

PLANNING PROPOSALS FOR CHEMICAL INDUSTRIAL TOWNSHIP – STUDY OF VAPI GIDC AND DAHEJ PHASE 1

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ABSTRACT

Industrial growth is the urgent need for the young Indian economy, which is rearing to create employment on its way to growth. In the coming decades, a democratic India will witness the rise of over 400 cities as dense urban conglomerates, which will catapult it into becoming one of the leading economies of the world. Industrial Townships offer great opportunities not only for enhanced employment but also for redefinition of social, environmental and economically equitable work-play-life solutions through demonstratively inclusive business models. Without proper zoning of industries and not providing proper buffers industries lead to haphazard and uncontrolled growth. In this paper attempt has been made to study the issues in Vapi GIDC and Dahej phase-1 due to chemical industries. The industries are classified according to MoEF guidelines into Red, Orange and Green industries. Planning proposals are given by proper zoning of these industries and implementing required buffer zone which will overcome existing issues.

Keywords: Industrial Township, Chemical industries, Buffer for industries, MoEF classification of industries

1. Introduction

Urbanisation is taking place at a faster rate in India. Population residing in urban areas in India, according to 1901 census, was 11.4%. This count increased to 28.53% according to 2001 census, and crossing 30% as per 2011 census, standing at 31.16%. Industrialisation is the period of social and economic change that transforms a human group from an agrarian society into an industrial one, involving the extensive re-organisation of an economy for the purpose of manufacturing.

The industries should have controlled growth and there should be optimum use of land. Maximum landuse should be there. If the growth is not controlled, there will be haphazard growth which may result in deterioration of environment, humans and wildlife.

Constant air and water pollution are affecting the quality of human lives with its harmful pollutants. The rapid growth of industries is leaving harmful effects on the human life, by polluting water and air. The impact of industrialization on the environment needs to be emphasized with more intensity and feeling as the world is quietly but surely facing destruction from man-made follies.

Planners play an important role in the growth of industries. The growth pattern of industries can be controlled proper planning. Industries should be planned according to some byelaws and policies. Government has certain policies which help in controlling the haphazard growth of industries.

Implication of certain byelaws and buffer zones by planners can reduce the extent of damage to environment by industries to a lower level.

By good planning industrial site should be kept away from habitats and wildlife thus reducing its adverse effect on them. Also, by proper planning and zoning of industries their pollution rate can be reduced to a certain extent. It will help in sustainable growth of industries in our environment.

Proper planning proposals can help to improve the ecological conditions of industries and maintain the balance in environment.

This paper discusses about the effort made to analyse the existing planning of industrial setup at Vapi GIDC and Dahej phase-1. The detailed analysis shows that scope for better planning option for the study area. By adopting various guidelines, byelaws and advance research are assessed for study area and detailed proposals are prepared and narrated as under.

2. Study Area Profile

Vapi GIDC

Vapi is located in Valsad district in the Indian state of Gujarat. It is situated on the bank of Damanganga River in southern Gujarat. It is surrounded by Union Territories of Daman on the west and by Dadra and Nagar Haveli on the east. The Arabian Sea is about 7 km to the west, where the Daman Ganga River creates its delta. Total area under Vapi Municipality including Chala and Dungara is 22.42 sq. km. The development of "Vapi Industrial Estate" was started by GIDC in 1967, which has spread over 11.4 sq. km and houses over 1500 industries, majority of which are SSIs.

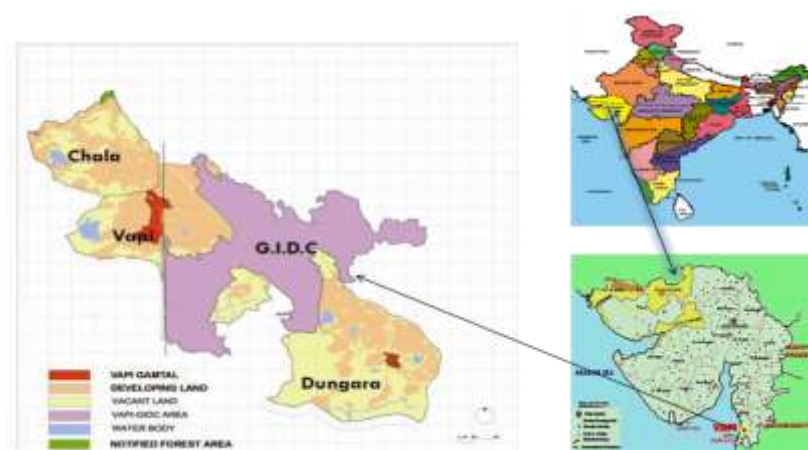


Figure 1 Location of Vapi GIDC

Today, the GIDC area predominantly hosts Chemical plants to the extent of about 70% of the total industries which mainly includes Chemical Distillation, Pesticides, Dyes, Dyes intermediaries and paints.

Dahej Phase-1

Dahej is located in the Gulf of Cambay in Bharuch district. It is about 45 km from Bharuch, which is now being connected to the Port of Dahej by a broad gauge rail siding with an initial capacity of 25-30 rakes a day. The nearest airports are at Ahmedabad, Surat and Baroda.

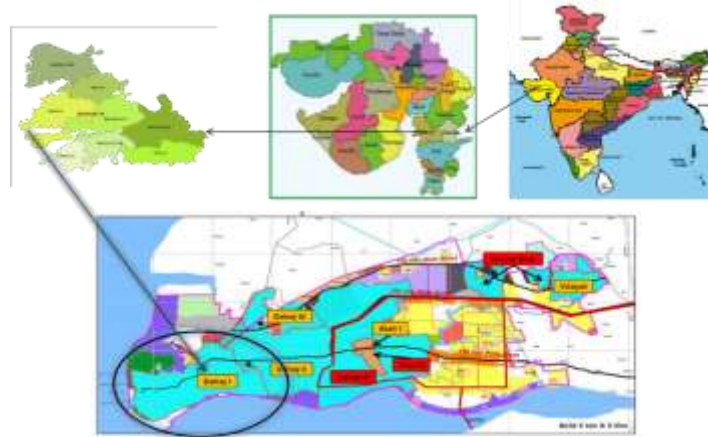


Figure 2 Location of Dahej phase-1

Network linkages

Vapi is situated at 40 Kms South of Valsad district. Daman, is at 20 kms in West of Vapi and Silvassa is 22 kms from Vapi.

National Highway No. 08, part of Golden Corridor, is one of the most busy corridors passes through city and connects Mumbai with Ahmedabad. Mumbai- Ahmedabad- Delhi broad gauge railway line of Western Railway passes through the city.

It is about 45 kilometres from Bharuch, which is now being connected to the Port of Dahej by a broad gauge rail siding with an initial capacity of 25-30 rakes a day. The nearest airports are at Ahmedabad, Surat and Baroda.

Existing Industries Scenario

Vapi GIDC

Vapi industrial estate was planned and developed by Gujarat Industrial Development Corporation way back in 1967-68; the chemical zone has evolved as a natural cluster over this period. The Estate, which was developed in 4 phases, now spreads over 1140 hectares and houses around fifteen hundred industries, most of which are SSI units. Vapi GIDC Estate is a Notified Area and all civic functions are performed by the Notified Area Authority.

About 70% of industries are chemical and remaining 30% are involved in paper, plastic engineering, textile, etc. Also it provides direct employment to the tune of 60,000 in addition to indirect employment to lakhs of people

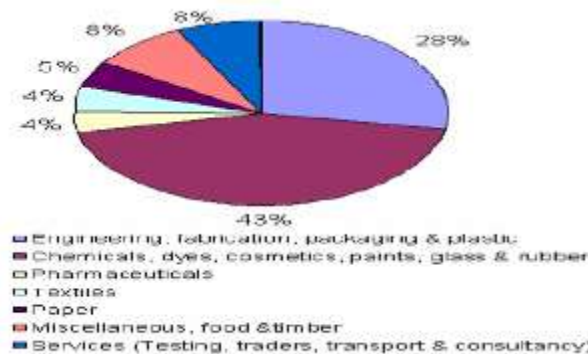


Figure 3 Industries in Vapi GIDC

Dahej phase-1

It has total area about 4000 ha. And it has major 30 companies working. It is connected to Bharuch by state highway.

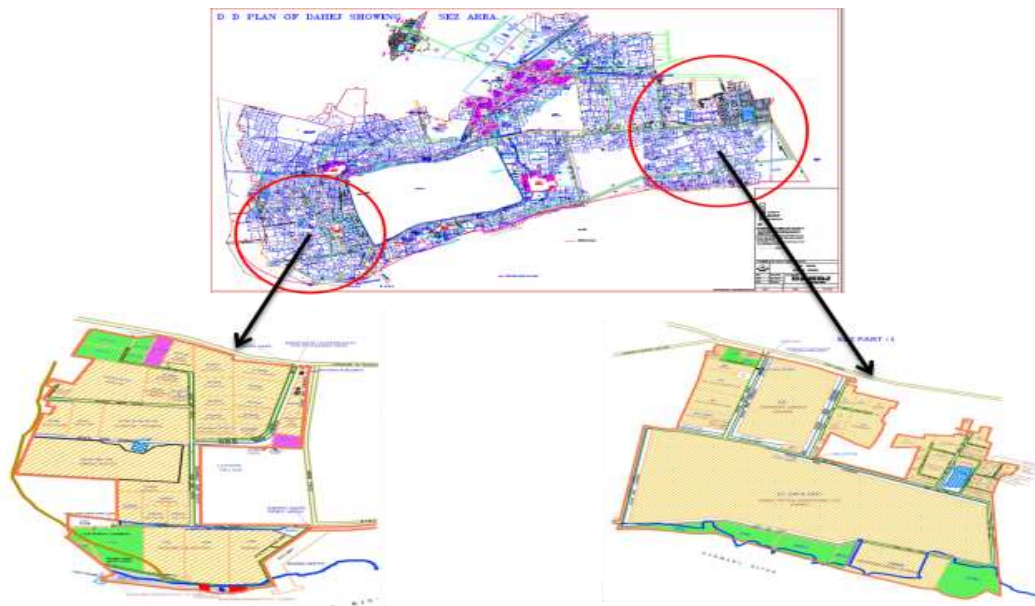


Figure 4 Location of Dahej SEZ

Dahej phase-1 also has SEZ areas in two parts, one at east and other at west. It also comes under PCPIR policy of Govt. for Chemical and Petrochemical industries.

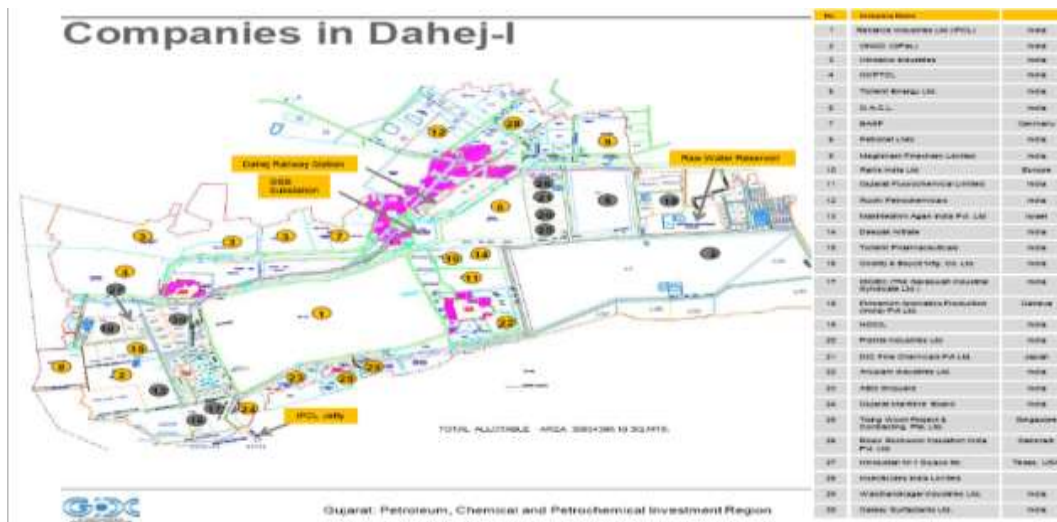


Figure 5 Industries in Dahej Phase-1

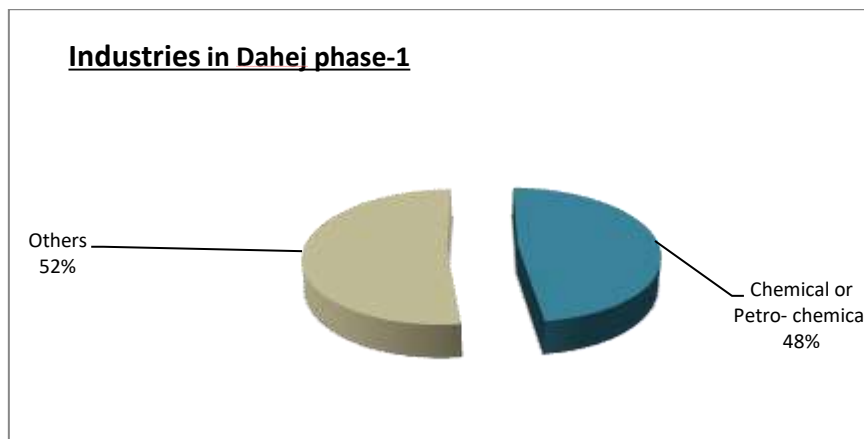
3. Data Collection and Analysis

For planning an industrial township, first knowledge about various industries is important. So, initial step is to acquire the data from most common sources as GIDC office and Nagar Palika.

Effective and sustainable planning of Industrial Township can be possible if the data relates to the each component is collected from the authentic source at the micro level. Following table shows the data and its source-

Table 1 Sources of Data

Sr. No.	Description	Source
1	Development Regulations in GIDC premises	GIDC
2	Guidelines for SEZ area	SEZ website dahejsez.com
3	Development control regulations for PCPIR	PCPIR policy
4	List of companies in Vapi	VIA (Vapi Industrial Association)
5	List of companies in Dahej phase 1	GIDC Bharuch
6	Vapi City Development plan	Nagar Palika, Vapi
7	Guidelines for Buffer zone	Book (Landscaping- Buffering and Tree Preservation)
8	Presentation and reports	GIDC and SIR
9	Draft development plan	GIDC

Existing Industries in Dahej phase-1**Figure 6 Industries in Dahej Phase-1**

Above pie chart shows that out of total industries in Dahej phase-1 48% are chemical and petrochemical industries.

Existing Industries in Vapi GIDC

Following are the various types of industries in Vapi-

- Chemical/Dyes/Pharmaceuticals/Scientific Glasses- 830
- Plastic- 1
- Electronics/Electrical/Instrumentation- 470
- Textile- 2
- Transport- 4
- Engineering- 849
- Machinery- 1
- Leather/Rubber- 35
- Paper and Packaging- 34
- Miscellaneous- 453

Following pie chart shows that about 70% of industries in Vapi GIDC are chemical industries. Vapi GIDC is one of the biggest chemical industrial clusters in India.

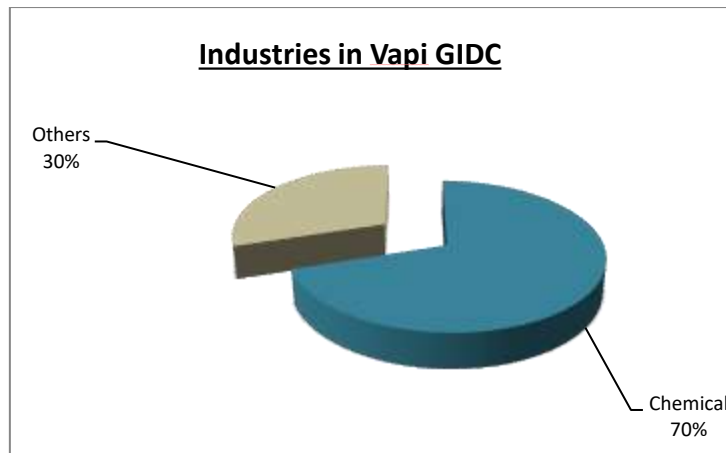


Figure 7 Industries in Vapi GIDC

According to MoEF guidelines existing industries in Vapi GIDC and Dahej phase-1 are classified under Red, Orange and Green categories. Figures below are showing the percentage of Red, Orange and Green industries in Vapi GIDC and Dahej phase-1.

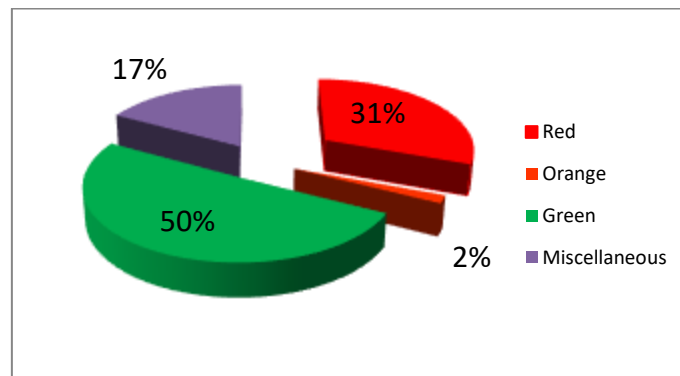


Figure 8 Vapi GIDC

It shows half of the industries existing Vapi comes under Green category.

The pie chart below shows in Dahej phase-1 60% of total industries are Red category industries.

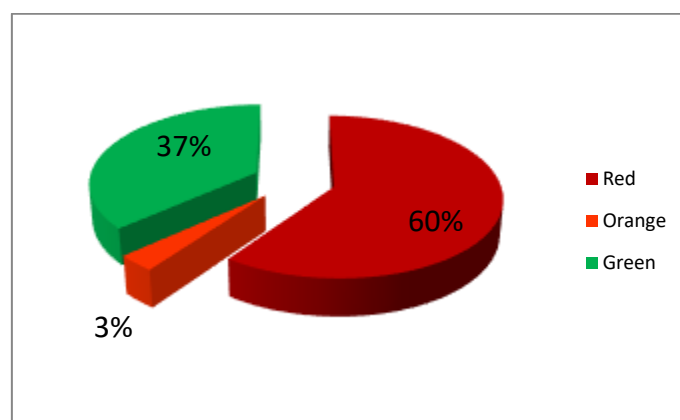


Figure 9 Dahej Phase-1

Colour code Mapping

On the basis of categorization of industries in Red, Orange and Green colour, their plots are marked and colour code map is made. This colour code map shows different coloured plots according to their pollution category.

The figure below shows the plots in Vapi GIDC as Red, Green and Orange category on the basis of type of industry.

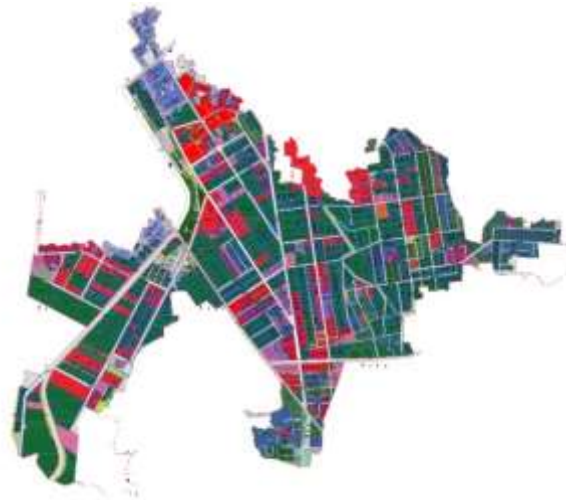


Figure 10 Vapi GIDC Colour code map

The figure below shows the plots of Dahej phase-1 marked as Red, Orange and Green industries.



Figure 11 Dahej phase-1 Colour code map

Industry Plot Area Percentage

This shows area of industries coming under Red, Orange and Green category for Vapi GIDC and Dahej phase-1.

About 50% of total industrial area of Vapi GIDC comes under Green category industries. In Dahej phase-1 87% of total industrial area is under Red category industries. Also, the development regulations of GIDC differ from GDCR in many aspects.

4. Planning Proposals

Proposals have been given for the development of Chemical Industrial Township in Dahej based on the issues identified in the study. Proposals are made for vision of future development of Chemical and Petrochemical industries in Dahej. The proposals are given based on the literature review and the existing industries scenario in Vapi GIDC and Dahej phase 1.

Planning proposal for Chemical Industrial Township

Based on the survey and casual talk with the experts, self-observation and data analysis for industries site is selected for the planning of Chemical Industrial Township Dahej.

Site Location

- The site is located in Dahej nearby Dahej-Bharuch state highway.
- It is almost at the centre region of Dahej.
- It is surrounded by Atali 2 on East side and Dahej phase-2 on the west side of the site.
- It has good connectivity with Bharuch by existing state highway.
- It fulfils the environmental guidelines for industrial location.



Figure 12 Proposed Site

Above figure shows the location of proposed site for township.

This site fulfils the following environmental guidelines (Acc. To UDPFI) for Industrial Township location-

- 0.5 km away from high tide line.
- 25 km away from Ecological and sensitive areas.
- 0.5 km away from flood plain.
- 0.5 km away from highway and railway.
- 50 km away from major settlements (3,00,000 population).
- Green belt between large scale industries.
- No forest land shall be converted to non-forest activity.

Conceptual Plan Alternative-1

- This plan is based on the concept of Garden city given by Ebenezer Howard.
- The landuse for residential and industries is having concentric pattern.

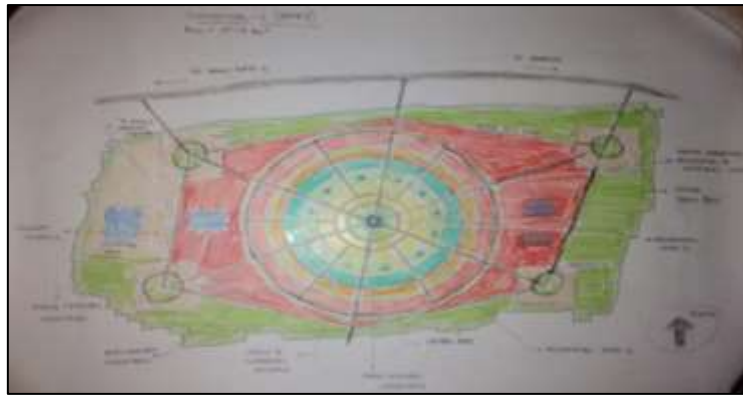


Figure 13 Conceptual Plan 1

Conceptual Plan Alternative-2

- This conceptual plan is made considering the wind direction.
- It has more number of roads connected to state highway to Bharuch thus making transportation easy.
- Following figure shows the wind rose diagram for the proposed site.
- Direction of the wind is from South-West.

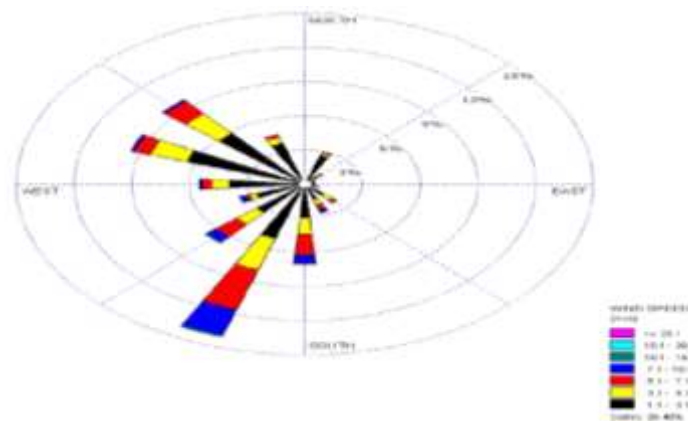


Figure 14 Wind rose diagram for Dahej

The maximum intensity of wind is from South-West direction as shown in figure.

So, industries should be kept in North-East direction so as to reduce the effect of air pollution on residential zone.

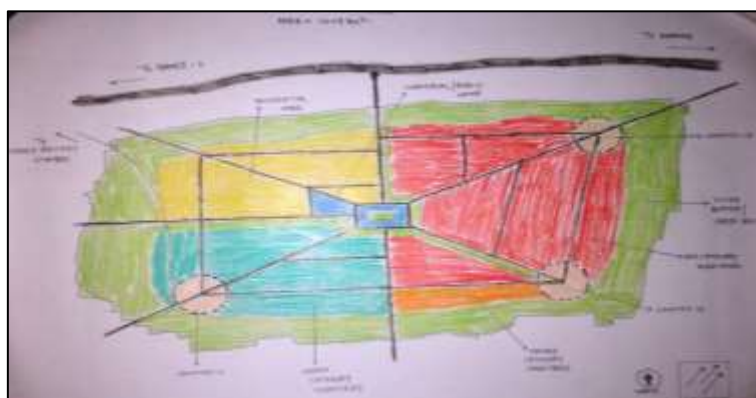


Figure 15 Conceptual Plan 2

Conceptual Plan Alternative-3

- This conceptual plan is based on block or rectangular pattern of roads.
- Wind flow direction in the vicinity has not been considered.
- Rectangular blocks are given all over the site.
- Roads are crossing each other at 90° resulting in good shapes of plots.



Figure 16 Conceptual Plan 3

After SWOT analysis of these three conceptual plans, conceptual plan 2 satisfies all environmental, UDPFI and other essentials guidelines. The detail conceptual plan 2 proposal is in Appendix.

Conceptual plan 2 provides proper zoning of industries and has good road network all around township connecting highway and all logistic parks. Also, residential zone is separated from industries and having buffer zone in middle protecting it from harmful effect of industries.

Table 2 Comparison of Conceptual Plans

Analysis	Conceptual 1	Conceptual 2	Conceptual 3
Strength	<ul style="list-style-type: none"> • Based on Garden city concept. • Circular road pattern. 	<ul style="list-style-type: none"> • Proper zoning of industries. • Good connectivity of roads. 	<ul style="list-style-type: none"> • Plan is based on block pattern. • Rectangular blocks are given to industries.
Weakness	<ul style="list-style-type: none"> • Residential zone is surrounded by chemical industries. 	<ul style="list-style-type: none"> • Commercial zone surrounded by industries. 	<ul style="list-style-type: none"> • Residential zone is in middle of site. • Logistics connectivity is not good.
Opportunity	<ul style="list-style-type: none"> • Generation of employment. • Labour requirement generated. 	<ul style="list-style-type: none"> • Investments should be made in chemical and Petro-chemical sectors thereby increasing employment opportunities. • Poor people will 	<ul style="list-style-type: none"> • It attracts investment in Chemical sector. • Labour requirement will increase.

		get work as labours in different industries.	
Threats	<ul style="list-style-type: none"> • Pollution will make the environment unhealthy and unpleasant. 	<ul style="list-style-type: none"> • Value of land will increase. • Buffer zones and green belts may get damaged due to uncontrolled growth of industries. 	<ul style="list-style-type: none"> • Buffer zones may get damaged to unauthorized industrial activities.

Chemical Industrial Township Plan

Based on the above SWOT analysis, conceptual 2 plan is best suited for Chemical Industrial Township. It provides good road network and proper zoning of industries. Also, it has more number of connectivity with highway and good logistics connectivity. Red industries are properly zoned according to wind flow so that residential zone is free from Air pollution. Buffer zones are also provided which protect residential and commercial zone from pollution, noise and bad odours.

Table 3 Comparison with URDPFI

Landuse	Proposal Landuse in %	URDPFI Landuse in %
Residential	20.3	20
Industrial	41.2	40
Commercial	2.3	4
Public and Semi-public	5.8	6
Recreational	18.2	18
Transportation	12.2	12

Following figure shows the Chemical Industrial Township in Dahej-



Figure 17 Chemical Industrial Township

Proposal for Buffer zone

Width of Buffer zone

- A green belt of width 100 meters is provided all around the site hence protecting the nearby area by adverse effect of Chemical industries.
- A separate buffer of 30 meters for Red category industries is provided in order to separate it from other zones.
- A 20 meters buffer is provided around Orange and Green category industries to separate them from residential, commercial and other zones.

Typical Section of buffer zone

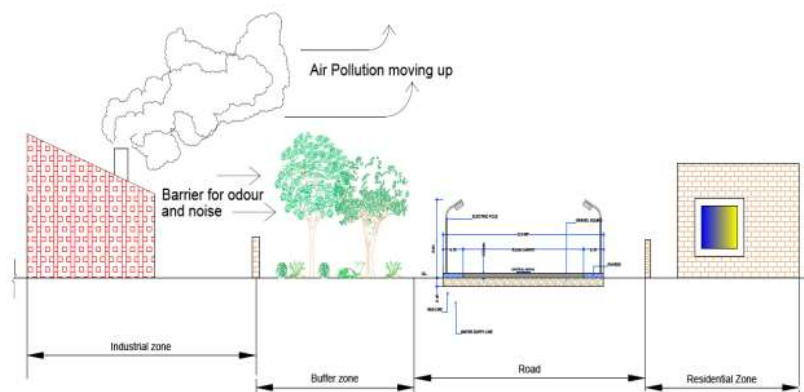


Figure 18 Section of Buffer zone

Proposal for Three-zone buffer concept

The “Three-zone Concept” provides a framework for planning and grouping types of plantings. Combining fast- and slow-growing trees, shrubs, grasses, and forbs helps protect the residential area, waterways and provide a diverse habitat for wildlife.

Zone 1

The trees in this zone help provide streambed and stream bank stability. In the drier portions of Zone 1, hard-woods such as black walnut, red and white oak, and white ash can be planted. Zone 1 is an undisturbed forest area where logging is generally not recommended.

Zone 2

This zone allows the water to infiltrate or percolate into the soil so that water-borne nutrients/pollutants are absorbed and cleansed through vegetation and other natural ecological systems. Zone 2 also provides long-term storage of nutrients in the woody biomass of trees and shrubs. Large trees dominate Zone 2.

Zone 3

Zone 3 is the transition zone between the forested areas in Zones 1 and 2 and adjacent land. Warm and/or cool season grasses are recommended in this zone. Other grasses may be combined with the switch grass to promote wildlife diversity within this zone.

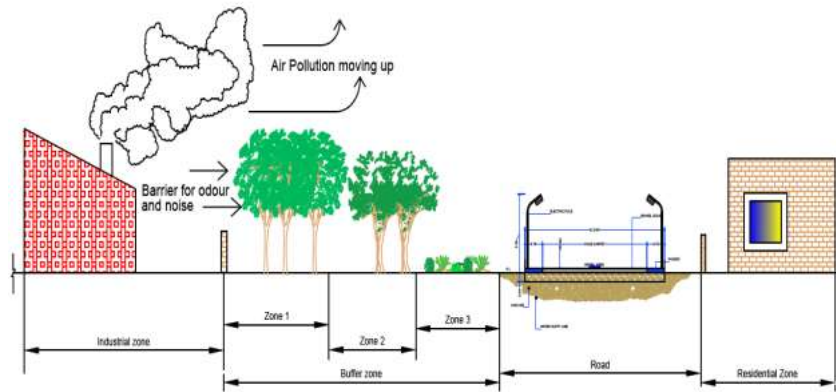


Figure 19 Three zone concept section

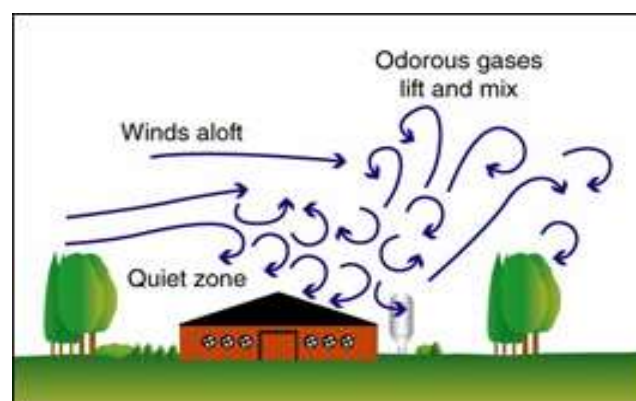


Figure 20 Buffer as Wind break

Proposed species of plants and trees for buffer zone-

Recommended Trees

- American Hophornbeam (*Ostrya virginiana*)
- Bald Cypress (*Taxodium distichum*)
- Bluejack Oak (*Quercus incana*)
- Chickasaw Plum (*Prunus angustifolia*)
- Crepe Myrtle (*Lagerstroemia indica*)
- Eastern Redbud (*Cercis canadensis*)
- Laurel Oak (*Quercus laurifolia*)
- Live Oak (*Quercus virginiana*)
- Loblolly Bay (*Gordonia lasianthus*)
- River Birch (*Betula nigra*)
- Sweetgum (*Liquidambar styraciflua*)
- Sycamore (*Plantanus occidentalis*)
- Tulip Poplar (*Liriodendron tulipifera*)

Recommended Shrubs and Hedges

- Christmas berry (*Lycium carolinianum*)
- Coontie (*Zamia floridana*)
- Coral bean (*Erythrina herbacea*)
- Crinum lily (*Crinum asiaticum*)
- Dwarf Palmetto (*Sabal minor*)
- Fetterbush (*Lyonia lucida*)
- Japanese Plum Yew (*Cephalotaxus harringtonia*)
- Ligustrum (*Ligustrum japonicum* and cvs.)
- Mary Nell Holly (*Ilex 'Mary Nell'*)
- Oakleaf Hydrangea (*Hydrangea quercifolia*)
- Red Star Hibiscus (*Hibiscus coccinea*)
- Simpson's Stopper (*Myrcianthes fragrans*)
- Walter's viburnum (*Viburnum obovatum*)

- Wax Myrtle (*Myrica cerifera*)

Proposal for Type of Industries for Township

Proposed Industrial Township is having three categories of industries based on the MOEF guidelines as Red, Orange and Green industries. Each industry has a certain parameter of pollution on the basis of which it has been classified.

Following list shows the type of industry proposed for these different categories-

Proposed Red Industries

- | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Fertilizer • Paper & Pulp • Pharmaceuticals • Aluminium smelter • Sugar industry • Glass & Fibre glass • Dyes and Dye intermediates • Pesticides • Oil Refinery • Petrochemicals • Zinc Smelter | <ul style="list-style-type: none"> • Synthetic Rubber • Paints & varnishes • Lubricating oils, greases or petroleum based products industry • Phosphorous and its compounds • Hydrocyanic acid and its compounds • Chlorine, bromine, iodine, fluorine and their compounds • Pigments & Intermediates • Petroleum Products • Detergent & soaps |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Proposed Orange Industries

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Fragrances and Industrial perfumes • Non-alcoholic beverages • Surgical and medical products • Laboratory wares and chemicals | <ul style="list-style-type: none"> • Pesticides/Insecticides and Agro chemical formulation • Pharmaceuticals formulation • Hotels and Restaurants |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Proposed Green Industries

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Polythene and PVC goods • Electronics equipment's • Water Softeners • Insulation and other coated papers • Fountain pens | <ul style="list-style-type: none"> • Oil ginning/expelling • Paint (by mixing process only) • Textile • Rubber footwear and goods • Electronic and Electrical goods |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Impact of Chemical Industrial Township-

Regional Perspective

There are 7 notified SEZs including functional Dahej SEZ without any provision for housing. So, this township will provide housing for around 10,000 people who commute from nearby areas like Bharuch (42 km), Ankaleshwar (56km) and Vadodara (111km).

Employment Generation and Housing

The township will result in the generation of employment of about 20,000 people for the local people and people from nearby areas. According to the PCPIR master plan an investment of Rs. 50,000 is expected to generate employment of around 8 lakh people and housing demand of 1 lakh dwelling

units. So, this proposed township will provide housing facilities for 10,000 people and helps to control floating population by providing them all essential facilities.

Environmental Effects and Solid Waste

This proposed township will categorize the industries according to their pollution parameters. It will reduce about 30-40% of existing pollution from residential zone because of proper zoning and proposed buffer zones. The plant species proposed in the buffer zones are capable of absorbing pollution, bad odours and noise hence reducing the pollution to a greater extent. Therefore, there will be tremendous reduction in the pollution level.

This township will encourage energy efficient buildings, eco-friendly transport system and zero waste disposal concept. For STP, WTP and solid waste disposal site 0.045 sq. km area has been proposed. It is at the south of the industrial township nearby Orange industries. It is kept away from residential zone and commercial zone so bad odours will not irritate people of township.

Hypothetical Proposal for Vapi GIDC

An attempt is made to overcome the issues in Vapi GIDC and a hypothetical conceptual proposal has been sketched.



Figure 21 Proposal for Vapi GIDC

Above figure shows the hypothetical conceptual proposal sketch for Vapi GIDC.

Salient features of proposal-

- Vapi having more 50% of Green industries so in proposal about 50% of industrial area is given to Green industries.
- There 3 logistic parks are given for all Red, Orange and Green industries.
- Outer buffer zone to all site is provided in order to separate it from nearby settlements.
- Also, individual buffers are provided to all categories of industries to reduce adverse effects of industries.
- These logistic parks are also connected by a outer ring road connecting NH 8 so that transportation of product does not make inner road congested.
- Residential zone is kept away from Red industries.
- Also NH 8 is passing through residential zone and railway connectivity is also near by.
- CETP is kept near Daman ganga river so that treated effluent will be thrown into it for dilution.

5. Conclusion and Future Scope of Study

The brief about whole study is summarized here after in two parts-

- Analysis of existing industrial setup at Vapi GIDC and Dahej Phase-1
- Planning proposal for Chemical Industrial Township at Dahej

Analysis of existing industrial setup-

Vapi GIDC

About 70% of existing industries are Chemical industries. During analysis the existing industries are classified as Red, Orange and Green categories according to the guidelines given by MOEF. After data analysis it is found that almost half of the industries in Vapi GIDC are in Green category. 63% of total industries are secondary industries. Out of total chemical industries 51% are involved in making basic chemicals.

Also, it has been found that Vapi GIDC has lack of planning and resulting in haphazard growth of industries. Today, it is facing major Air and Water pollution problem. There is no criteria taken for the buffer zone and proper zoning of industries is not there.

Dahej Phase-1

Data analysis for the major 30 existing industries in Dahej Phase-1 has been done. it is found that 48% of these industries are Chemical and Petrochemical industries. Also, 52% industries are secondary industries.

Some of the major industries in Dahej Phase-1 are Reliance, ONGC, Hindalco, etc. In data analysis, it has been found that 60% of the industries are Red category industries which are spreading about 87% of total area of Dahej Phase-1.

Planning proposal for Chemical Industrial Township at Dahej-

Alternative conceptual plans are made and their SWOT analysis is carried out.

The analysis derived that the alternative 2 is the most efficient option for the proposal of township fulfilling most of the required guidelines and the detailed proposal shows the following features-

Area = 15.08 sq. km

Residential zone is provided for workers and labours.

- 10% residential zone is for EWS housing.

More than 40% of landuse is for industries.

Benefits-

- Proper zoning of industries.
- Buffer zones are provided.
- Red, Orange and Green industries are separated.
- Efficient road network.
- All public and commercial amenities are in centre.

The buffer zone considering the type of industry has been proposed.

For Red industries = 30m

Site Buffer = 100m

For Orange and Green industries = 20m

This proposal will generate direct and indirect employment for 20,000 people and results in reduction of present pollution by 30-40%. This township can accommodate around 10,000 people including bungalows, apartments, row houses, etc.

Future Scope

Following points show the work that can be carried out in future-

- Detailed Planning of infrastructure facilities and other spaces like logistics parks for township can be done
- Financial aspects and cost estimation for the township can be done and studied
- Detailed studies for buffer zones manipulation can be carried out.
- Proposal for other types of industries can be added which may have efficient growth
- Planning of individual logistic parks may be an approach for efficient township

References:

- Raymond P. Cote, E. Cohen-Rosenthal “Designing eco-industrial parks: a synthesis of some experiences”(1998), Journal of Cleaner Production
- Yong Geng and Jun Yi, “Integrated water resource management at the industrial park level: A case of the Tianjin Economic Development Area”, (2006), International Journal of Sustainable Development & World Ecology
- Koichiro Akimoto, “Industrial policy and industrial park development in Japan”, (1992), Asian Geographer
- Martin Perry Shaw & Caroline Yoeh, “Singapore's Overseas Industrial Parks”, (2000), Regional Studies
- Pauline Deutz & David Gibbs, “Industrial Ecology and Regional Development: Eco-Industrial Development as Cluster Policy”, (2008), Regional Studies
- Hermann G. Hauthal and Tiina Salonen, “Chemical Industrial Parks in China”, (2007), Leipzig Germany
- Narimah Kasim and Mohm Hilmi Izwan Abd Rahim, “Implementation of Buffer Zone in Industrial Area”, (2014), IEEE, Science & Engg.
- Mohanad El-Harbawi and S. Mustapha, “SCIA: GIS-Based Software for Assessing the Impacts from Chemical Industrial Accidents”, (2010), ASCE
- Nivruti T. Nirgude, Sanjay Shukla and A. Venkatachalam, “PHYSICO-CHEMICAL ANALYSIS OF SOME INDUSTRIAL EFFLUENTS FROM VAPI INDUSTRIAL AREA, GUJARAT, INDIA”, (2013), CODEN: RJCABP
- Mittal Jay and Bayhut Shweta, “Regional Development Dichotomy”, (2014), International Journal of Humanity and Social Science
- Zhijiang Yang, Zhen Hu, and Xiaoyi Wang, “Study on Key Techniques in Pipe Corridor Management - An Example from Shanghai Chemical Industry Park”, (2009), ASCE
- Ming JIAN and Fen CHEN, “Interactive Development Between Manufacturing Industry And Logistics Industry In Sichuan Province”, (2014), ASCE
- Rajesh Kumar, Manoj Sharma, Ashok Srivastava, Jarnail S. Thakur, Surinder, K. Jindal & Harjinder K. Parwana, “Association of Outdoor Air Pollution with Chronic Respiratory

Morbidity in an Industrial Town in Northern India”, (2010), Taylor and Francis

- Kallrath Josef, “Combined strategic and operational planning – an MILP success story in chemical industry”, (2002), Springer
- Panchal Manish and Paradkar Siddharth, “Integrated Development - A key to sustainable growth of Gujarat as a chemical hub”, (2013), Chemical Industry Digest

WEBSITES

- viavapi.org
- dahejsez.com/
- <http://www.gidc.gov.in/>
- gujaratpcpir.org/
- www.vapimunicipality.com
- www.moef.nic.in/
- www.theciip.org
- engineering.dartmouth.edu
- <http://icta.uab.cat/>
- <http://www.dubuquesmartplan.org/>
- <http://www.ieslab.com.cn/en/sitefiles/services/cms/page.aspx?s=1&n=58&c=180>
- <http://www.smartheating.cz/en/smart-industrial-park/>

BOOKS

- “GARDEN CITIES OF TO-MORROW” by Ebenezer howard
- Landscaping- Buffering and Tree preservation

POLICY

- Gujrat Industrial policy 2015
- PCPIR, SEZ and GIDC development control regulations
- Gujrat Integrated Township policy

REPORT

- Vapi CDP
- GPCPSIR Development Plan
- A report on Chemical and Petrochemical Industry in India April 2015
- Riparian forest buffer design, establishment and maintenance
- Windbreak Plant species for Odour management by NRCS