



SITE SUITABILITY FOR INSTALLATION OF SMOG TOWERS USING GIS TECHNIQUE IN LUCKNOW CITY

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Abstract

Air pollution has become a significant menace all around the world. With an improving economy and increasing number of economic activities the capital city of Uttar Pradesh Lucknow is no different, witnessing an aggravated air pollution condition, hence air quality mapping and installation of smog towers has become the need of the hour. A relatively new technique "Remote Sensing and GIS" can be used to determine the site for the installation of a smog tower to achieve optimum results [9,12]. The air quality in Lucknow is monitored by six stations and the parameters used as a base for this study are Particulate Matter, that is PM₁₀ and PM_{2.5}, AQI, Humidity, Settlement, Population, Industrial cluster. Industries emit pollutants that mix with the environment and cause threat to human and environment life. The study uses the software ArcGIS and Google Earth Pro for the collection and analysis of data that have been obtained from the six air quality monitoring stations, a buffer area of 2 km has been selected around the industries so that the population that is directly under the exposure of harmful pollutants can be taken into consideration, after combining all the data and performing the analysis the suitable sites for the installation of Smog towers was found.

Keywords: Remote sensing, GIS, smog towers, air quality, suitable site.

Introduction

Clean air is important for survival on this planet, various human activities have altered the basic composition of Earth's atmosphere, if nothing is done to reverse the effects it can have adverse impact on the civilization. As the day progresses more and more human population is being exposed to the air pollution threat. Public health [1-4] is a major issue and particulate matter pollution is one of the greatest concerns, due to constant increase in industrial and anthropogenic activities various pollutants have accumulated in the atmosphere, furthermore, air pollutants can have drastic direct effect on plants, soil and animals. It influences the self-regulating abilities and contribute to the change in the basic structure and functioning of plants, animals and soil. India is a booming economy and a developing country, undergoing a crucial industrial transformation and that enhances the existing air pollution problem in the country. Air is an essential component in our biosphere, you can live without food for days but you cannot live even for a minute without clean air. On an average an adult consumes 15 kg of air, the water and food consumption of an adult is 1.5 kg and 0.75 kg respectively. Industrialization adds to the economy but the ill effects caused due to these activities are reflected in the form of environmental adversities. Urban pollution has its short term and long term affects on human health and air pollution negatively impacts the ecosystem, materials, building, artwork, materials. In the current scenario the ambient air quality is gaining grip as major environmental issue. Many studies have reported that the air pollution is causing drastic effects in the lifestyles of all mankind, animals, plants as well as soil. The adverse effects of air pollution on human health is an established fact now.

Methodology

The focus of this study was to select a suitable site for the installation of smog tower in the Lucknow city, using a modern Geographic Information System technique (GIS) [4].

In this study ArcGIS software was used to analyze the collected data and locate the most favorable site for installing a smog tower. The selected GIS technique consisted of five central phase which included data acquisition, pre-processing, data Management, analysis and manipulation, and product generation [11]:

- **Data acquisition:**

This process is used for gathering spatial and non-spatial geographical information from different sources. The data can be captured in two forms- Analogue (physical data like maps) and digital (computer readable forms like satellite data).

- **Preprocessing:**

The conversion of gathered data into a suitable format is called as preprocessing. Data format conversions, digitization of maps, and recording of field into the database of the software is done in preprocessing. The techniques like data reduction, error correction are done with an intention to prepare the data for further analysis.

- **Data Management:**

Data Management gives an opportunity to store data, make query and operate on geographical data, it enables some functions like adding, deleting, or define the database contents.

- **Analysis and Manipulation:**

The GUI enhances the manipulation property of the software, it manipulates the data according to the requirements of the analysis, it is possible to obtain a visual representation of the spatial data with the help of a GIS database and preprocessed data. A GIS uses some mathematical tool like Boolean Algebra for analysis.

- **Product Generation:**

This is the last phase of a GIS life cycle, result is yielded in this phase in the form of an interactive digitized maps, reports, charts all of these can help in policymaking.

The following parameters were selected to be analyzed to evaluate the suitability of site:

- (i). Humidity
- (ii). PM 10
- (iii). PM 2.5
- (iv). AQI

The values of the above-mentioned parameters were acquired from the official AQI India website [10] and put into GIS map to reveal the most suitable site. The study area was selected using Google Earth Pro. The area which showed the maximum ground level concentration for most time of the year was selected as the suitable site for installation of smog tower. The software ArcGIS Desktop 10.8 was used to analyze and produce results using the concepts of GIS.

Results and discussion

The following maps were created and suitable site was located by analyzing [4-6] these maps on ArcGIS and Google Earth Pro:

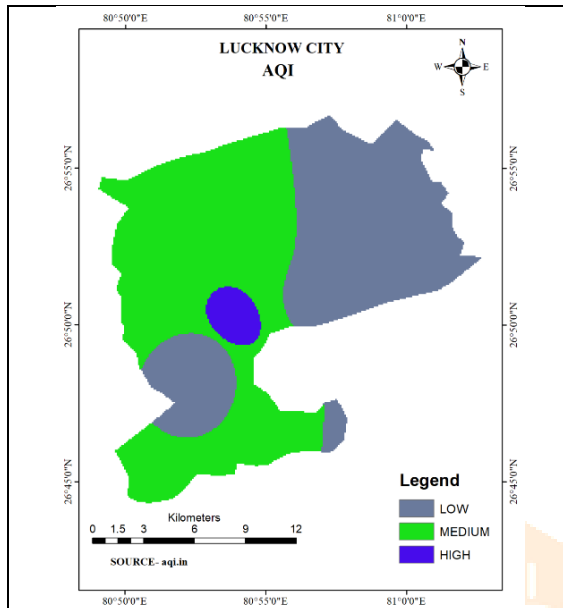


Figure 1 AQI Map

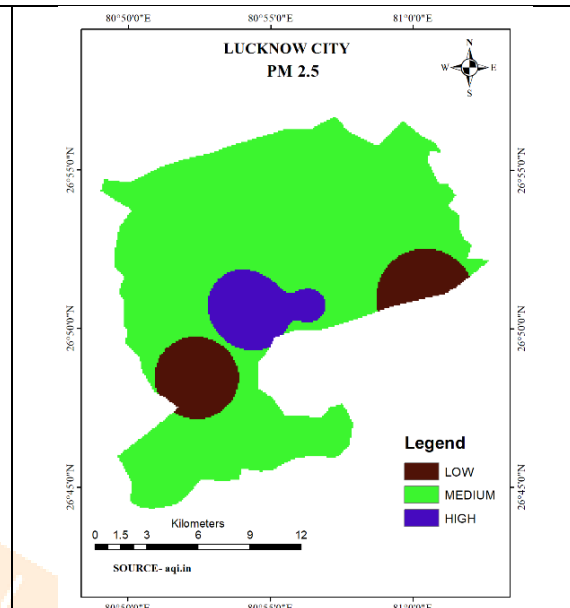


Figure 2: PM 2.5 Map

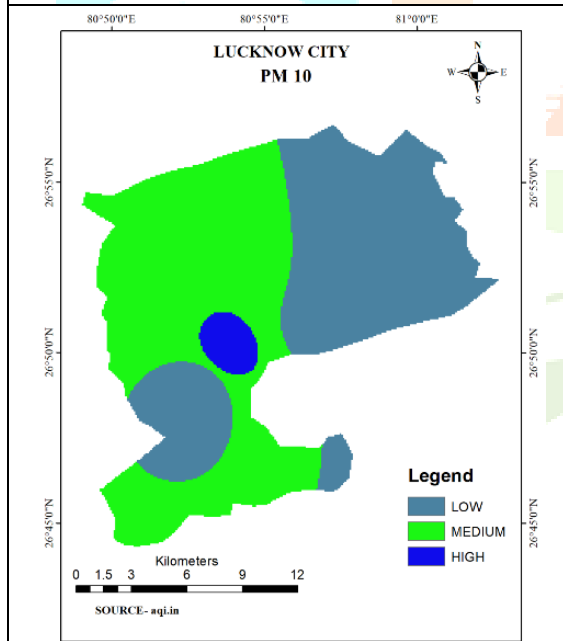


Figure 3: PM 10 Map

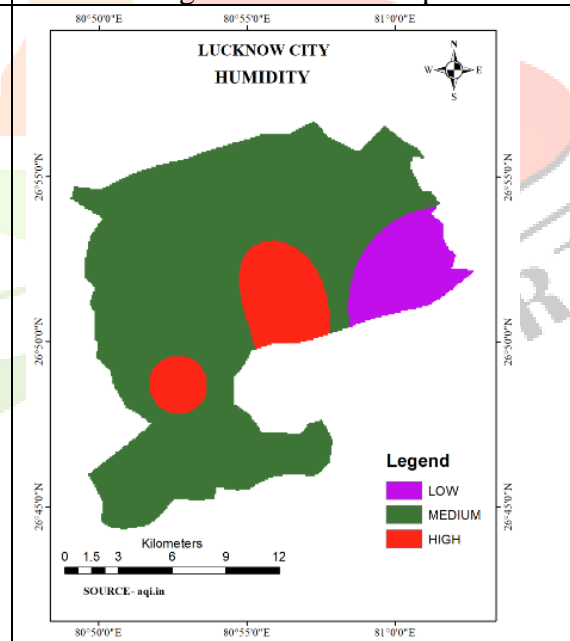


Figure 4: Humidity Map

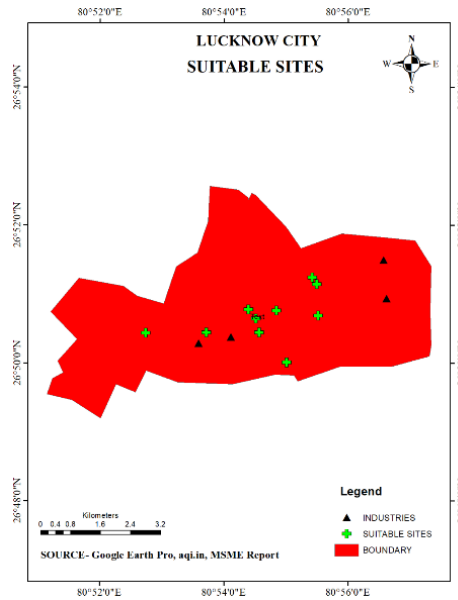


Figure 5: Suitable Sites Map

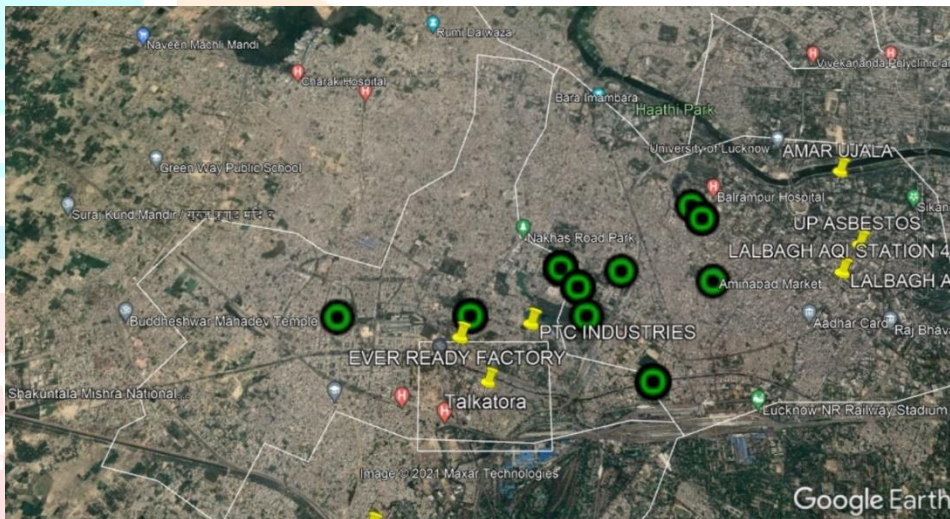


Figure 6: Suitable Sites on Google Earth

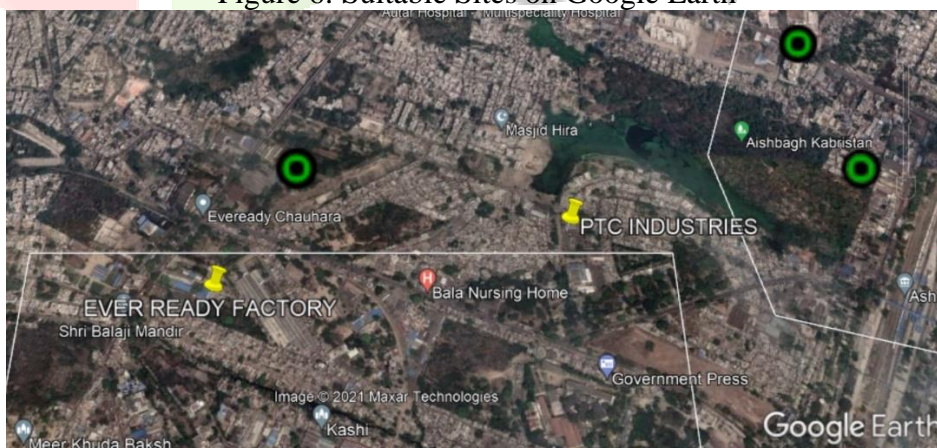


Figure 7: Most Suitable Sites

Conclusions

This study involved the use of GIS that helped capture, process and analyze the geographical data, it proved to be an efficient tool to locate most suitable site for the installation of smog tower. There is one suggestion based on this study that number of monitoring stations installed must increase in the periphery of the Lucknow city as it is expanding with the growth in economy, more number of stations will help in more accurate analysis.

New methods should be ventured [7,9] to deal with the urban air pollution problem, as it is one of the most complicated issues of the 21st century. This study proves that satellite remote sensing and GIS methods are powerful tool that can be used by policymakers, environmental managers and local authorities to tackle the air pollution problem in urban areas.

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