Jr. of Industrial Pollution Control 22 (1)(2006) pp 161-170
© Enviromedia
Printed in India. All rights reserved

INDUSTRIAL ESTATE PLANNING FOR MANGALORE TALUK IN KARNATAKA, USING REMOTE SENSING AND GIS

LOKESHWARI NAVALGUND*, V. SHREEDHARA AND G.SRINIKETHAN*****

*Department of Chemical Engineering, SDMCET, Dharwad, India
** KSRSAC Bangalore
Department of Chemical Engineering, NITK, Surathkal, India

Key words : Zoning atlas, Pollution, Industrial site selection, Thematic maps, GIS.

ABSTRACT

The present work presents a technique to prepare zoning atlas to classify the environment and risks involved in siting an industry. Based on risks involved in a classified zone, the best-suited industries are recommended. Mangalore city has been taken as the study area for the present work. Sensitivity of study area has been checked in terms of air pollution, surface water pollution and groundwater pollution. The study relies upon the database procured for this purpose from Central Pollution Control Board (CPCB) and Karnataka State Remote Sensing Technology, Bang lore. The database mainly comprises of topographic maps, thematic maps and groundwater information. Buffering and overlaying of the thematic maps have been carried out as per the guidelines of CPCB.

INTRODUCTION

Industrialization is on the increase and so is the environmental pollution due to emissions and waste generated from the industries. The industrial pollution due to its nature has the potential to cause irreversible reaction in the environment and hence is posing a major threat to sustainable development. Some areas or ecosystems are more susceptible to adverse environmental

Correspondence : Lokeshwari Navalgund , Email : lokeshwari_n@yahoo.com

impacts than others; the unplanned and haphazard location of industries might substantially increase the risk to the environment. Presently, regional plans that suggest suitable sites compatible to the surrounding land use do not exist in India. Hence, the industrial entrepreneur is forced to purchase a site convenient to him and then apply for clearances. Environmental planning is a proven tool for reducing the impacts from such risks. Proper siting of newly planned industries and industrial estates is a strong pollution preventive instrument that ensures environmental soundness of the industrial development. Site selection based on environmental criteria with the objective of minimizing adverse environmental impacts is, therefore of vital importance. Zoning atlas is a set of thematic maps, which classify an area according to a set methodology to achieve a certain objectives. It provides solution for all the problems caused by haphazard industrial siting, and also helps in tackling the problem itself.

Objectives of the study

The objective of this work was to present a methodology for preparation of a zoning atlas for siting of industries in Mangalore city using a Geographical Information System (GIS). The Mangalore city has been chosen as the study area because it is well developed in industries and has created lot of pollution problems. It has many rivers, highly populated city for which it has to be protected from pollution. A GIS is an indispensable tool for pollution management. In addition to its powerful capabilities in processing, analyzing and modeling spatial data, GIS provides excellent visualization tools that can be used effectively to present pollution results and alternative solutions to pollution problems. Therefore, the use of GIS can improve not only the analytical capabilities for pollution quality management but also our ability to communicate work results and research findings to the decision makers and the public in general. Arc View and ARC/INFO GIS software's were used in preparing zoning atlas for Mangalore city. The zoning atlas classifies the environment in the district and depicts the pollution tolerating potential of various sites/zones in the district. It also recommends the possible alternate sites for industries through easy-to-read maps. Thus, objectives of preparing a zoning atlas for siting of industries are :

- To effectively use the natural resources and environment data collected us ing remote sensing and conventional method into geographic information system for demarcation of ideal sites for industries.
- To identify appropriate location for industries with optimum cost, time and to prevent risks.

Study area and location

Dakishna Kannada is one of the 27 districts of the state of Karnataka, which is located on west coast of India. Mangalore city in Dakishna Kannada, which is one of the industrialized well developed and well, connected by rail, road and air was taken as study area. The industrially developed is mainly due to the recent development of new Mangalore port, the national highway and konkan railways. The impact of theses industries is studied in this place. The population of taluk is 4, 90,566 as per census record. Gurupur and Netravathi are major rivers of the area with other minor rivers through out the taluk.

METHODOLOGY

CPCB (1995) gives the general guidelines to be adopted while zoning the suitability of an area as per environmental aspects. It is not a comprehensive draft. Certain aspects, depending upon the study area, are discretionary. The entire methodology has been divided into following steps as follows

Maps and data acquisition

Maps and data related to air quality and surface water parameters were acquired from KSRSAC office in Banaglore. Required topographic sheets, thematic maps and data were taken and converted into digital form. The three topographic sheets, covering the study area at 1:50,000 scale (48k/16, 481/13 and 48p/l) published by Survey of India (SOI) were scanned to convert them into digital form and mosaic has been made.

Georeferencing

Assigning of ground coordinates to digital database of the previous step by means of georeferencing and resampling operations respectively. For carrying outgeometric correction, the mosaic map was georeferenced. The study area is located between the north longitude 74° 45'and between east latitude.

Generation of thematic maps

Thematic maps covering air quality, land use, sensitive zone, ground water quality, river pollution stretch, ground water potential and surface water dependency were generated from the maps obtained from KSRSAC.

Overlay operations on thematic maps

Methodology to be adopted for the assessment of air pollution, surface water pollution and groundwater pollution sensitivities has been explained in detail. Performing various overlay operations on the thematic layers as per the guidelines by making use of GIS environment.

Zoning of suitable areas

According to CPCB (1997), every air polluting industry hasbeen categorized into three classes, depending on the air pollution they cause. Similarly, surface water polluting industry and groundwater polluting industries have been classified into three classes, which are discussed later.

Sensitivity assessment

Sensitivity assessment means determination of the vulnerability of area towards air, surface water and groundwater pollution. This vulnerability is measured in terms of three classes-high, medium and low sensitive areas. The sensitivity of an area due to pollution from industries needs to be evaluated so

as to minimize the environmental impacts and risks. The major components of the sensitivity are :

- ★ Air pollution sensitivity
- ★ Groundwater pollution sensitivity
- ★ Surface water pollution sensitivity

Based on the sensitivity as above, the site suitability to receive a particular type of pollution and hence the type of industry can be determined. Sensitive zone map is the map showing all the zones where industries are prohibited due to legal/social reasons. This map was overlaid on each of the air, surface water and groundwater pollution sensitivity map to calculate the risk map that shows the remaining areas available for siting of industries along with their sensitivities. Risk map differs with sensitivity map only in the manner that they also include the areas where industrial siting cannot be done due to legal or social reasons.

Air pollution sensitivity

The sensitivity of the environment due to air pollution depends on the meteorological characteristics of the receiving environment, the topography of the area and the present air quality. The meteorology and the topography of the area have to be studied to analyze how well the area is able to accept or disperse the pollutants. The existing air quality has to be checked so that the areas already stressed with pollution are not further stressed by more industrialization. The air quality map provides information about the status of ambient air quality in the district, the ambient air quality is depicted as high, medium and low sensitive ones. The high air sensitive means that the level of concentration of pollutant in the air is very high and no more industries can be located. The medium air sensitive means that the level of concentration of pollutants in ambient air is not exceeding the prescribed standard but is very close to the standards. The low air sensitive means that the air pollutant concentration is within the standards. In dispersion sensitivity the high sensitive areas should be those that are beyond a distance of 5 km from the high air quality areas and 2 km from medium air quality areas. Applying buffering operations at the boundaries of high, medium and low air sensitive regions should generate the air pollution sensitivity map. The low sensitive regions should extend 2 km from areas having high air quality. Also, it should extend 25 km to sensitive zones such as national parks, sanctuaries, areas with endangered species, etc. and monument areas of special significance.

Air polluting industries

These are which emit any solid, liquid or gaseous substances into the atmosphere in such concentrations, which may be or tend to be injurious to human beings or other living creatures or plants or environment.

A l category : Industries with emissions from combustion of fuels using coal 125 t/hr or equivalent fuel or industries having process emissions emitted through organized let out system or having fugitive emissions or odor nuisance or industries generating noise levels >90 dBA.

A 2 category : Industries with combustion emissions from usage of coal < 125 t/hr or equivalent or generating noise levels between 70-90 dBA or having diesel generator sets of capacity > 50 KVA.

A 3 category : Industries having emissions only from boilers of steam generation capacity less than 2 t/hr but using coal or noise of < 70 dBA or using diesel generator sets of capacity up to 50 KVA

Surface water pollution sensitivity

Sensitivity of an area to surface water pollution depends upon surface water use; quality of surface water and surface water flow. The corresponding georeferenced thematic maps are studied, categorized and overlay operations are performed to measure the overall surface water pollution sensitivity of the area in terms of three classes high, medium and low. The water quality in the areas where surface water is used for drinking purpose is high because it is supplied to the areas after disinfections and no conventional treatment is done. Drainage basin of the river should be considered as high if 90% of the year has its flow rate greater than 100 cum/sec, medium if 90% of the year has its flow rate between 1-100 cum/sec and low if its flow rate is less than 1 cum/sec over the year. River Netravati basin is classified as high on the basis of observed facts.

Groundwater pollution sensitivity

Sensitivity of an area to groundwater pollution depends upon quality of ground water, groundwater use, groundwater potential, and groundwater table and infiltration rate through soil. The corresponding georeferenced thematic maps are studied, categorized and overlaid to find the sensitivity of an area due to groundwater pollution in terms of three classes high, medium and low. The groundwater quality map represents the quality of groundwater in the district with respect to drinking and irrigation purposes. The quality of groundwater should be indicated as high in those areas where water is potable and low in those areas where it is not even fit for irrigation purposes. Medium quality areas are those areas where water is fit for irrigation purposes but does not fit for drinking purposes. According to CPCB (1995) groundwater use should be considered as high if it is used for drinking purposes and low if used otherwise.

Water polluting industries

Water polluting industries are those which contaminate or likely to contaminate or alter the physical, chemical or biological properties of water or discharge any sewage or trade effluent or any other liquid, gaseous or solid substance into water (directly or indirectly) as may, or is likely to create nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms.

W 1 category : Industries generating wastewater of inorganic nature or organic waste of not easily biodegradable or toxic nature or combination of all.

W2 category: Industries generating wastewater, which is easily biodegradable and non-toxic, industries generating slurries and high temperature effluent.
W 3 category : Industries with wastewater from domestic use/cooling or boiler blow down (having no temperature variation and metals or other contaminants) or generating no wastewater or industries with complete recycling system/ reutilization with zero discharge.

Solid waste generating industries

Industries that generate solid waste and hazardous waste are classified as solid waste generating industries, which cause groundwater pollution at the dumpsites. They are further classified as below :

S 1 category : Industries generating hazardous waste and as defined under rule 3(i), 3(n) and 4 of Hazardous Waste Management and Handling Rules, 1989.
S 2 category : Industries generating inorganic and organic compost able waste and all wastes with leach ate potential.
S 3 category : Industries generating solid waste of inert nature or no waste or with recycling arrangements.

RESULTS AND DISCUSSION

The zoning of area has been done based on the sensitivity to air pollution, surface water pollution and groundwater pollution and sensitivity maps prepared. To determine the industries that fit into a particular zone, the pollution generation potential of the industries is to be determined. Classification of industries is based on the air, surface water and groundwater pollution they

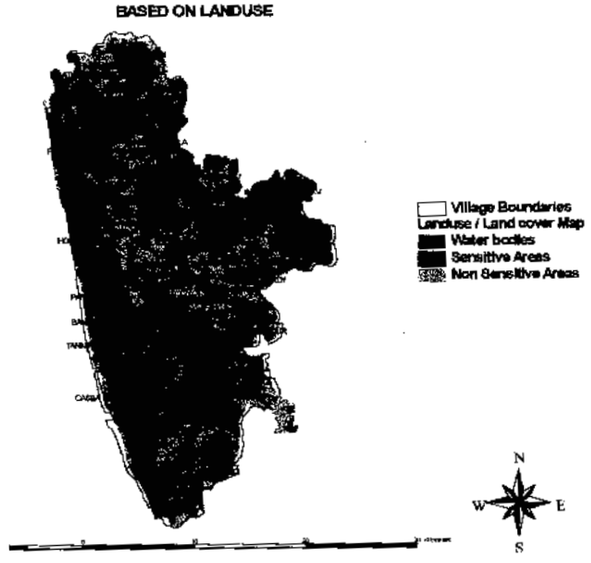

Fig. 1 Based on land use

cause. Based on this, type of industries is recommended in the classified zones of risk maps. Many industries cause air pollution as well as surface water pollution together. Their combined suitability is determined in industrial suitability map by combining air pollution sensitivity map, surface water pollution sensitivity map and sensitive zone map.

In present study to identify suitable location for siting industries different

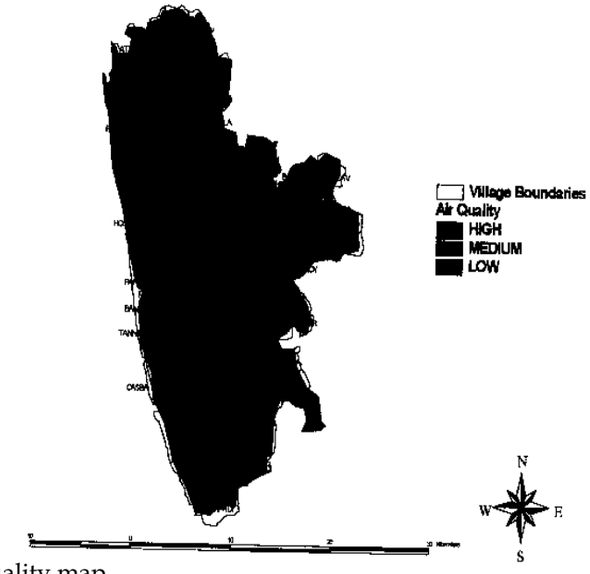

Fig. 2 Air quality map

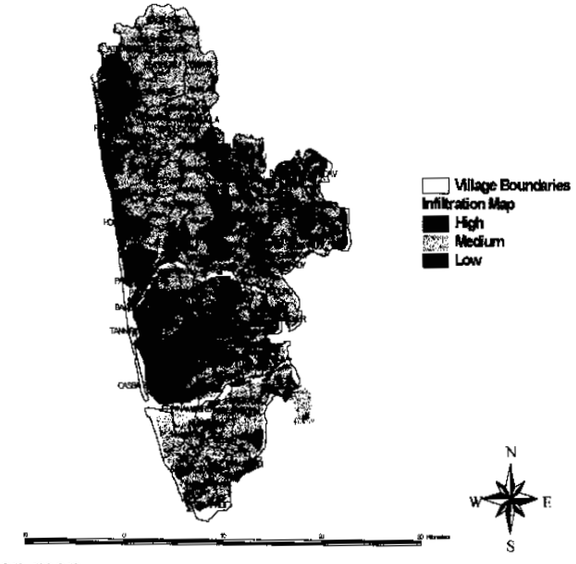

Fig. 3 Infiltration map

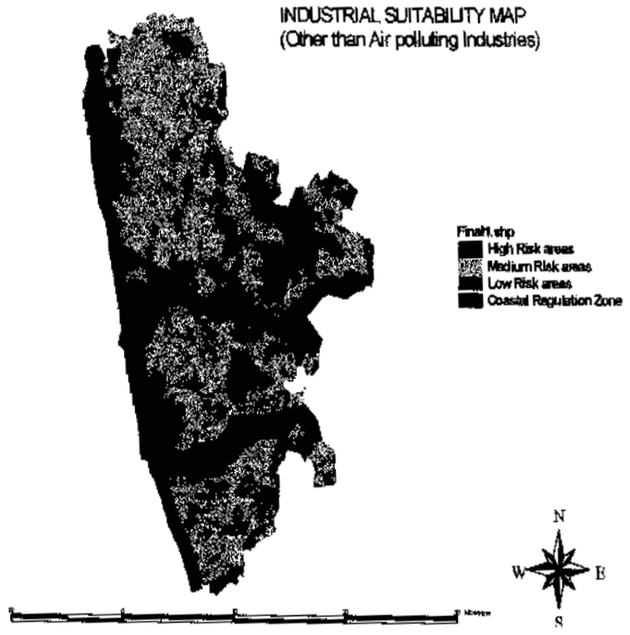

Fig. 4 Final industrial suitability map

resource maps are essential. Therefore remote sensing techniques were used to generate database. Land use/ Land cover integrated with CRZ map shows the sensitive area, non-sensitive area and water bodies. No industrial activity is allowed in sensitive area. CRZ is the Coastal Regulation Zone, which was taken into consideration as per the CPCB guidelines, where industries cannot be located. It also includes all the sensitive areas as per the guidelines of CPCB, which includes agriculture land. It is shown in Figure 1. Air quality map shows the high, medium and low sensitive areas. No air polluting industries are allowed in high sensitive area zone. It is the south part of Mangalore taluk that has most of the major and minor industries located and it is polluted and no more industries can be located in that region. Even though north part of the area shows the low sensitive zone industries cannot be located because the final suitability map prepared shows it is sensitive area because of lands, river and coastal zone. It is shown in Figure 2. The slope infiltration map integrated with CRZ map shows the high sensitivity zones were no water polluting activities are allowed. Though the low and medium areas are shown for locating water-polluting industries it is not permitted because of lands and sensitive areas. It is shown in Figure 3.

All these maps are integrated and site suitability for industries was developed based on the guidelines of ministry of environment. Hence it can be seen that Mangalore taluk cannot be located with any industries as it has rivers, CRZ regulation and sensitive zones. It is shown in Figure 4.

Limitations of zoning atlas

The zoning atlas, besides its several advantages suffers from the following limitations :

1. The zoning atlas considers only the environmental aspects. It is beyond the scope of the present work to look into economic aspects such as availability of raw material, market, labor etc.
2. The atlas is prepared mostly on the basis of available information as it is very expensive and time consuming to gather primary data.
3. This atlas provides only the macro-level aspects. For micro-level planning, detailed studies have to be carried out. The information provided by the set of maps should primarily be used for reconnaissance of the planning area.
4. The atlas and recommendations have been developed based on the current scenario of the area. The atlas needs modification/updating as and when the scenario of land use or the environmental quality or any theme (data/ information) relating to air/water pollution sensitivity changes.

CONCLUSION

The industrializations is on the increase without due concern to the environment and ecological impacts. The haphazard unplanned and unscientific siting of industries effects the environment very seriously. In order to prepare site suitability for industries various land resources and other pollution data of air quality, groundwater and surface water quality of the study area are essential. Remote sensing technique is an act tool for generating spatial resource information. In present study maps taken were landuse, soil, slope, drainage, base maps etc. In present study ARC/INFO version 7.1 and Arc view was used to integrate and analysis. A guideline given my ministry of environment and ecology was used for preparing the criterion for locating industries.

Manual integration is a difficult task, therefore GIS were employed to carry out the integration and to locate the suitable sites. The final map of Mangalore taluk that is the industrial suitability map shows that their cant be any location of industries, mainly because of rivers and the pollution level is also high at most of the regions. Hence atlas for siting industries prepared using remote sensing and GIS has given approaching results and is excellent tool for such kind of studies.

ACKNOWLEDGMENT

Authors thank the Department of Chemical engineering, NITK Surathkal, and the staff of KSRSAC, Bangalore and KSCST Bangalore for helping in carrying out the project.

REFERENCES

Census of India, 1991. Dist of Census of Handbook of Dakshina Kannada.
CPCB, 1995. Manual for Preparation of Zoning Atlas for Siting of Industries. Project

report submitted to Ministry of Environment and Forest.
CPCB, 1997. Zoning Atlas for Siting of Industries (based on environmental consideration).
CPCB, 1998. Environmental Management Plan. ESRI Manuals of ARC/INFO and Arc View, 1997
Gupta, S.K., 2000. A Novel Approach for Assessment of Action Plan Schemes on Water Quality of River Ganga.
Mather, P.M. 1987. Computer Processing of Remotely Sensed Images, John Wiley and Sons, New York
KSCST, 1997. Landuse/Landcover mapping for landuse plan of Dakishna Kannada.
KSRSAC, 1998. Inventory of Dakshina Kannada Dist, Karnataka using Remote-sensing techniques.
Rao, D.P. 1978. *Remote Sensing Techniques*.

A HAND BOOK OF EFFLUENTTREATMENT PLANTS
by Maehajabin Shaikh

- Contents
- Effluent Treatment Plants
- ETP Units
- Grit Chamber
- Oil and Grese Trap
- Equalization Tank and Neutralization Tank
- Chemical Coagulation and Flocculation
- Chemical Effding System
- Mixing Tanks
- Primary Settling Tank/ Clariflocculator
- Activated Sludge Process
- Pressure Sand Filter
- Activated Carbon Coloumn
- Electrical and Mechanical Equipment of ETP
- Electrical and Mechanical Equipment of ETP
- Clariflocculators
- Areation Equipment
- Pumps, Piping, Valves
- Operation and Maintenance of Electrical and Mechanical Equipments of an ETP
- ETP Workshop Facilities
- Start-up Procedure-Commissioning of ETP
- Start up Procedure of an ETP
- Commissioning of ETP
- Normal Operation, Shut-Down Operation and Power Failure Op eration of Mechanical Units
- ETP Chemicals
- ETP Chemicals and Handling
- ETP Laboratory
- Wastewater Sampling
- Laboratory Facilities
- General
- Record Keeping
- House Keeping
- ETP Personnel
- Safety Aspects in Operation of ETP
- Cost Effectiveness and Estimation of Operational Cost Expenses
- Green Belt Development
- List of Indian Standards and Speci fications (IS) on Wastewater Treatment, Published by Bureau of Indian Standards
- Important Definitions
- List of Suppliers

Price : Rs. 550.00

ORDER TO :

ENVIRO MEDIA
Post Box No. 90, 2nd Floor, Roahan Heights, Karad - 415 110, India
Email : str_rktem@sancharnet.in, rktem@pn3.vsnl.net.in