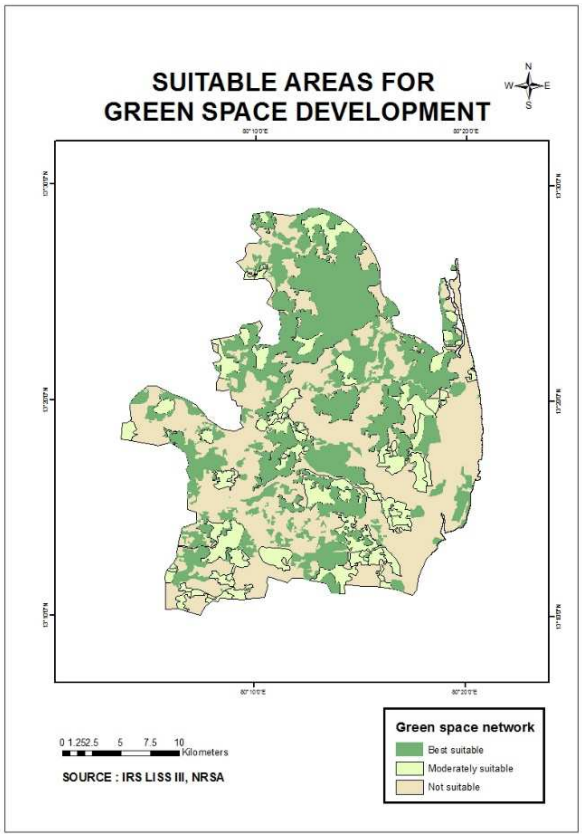


**Figure 4: Green Space Network in Ponneri**

The form of buffer zone map multiple ring buffer at a distance 1 km, 5 kms and 10kms was created. The location of industries is identified with the help of the map. All the four maps were used as inputs for weighted overlay analysis,

wherein the priority was given to the industries and the pollution map. The output map after weighted overlay analysis shows the appropriate place for green spaces. The best suitability has come out through ranking. Figure 3 Best suitable networks in the Ponneri taluk covers around 12% of the total area and 33% area are moderately suitable for development of green space. Suitability analysis will be a difficult task to identify the appropriate spaces for developing green spaces. There are four parameters that have been identified for allocating green spaces. They are not the optimal ecological factors combination and not enough to carry out the GIS – based suitability analysis. This research will depend on the data available. Hence the study has been done with data available to arrive the best of the knowledge.

**Table 2: Best Suitable Areas for Green Space Network**

| S. No | Green Space Network in Ponneri | Area (In sq. kms) |
|---|---|---|
| 1. | Best Suitable | 237.057 |
| 2. | Moderately Suitable | 167.23 |
| 3. | Not Suitable | 242.71 |

## CONCLUSIONS

Urban green spaces and suitability analysis are the two important terms used in this research. There are some good green areas in urban green space that may be natural or man-made that helps in ecological balance, playing an important role in urban environment, landscape and recreation. Suitability analysis is the process to determine whether the land resource is suitable for some specific uses. Suitability analysis can be used to help direct the future growth of the green spaces and protect the other important land uses at the same time. The result of implementing the proposed approach is a map that categorises and illustrates the different levels of green space suitability throughout the study area. As can be seen on the map in Fig 4 of the best suitability scenario, large proportions of the study area are found to be not suitable for green space development. This is the direct result of the growing conflict between the ecological environment and development restriction. Areas that receive high and moderate suitability levels are revealed to be the areas of existing green spaces, vacant areas and government reserved areas. This is suitable for future growth of green spaces. The suitability results can provide helpful knowledge on the factors interactions and their relation to the urban environment within the study area. It can be used to help people make better, more informed decisions, thus providing a healthier quality of life for the community and the surrounding ecological environment.

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