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ENVIRONMENTAL ECONOMICS RESEARCH COMMITTEE

Theme: Environment, Health and Economics
EERC Working Paper Series: EHE-4

Estimating the Environmental Cost of Industrialisation in Gujarat: A Case Study of Ankleshwar GIDC

Maya Shah and Ashir Mehta

M S University, Baroda

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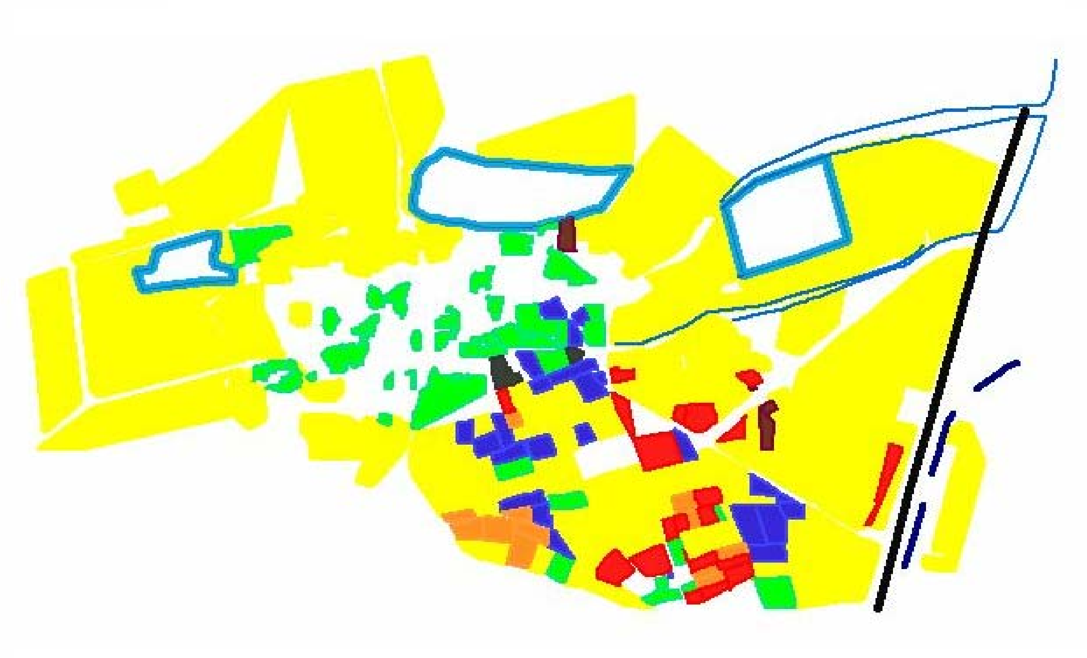
ESTIMATING THE ENVIRONMENTAL COST OF INDUSTRIALIZATION IN GUJARAT - A CASE STUDY OF ANKLESHWAR GIDC

MAYA SHAH



UNDER
WORLD BANK AIDED INDIA ENVIRONMENTAL MANAGEMENT
CAPACITY BUILDING TECHNICAL ASSISTANCE PROJECT

CO-ORDINATED BY
EERC IMPLEMENTATION CELL AT
INDIRA GANDHI INSTITUTE FOR DEVELOPMENT RESEARCH, MUMBAI

DEPARTMENT OF ECONOMICS
FACULTY OF ARTS
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA
VADODARA - 390 002
JUNE 2003

PREFACE

Countries that want to develop have to industrialise their economies. While industrializing certain costs have to be borne in mind and industrial strategies should be developed accordingly. GIDC is an outcome of an industrial strategy developed by Government of Gujarat – A strategy that was guilty of ignoring the environment totally. We proudly exhibited our Golden Corridor and forgot the gas chamber that was its byproduct. We therefore thought it fit to make an attempt at drawing our attention to the loss of value of physical property created in these industrial areas.

This project is an attempt to apply tools of environmental economics to actual real life situation. It uses techniques of environmental valuation to get an idea about the damage in terms of cost of losing property value for residents of GIDC. On account of paucity of published data on air quality the study also uses peoples' perceptions and their experience in this regard. In a country like ours that is bitten by poverty and unemployment environmental quality may take a back seat. This should not be an excuse for not undertaking such an exercise.

Ankleshwar industrial estate is located on the Mumbai – Ahmedabad highway and houses more than 1000 industrial units. First of all maps for Ankleshwar GIDC and Ankleshwar town were collected and areas from where samples were to be selected were identified. Primary data were collected and statistical techniques were applied to analyse the data. In this exercise large number of people helped us. It is of course not possible to name each and every individual that helped us. Still we attempt to acknowledge our gratitude here by mentioning most of them in our Acknowledgement.

ACKNOWLEDGEMENT

At the outset we express our sense of gratitude to World Bank and to the EERC team for giving us a generous grant of Rs.7,00,000/- to take up this project.

We thank our University authorities for permitting us to take up this project. Our Chief-Account-Officer, Shri N.N. Shah, went out of his way to help us in finalizing our accounts and issuing the necessary utilization certificate.

Dr. N.M. Bhatt, as a consultant, helped us in interpreting the results of water samples that we collected from different houses, analysing the water samples in his laboratory and making the data on air pollution available to us. He has been of great help to us.

Mr Yogesh Manohar of the Geography Department digitized the maps, colour coded them and even went to Ankleshwar GIDC, and Municipality office with our field investigators to get the required information. We appreciate his help.

Dr. Madhu Verma of Indian Institute of Forest Management, Bhopal, had been very helpful and made very valuable suggestions to us when we, alongwith Prof. Sudershan Iyengar, visited her institute for consulting her. She was very kind to us and even gave us Xerox copies of few articles that proved to be of tremendous use to us. We are extremely grateful to her for her help and co-operation. She spared a copy of her Final Report that she had already submitted.

Prof. Sudarshan Iyengar, Director, Gujarat Institute of Development Research, has been excessively kind and supportive of our effort. He was so nice as to respect our request and accompanied us to Bhopal to consult Dr. Madhu Verma. We have been on and off consulting him informally and demanding his time and attention he so generously gave us. Our words fail us in expressing our sense of gratitude to him.

Ms. Sanchita Datta our Research Associate has been a tremendous support to us. She accompanied our field investigators to GIDC and Ankleshwar town every time they went. She trained them and personally supervised data collection. A considerable portion of introduction on Ankleshwar GIDC and data collection has been written by her. She did not allow her marriage to come in the way of our completion of the project. After taking a short break for her marriage she devoted herself completely to the project. I appreciate her commitment and zeal with which she worked. During her absence Mr. Kishore worked for the project and helped us in going ahead with our work. Dr. Ashir Mehta of Economics Dept., M. S. University, was appointed as Co-Principal-Investigator in this project.

Dr. Arup Mitra of Institute of Economic Growth, Delhi, was kind enough to make suggestions for improving our work. Dr. Shreekant Gupta, MIT, USA, has been a tremendous help to us. He sent his comments on our Report of the First Phase and his comments proved to be extremely helpful to us. Not only did he spend his time on commenting on our drafts, methodology etc. but he was so generous as to send us copies of some of the articles that we could not refer to. He even sent us a copy of an article that had gone to press in April 2002. We are really touched by his support, concern and help. Our words fail us in expressing our sense of gratitude towards him.

Prof. Bhavana S. Kantawala, Head, Department of Economics, M.S. University of Baroda, helped us in the econometric exercises we undertook. Her expertise in econometrics clarified many doubts regarding residualisation and interpretation of results. Her knowledge was an asset that we generously used. We acknowledge the help that we received from her with gratitude.

Finally, our departmental and project administrative staff have been extremely helpful and supportive. Dr. Vinod Padaria, Mr. B.C. Patel, Mr. Hemant Chauhan and Mr. Bhupesh Pathak have worked tirelessly, sacrificing even their holidays to help us complete this project in good time inspite of riots in Gujarat. We are touched by their commitment and loyalty.

Inspite of all the help and support from excellent people some errors, omissions and limitations are bound to remain. For these lapses nobody but the author alone is responsible.

6th June 2003 Maya Shah

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Section – I: Introduction

Industrialisation is considered to be an instrument for economic development. In our zeal to industrialise we offer all sorts of concessions and other carrots to attract capital from within and without a geographical area. Gujarat tried to encourage industrilisation by offering infrastructural facilities for small and medium scale industrial units by establishing Gujarat Industrial Development Corporation [GIDC] in 1962. The Government of Gujarat [GOG] succeeded to a certain extent and Gujarat became one of the highly industrialized states of our country.

"Gujarat ranked eighth in industrial development among the major states in India in 1960, the year in which it came into existence", [Hirway, 1999 pp.251]. As a result of our policies we not only industrialized at a faster rate but also succeeded in changing our industrial composition. The composition of industries in the state shifted from a largely textile based manufacturing to production of chemical product, petrochemicals, pharmaceuticals, metal and metal products, petroleum products, plastic etc.

Table – 1: Industrial Growth* in Gujarat and India

Year	Gujarat	India
1960-61 to 1970-71	3.0	5.2
1970-71 to 1980-81	5.5	4.0
1980-81 to 1990-91	8.Increased	7.6

*Annual Compound Rates of Growth:

Source: Impact of Industrialisation in Peripheral Economy: A Case Study of Ankleshwar Industrial Estate in Gujarat, 2000, pp.12.

The growth strategy adopted by GOG was growth through development of chemicals/petrochemicals industries. To our horror we have now realized that Gujarat is not only a highly industrialized state but is also a highly polluted state. How did this happen? Where did we go wrong? We went wrong in our basic assumption that environmental goods are free for individuals as well as for the society at large. In sum we forgot to incorporate the environmental costs in our cost calculations.

In our enthusiasm to industrialise we ignored the development of infrastructure and forgot that free natural resources are not in fact free but have their own costs. The lack of emphasis on social structure and needs is observed by Amita Shah, "the establishment of the Industrial Estate Programme in the late sixties, which emerged out of the two pronged approach for inducing industrial growth with special emphasis on developing rural backward regions, focused merely on physical infrastructure without linking it with the social needs of formation of human capital and natural resource development for enhancing agriculture base". [Shah, A., 2001, p.2]. The existing cluster of pollution–intensive industries, like chemicals, pharmaceuticals, paints & dyes, pesticides, etc., – developed in various industrial estates lead to an over – exploitation of the 'environmental sinks' in regions where they were located.

Labour Commissionerate in Gujarat has identified 46 Chemicals in Gujarat as extremely toxic and hazardous. Vadodara is at the top in producing such chemicals with 84 factories [29% of the state total; followed by Ahmedabad [60 factories], Valsad [42 factories], Bharuch [33 factories] and Surat [29 factories], that is 80% of the factories producing such extremely hazardous toxic chemicals are located in these five districts [Hirway, 99, pp.252-253]. Widespread contamination of water [ground and surface], air and soil have been reported from the various industrial cohorts in these regions.

It has now been realized that environmental cost is a very important, if not the most important, cost that we have neglected so far. It is therefore now required to have some idea regarding these costs that were never an important part of our calculation. The obvious question that arises in this context is how do we calculate the cost of a non-marketed good like environment?

Economic valuation of environmental costs/benefits poses serious difficulties on account of absence of markets. The negative externalities [pollution] posed by industrial/manufacturing processes do not get reflected in the production costs. This leads to `free riding' of the sink-capacities of the available water-ways [creeks, rivers etc.], atmosphere and soil with deleterious consequences on human health, agricultural crops and building materials.

Misconceived industrial strategy tends to treat environmental resources as free gifts of nature. The treatment of environmental goods as free gifts of nature results mainly from the problems associated with establishing property rights in these resources. The resources owned by every one are in effect not cared for by any one. It is, thus, natural to overexploit these resources. This is what has happened in Gujarat.

We have now realized that this overexploitation of natural resources has costed us heavily in terms of human health, land productivity, availability of water, loss of property value, etc. Unfortunately there is no magic wand that gives us the value of these environmental resources. There are very many different ways in which the environmental resources can be valued and the costs of neglecting them can be estimated. The present study is an attempt in the direction of measuring environmental costs concentrating on a small area of Gujarat state.

Gujarat is now an industrial state with 122 fully developed estates, more than 50% of the numbers of units in these estates are located in the Baroda-Vapi tract. The Ankleshwar Industrial Estates was established in 1971 by the GIDC and by 1975-76 the sheds were allocated. The AIE now ranks second among all the 122 fully developed estates in terms of employment, investment and production. We, therefore, decided to study Ankleshwar GIDC in greater details. AIE has been studied by quite a few researchers. None of them has attempted to estimate environmental costs in terms of property values.

The Study Area in Perspectives

The Ankleshwar Industrial Estate is a strategically conceived industrial phenomenon on the industrially developed Ahmedabad – Baroda – Vapi – Bombay corridor. It is strategic because of the following locational advantages:

[a] Its Proximity to urban industrial conglomerates of Bharuch, Valsad, Baroda and Ahmedabad.

[b] Availability of subsidies under the special backward area upliftment programme promoted by the state.

[c] Availability of oil and natural gas in and around Ankleshwar.

[d] Existence of a convenient outlet for effluent disposal due to its proximity to the sea as well as to the Narmada River. The AIE has two creeks, Amlakhadi and Sarangpur Khadi that carry treated wastewaters to the Narmada River.

The Ankleshwar Industrial Estate [AIE] was formed in the late 1960s that was followed up by an intensive, need based Project Linkage Scheme launched in the early 1980s. While the AIE was conceptualized as a planned clustering of industrial enterprises, providing basic industrial infrastructure like water, electricity, technical guidance, transport, bank etc., it was the Project Linkage Scheme that identified the missing – links affecting the economic advancement of the rural peripheral economies. The Project Linkage Scheme concentrated on:

[1] Skill – Formation,

[2] Communication,

[3] Housing, and

[4] Self-employment..

A survey-based study conducted by V. Kathuria to find out the exact number of working units in AIE and the workers employed therein observed that there existed about 1087 working units in the estate that employed 35,000 workers and employees. Further, the workers surveyed in the same study showed that most of the migrants who came to the estate seeking employment did not have alternative opportunities which placed them in a weak bargaining position and made it difficult for them to have decent working and living conditions.

In a decade and a half of industrial growth [from the period of its inception in 1971 till about the mid-eighties] the AIE had grown eight-fold in terms of the number of units and ten-fold in terms of employment. From being the fourth largest industrial estate in terms of the number of functioning units, the AIE moved to the third rank by 1995-96 and had graduated to the second rank in terms of value of investment, production and number of employees. By the end of 1997-98 the AIE ranked first among industrial estates in terms of its size, investment and revenue generated from infrastructural facilities but the potential for generating unsustainable inter-temporal externalities due to massive industrialization was over-looked. The neglect of externalities jeopardized "the longer term sustainability of industrial growth in the region" [Shah, A., Kathuria, V., 2000 pp.152].

Apart from the traditional question in development studies regarding institutions required to improve the existing patterns of social and economic life, an additional question to be taken care of was from an ecological perspective, i.e. which social and economic institutions are needed to reproduce existing patterns of social and economic life in the long run – this is referred to as the political economy of the environment. [Opschoor, J.B. 1998 pp.28]. Absence of well planned development strategy on the part of GOG gets reflected in huge dumps of industrial wastes near residential areas, coloured water running on the streets with poor children playing in it and cattle drinking from it, chimneys belching out smoke and ruining the life and property in GIDC and nearby areas.

The Ankleshwar Industrial Estate houses mainly dye factories, chemical and allied industries, paper and pulp producers, pesticide, textiles, pharmaceuticals, paint manufactures and engineering companies. The potential for air pollution in all these manufacturing units is quite high, as shown in Table – 2. One of the significant impacts of industrialization has been traced from the deteriorating quality of air in and around the periphery of the estate. Our survey–based study which attempted to look into the environmental dimension [in context of air pollution] of industrialization was indeed startled to find toxic pollutants being freely and generously emitted from the manufacturing units mostly in the early evening / mid-night hours. The ex-AIA president dismissed the whole fact of air pollution with his statement "Stench is not a pollutant". Agreed that stench or bad smell is not a pollutant but this should not lead us to conclude that there is no problem of air pollution in the AIE. Some of the air pollutants, along with their sources, are listed below.

Table – 2: Typical Sources of some Air Pollutants in Ambient Air

Sr. No.	Air Pollutants	Major Sources
01.	Sulphur Dioxide (SO2)	Fuel combustion, power station, industrial process, chemical process, diesel vehicles, solid waste disposal, smelters
02.	Nitrogen Oxide (NOx)	Transport [road, rail, passenger and commercial], fuel combination, power station, industrial boilers, chemical processes, waste incinerators, smelters
03.	Particulate Matter [SPM, RSPM-PM10, RSPM-PM2.5]	Fuel combustion, power station, construction activities, industrial process, diesel vehicle exhaust, re suspended road dust, domestic refuse burning, domestic wood
04.	Carbon Monoxide [CO]	Transport, combustion, industrial process, solid waste disposal, refuse burning
05.	Ozone [O3]	Secondary pollutants formed during photo –chemical reaction
06.	Organic compounds	Transport, oil based fuel combustion sources, chemical processes, solvent use, waste incinerator, vaporization of fuel
07.	Benzene	Petrol combustion products, petrol filling stations chemical process.

Source: _CPBC, 2000: Air quality Status and Trends in India NAAQM/14/1999-2000, P.17.

The Central Pollution Control Board recognizes Ankleshwar as one of the prime industrially dense locales with high exceedence factor for Sulphur Dixoide [e.g. 1995 – Residential area (high) 1996 – Industrial, Residential (high) and high to critical exceedence factor for Suspended Particulate matter, particularly in the residential areas during the years of 1995, 1996 and 1997]. Table – 3, given below, shows the way in which critical, high, moderate and low pollution levels are calculated.

Table – 3: Air Quality Assessment – Exceedance Factor - The Exceedence Factor [EF] has been used as the relative value of ratio of observed annual mean concentration of an air pollutant with that of respective air quality standards: -

$$\text{Exceedence Factor [EF]} = \frac{\text{Observed Annual Mean Concentration of Air Pollutant}}{\text{Annual air quality standard(3) for respective pollutant and land use area class}}$$

The four categories analysed are: -

Critical Pollution [C] - E.F. more than 1.5 x 5
High Pollution [H] - E.F. between 1.0 – 1.5 x 5

Moderate Pollution [M]	-	E.F. between 0.5 – 1.0 x 5
Low Pollution [L]	-	E.F. less than 0.5 x 5

Where 5 – Ambient air Quality Standard

This means that the concentration levels of SO_2 for residential and industrial areas in Ankleshwar GIDC were about 1.5 times the annual air quality standard. The suspended Particulate Matter concentration in residential areas of Ankleshwar GIDC was critical meaning thereby that this concentration was more than 1.5 times the ambient air quality standard. In sum, it has been an accepted fact that Ankleshwar GIDC is highly polluted. This implies that industrial growth, ☾ la Ankleshwar Style, cannot be a sustainable growth strategy. The problems of sustainability have become very prominent since the publication of the Brundtland Report. “Since the Brundtland report [WCED 1987], sustainability has come to mean: the capacity to maintain a certain phenomenon [e.g. growth] based on the potential of inherent or underlying social, economic as well as ecological processes” [Opschoor, J.B., 1998, pp.22]

The integrative dynamics of sustainability “encapsulating social, environmental and economic sustainability” [Opschoor, J.B., 1998, pp.22] has, in the past fifteen or more years, broadened the concept of individual’s well-being/welfare. This has been noticed in the upgrading of the standard neo-classical economic theory that had to be reformulated to include in the individual’s consumption basket, the non-market services such as environmental quality along with private goods, and, goods & services produced by government, determining welfare of an individual. This made it necessary to have some, price tag attached to environmental goods and services, similar to public and private goods and services. The researchers in this area had to some how value a non-market good to be able to estimate the welfare gain of an improved environment. Two broad approaches were developed, viz. Demand Curve Approach and Non-Demand Curve Approach, to have monetary valuation of a non-market good like environment.

The demand curve approach attempted to estimate environmental values through analyzing consumer’s preferences for the resource service flows.

The preferences can either be stated/expressed [– where individuals are asked explicitly how much they value an environmental good, e.g. the Contingent Valuation Methods of estimating the passive use values lost on account of the Exxon Valdez oil spill]. Or revealed through choice experiments, wherein the environmental amenity is viewed as having to do with the quality of a privately consumed good. The hedonic price analysis, appeared to afford an ideal means of exploiting a private decision to value a non-market good; "the fact that the price of residential location can be expected to bid up when it possesses higher levels of say b [which denotes environmental quality or a proxy for it] or other good attributes such as bedrooms, lot size etc. [denoted by the Vector W.] and bid down when the location has undesirable attributes, insures that the hedonic price function, denoted by Ph,w,b is well –behaved" [Bockstael N.E. & McConnell, K.E. in ed. Herriges J.A., Kling C.L. 1999, pp.17].

The practice of revealed preference valuation is far more difficult than the concept, and, therefore, in practice contingent valuation has been preferred. Recent literature on empirical environmental studies estimating values advise a combination of revealed and stated preference methods. "Revealed preference studies may not be experiments, but they still almost always require survey work since they depend on non-market behaviour". [Bickstael, McConnell 1999, pp.29] The need to learn from stated preference methods about perceptions, motivations fuelling the reasoning process and then linking it up with their "behaviour [observed]' in the context of the problem being studied has been advised for strengthening the reliability of the revealed preference methods to estimate environmental quality. The idea therefore is to stimulate the survey exercise not just by asking, people "what they have done" but rather asking them "what they would do". The basic theory regarding environmental valuation is surveyed in Section-III of this study. But, before that, we discuss the Rationale and objective of this study in the next section.

The present study is divided into six sections. Section-I is the Introduction part, Section-II deals with Rationale and Objective of the study. Section-III

Surveys the Methodology used to value environmental resources and the methodology adopted in this project. Section-IV discusses Data Collection and analysis. Section-V and VI are devoted to an analysis of our Findings & Results; and, Recommendations, respectively. Last Section consists of References.

Section-II: Rationale and Objective

It has been an accepted fact that most of the environmental goods are non-market goods. As a result there is no price that can be taken as a cost of good/resource. Further, there are no clear well-defined property rights resulting into them being treated as free goods. When plan for industrial action is prepared various factors like availability of inputs, costs of inputs, linkages with markets etc. are undertaken but the costs in terms of environmental costs resulting into loss of human life, increasing morbidity, loss of property value etc. are rarely, if at all, taken into consideration.

This study tries to apply the methods of estimating the costs in terms of environmental costs. It is an attempt at applying the principles of environmental economics to actual empirical situation. In our enthusiasm to industrialise at a fast rate, we seem to have committed the mistake of ignoring the environmental effects of wrong industrial strategy. Thus, the primary rationale for this study is to use techniques of environmental economics to specific situation.

The basic objective of this study is to observe and estimate the environmental costs of industrialisation in one of the highly industrialised states, viz. Gujarat, of our country. Gujarat adopted the policy of developing through chemical industries. In order to give a boost to industrialisation Gujarat Industrial Development Corporation [GIDC] was established in 1962. Another objective that the GIDC was supposed to promote is development of backward areas of the state. We did very well on the industrial development front but did equally bad on the environmental front. It is, therefore, in fitness of things that we at least make an attempt at knowing the environmental costs that we have incurred in the process. This is what the present study attempts to do.

There are large number of costs that can be incorporated in environmental costs. The environmental costs resulting from environmental degradation and pollution may be in terms of its impact on living things. In this case we usually study the loss in terms of human health, i.e. increased mortality and morbidity. It could be in terms of loss of non-human life as well. The environmental cost can also be in terms of loss of agricultural productivity, soil erosion, water contamination, water scarcity, loss of value of property, increased costs of maintenance of property, etc. It is humanly impossible to study all these costs in one go. Our objective here, therefore, is to concentrate on only one type of cost, viz. in terms of loss of property value as reflected in either falling or slowly growing value in an industrial area. The industrial area that we have selected is the Ankleshwar GIDC. Before we discuss the methodology adopted in this study it would be appropriate to get some idea about Ankleshwar GIDC.

Ankleshwar GIDC

Ankleshwar Industrail Estate [AIE] houses around 3000 individual companies belonging to small, medium and large industrial units covering sectors like chemicals, dyes, pesticides, plastics, pharmaceuticals, engineering etc. In fact Ankleshwar GIDC houses the largest chemical estate in Asia with an area of 16 square km. and having more than 400 chemical plants.

Ankleshwar GIDC falls in the “Golden Corridor” of Gujarat state. The Golden Corridor is an industrial belt starting at Vapi in the southern part and going to Ahmedabad in the north. “It is so called because of the wealth that has been generated by rapid industrial development. However the price of this economic success has been, and continues to be, widespread and in many regions, severe environmental damage”. [Labunska, Stephenson, Brigden, Santillo, Stringer, Johnston & Ashton, 1999, P.6]. This corridor includes three large industrial estates situated in Ankleshwar, Vapi and Nandesari. These industrial units are characterized by very poorly managed and inadequately available waste treatment facilities. Such a neglect of proper planning of waste treatment has resulted into indiscriminately dumped solid wastes on open ground creating health hazards and other environmental problems. “It is reported that many of the medium to smaller sized units simply discharge their effluents to a chaotic system of open roadside ditches and an incomplete and broken underground pipeline net work, that carry mixed effluents to pumping stations or directly to the river system for discharge". [Labunska, et.al., 1999, P.9]

From a sludge sample collected from the area adjacent to CETP the Green Peace Investigation team observed that "This sample contained high levels of copper, therefore illustrating that even if the CETPs are capable of removing heavy metals from the in-coming waste stream, metals are still left in concentrated solid residue". [Labunska, et.al., 1999, P.14]

The long and short of the story is that Ankleshwar GIDC is a highly polluted industrial estate. It is therefore, high time that we study this industrial estate from the angle of environmental issues.

As discussed in Section-I we are to use the demand curve approach to valuation of environmental good. This approach consists of three different methods, viz. Contingent Valuation, [CV], Hedonic Pricing [HP] and Travel Cost Method [TCM]. The last method, viz. TCM, is used for valuation of outdoor recreation site and treats travel cost as a surrogate price of the site. Our problem of valuing environment in terms of loss of property value does not address itself to valuation of outdoor recreation site. We, therefore, do not use this method in our study.

Property, i.e. real estate, is considered to be a bundle of characteristics a la Lancaster and Sherwin. The price of property is expected to capture the implicit price of these characteristics including the implicit price of environmental good, i.e. clean air in our case. This is done by directly estimating the value of clean air by using the CVM, and also indirectly by using the HPM. We use both these methods in our study. In the CVM, we directly get the Willingness To Pay (WTP) and through HPM, we get it indirectly through hedonic prices. Which is a better method of the two for valuing an improvement in air quality cannot be unequivocally decided. In the CVM, there are problems of getting hypothetical answers to questions regarding WTP/WTA for an improvement/deterioration in air quality. Some prefer HPM because the results that we get are through observing market behaviour. Further, in the case of CVM there is a possibility of getting large number of observations with zero [protest] responses. We, therefore, thought it worth its while to use both the methods of valuing the environmental goods.

Brookshire, Thayer, Schulze and D'Arge, in an interesting article of 1982, compared the two methods, viz. CVM and HPM. "Thus, the rent differential associated with air quality improvement from hedonic analysis of the property value data must exceed estimates of household willingness to pay for the survey responses if the survey responses are a valid measure of the value of air quality improvement". [Brookshire et.al.1982, P.166]. We in this study have gone in for survey method for contingent valuation as well as for hedonic pricing. This is so because we do not have a well-developed property market. In fact our property market is quite distorted on account of government rent controls, existence of black money, etc. Over and above this, it is difficult to get reliable records for house sales. We have concentrated our attention on Ankleshwar GIDC which is known to be highly polluted. While collecting data from Ankleshwar GIDC we had to bear in mind the fact that there are three types of property, viz. Residential, Industrial and Commercial.

We had a plan of collecting information for all the three types of property. Unfortunately the industrial units refused to give us the necessary information and some of them were quite hostile to our gathering information on prices of property, pollution etc. We, therefore, were forced to give up industrial property and had to concentrate on residential and commercial property. Large number of questions on purchase price, expected price, perception of pollution, accessibility of the property, income, education, family size, travel time, travel cost, health etc. were asked in the questionnaire. We were told that there are about 37 housing societies in Ankleshwar GIDC. Samples from all the societies were collected. While collecting data we realized that there were some societies, particularly on the Rajpipla road, that were not registered and samples from these societies were also collected.

Usually the CVM is used to know the value of an outdoor recreation site that visitors have. But, contingent valuation approach is used, in some cases, to derive the demand for clean air as well.

We had real problem of getting data on air pollution. There were only two monitoring centers in Ankleshwar GIDC. One in the industrial area and one in the residential area. Thus, all the houses in residential areas had the same value for air pollution. These data are collected by GPCB and are highly suspect. Further, on account of increasing awareness and accompanying militancy in regard to pollution the GPCB did not give us the required data, even the data published in various issues of GPCB that we were not able to buy from market, were not given to us. On account of these problems we decided to use the perception of people regarding levels of pollution. We agree that perceptions are highly subjective but if their perception of highly polluted area coincides with relatively lower purchase prices of property then we have reasons to believe that people's perception does affect property prices. In fact, 3-4 variables captured people's perception regarding pollution and property price behaviour. The questions asked in this regard were - Do you think pollution in your area is unbearable/bearable/moderate? Which is the area where property prices have increased fastest Bhavana farm/Ankleshwar GIDC/Ankleshwar town? Do you think that the price of your property has fallen on account of pollution/industrial recession/subdued market etc? Another variable related to air pollution is the maintenance cost. Here also the respondents were asked to give the actual maintenance cost of their property and the reasons thereof like social occasion, pollution etc.

Prof. N.M. Bhatt, Senior Reader in Environmental Engineering in the Faculty of Engineering & Technology of our university, and a consultant to our project who is also a member of Pollution Monitoring Committee appointed by Gujarat High Court informed us that data on air pollution are just not available before 1990. He was able to give us the data on three air pollutants, viz. SO2, NOx and SPM, for Ankleshwar GIDC for the last twelve years, viz. from 1990 to 2001. We are so very grateful to him for supplying these data. We have used these data for these years along with the purchase price of the property for the relevant years.

In sum, we have collected information on structural variables accessibility variables, socio-economic variables and environmental variables alongwith purchase price for owned houses and rentals for rented houses. Similar information was collected for commercial property as well.

Ankleshwar GIDC is an area of our interest. We do need to have some idea about the price behaviour of real estate in a non-polluted area to have a comparative picture. We have selected Ankleshwar town as a base for such a comparison. Ankleshwar town is very near to Ankleshwar GIDC and is supposed to be non-polluted. People residing in Ankleshwar town commute to Ankleshwar GIDC for work. For Ankleshwar town there are no published data on pollution and we have also not collected data on perception of pollution but the rest of the data were collected.

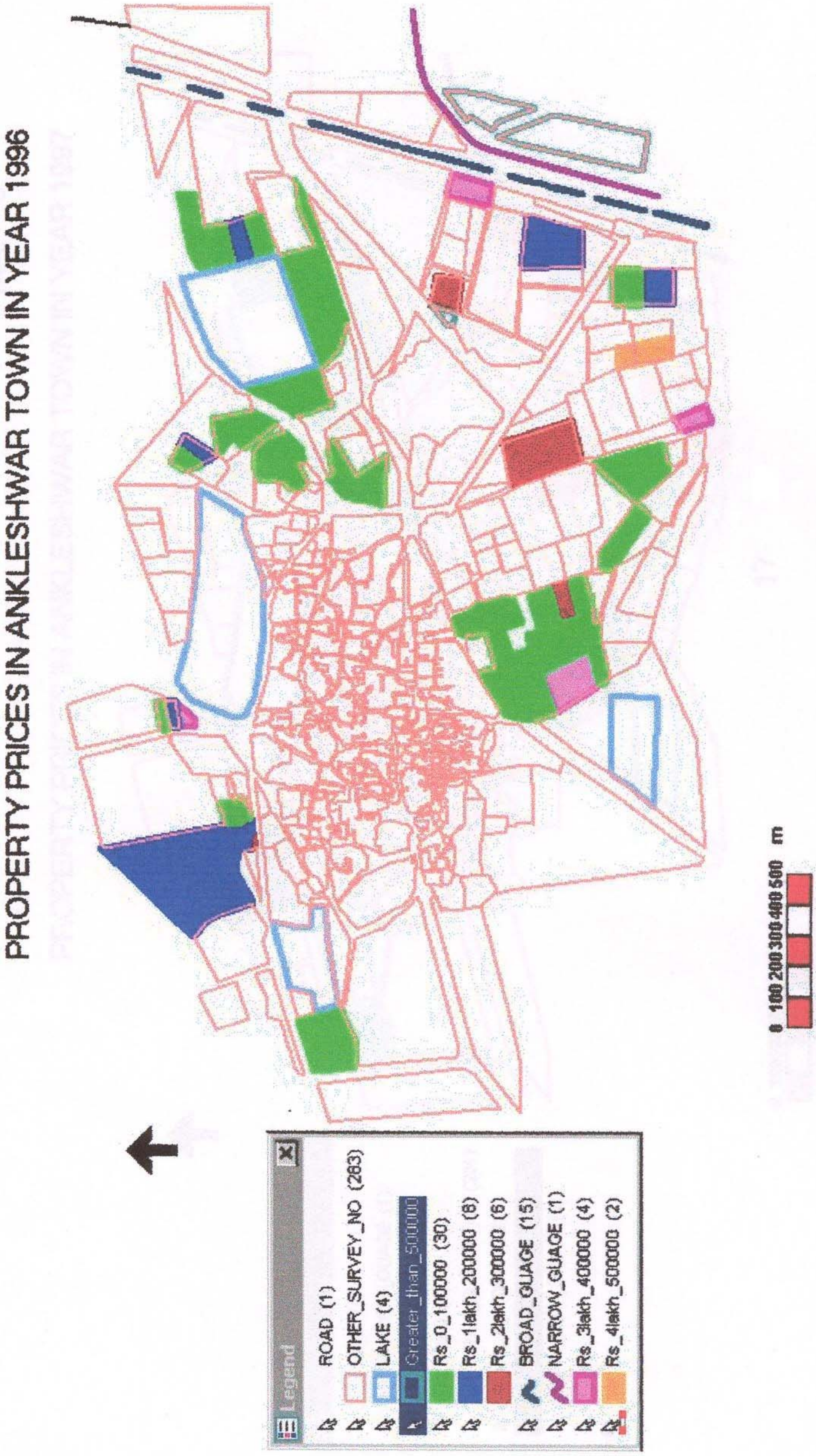
Further, we also interviewed about 30 real estate agents to get an idea about the residential and commercial property in areas in which they were operating, which was mainly Ankleshwar town. In GIDC there were hardly 2-3 agents operating.

Now a small discussion on selection of the samples. First of all the maps of Ankleshwar town and GIDC were collected. Then from the sub-registrar's office in Ankleshwar town the data on sale of houses for the last five years, were copied to get an idea about different localities and the land price prevalent in them. Using this information map for Ankleshwar town was digitized by Mr. Yogesh Manohar of the Geography Department [M.S. University, Vadodara] showing the concentration of poor, non-poor, may be rich localities in town. The areas were then demarcated from which the samples were to be collected from households. More than 600 households in Ankleshwar town were interviewed and data were collected. This information is given below in Maps 1 to 6, which were digitized and colour coded.

MAP No. 1

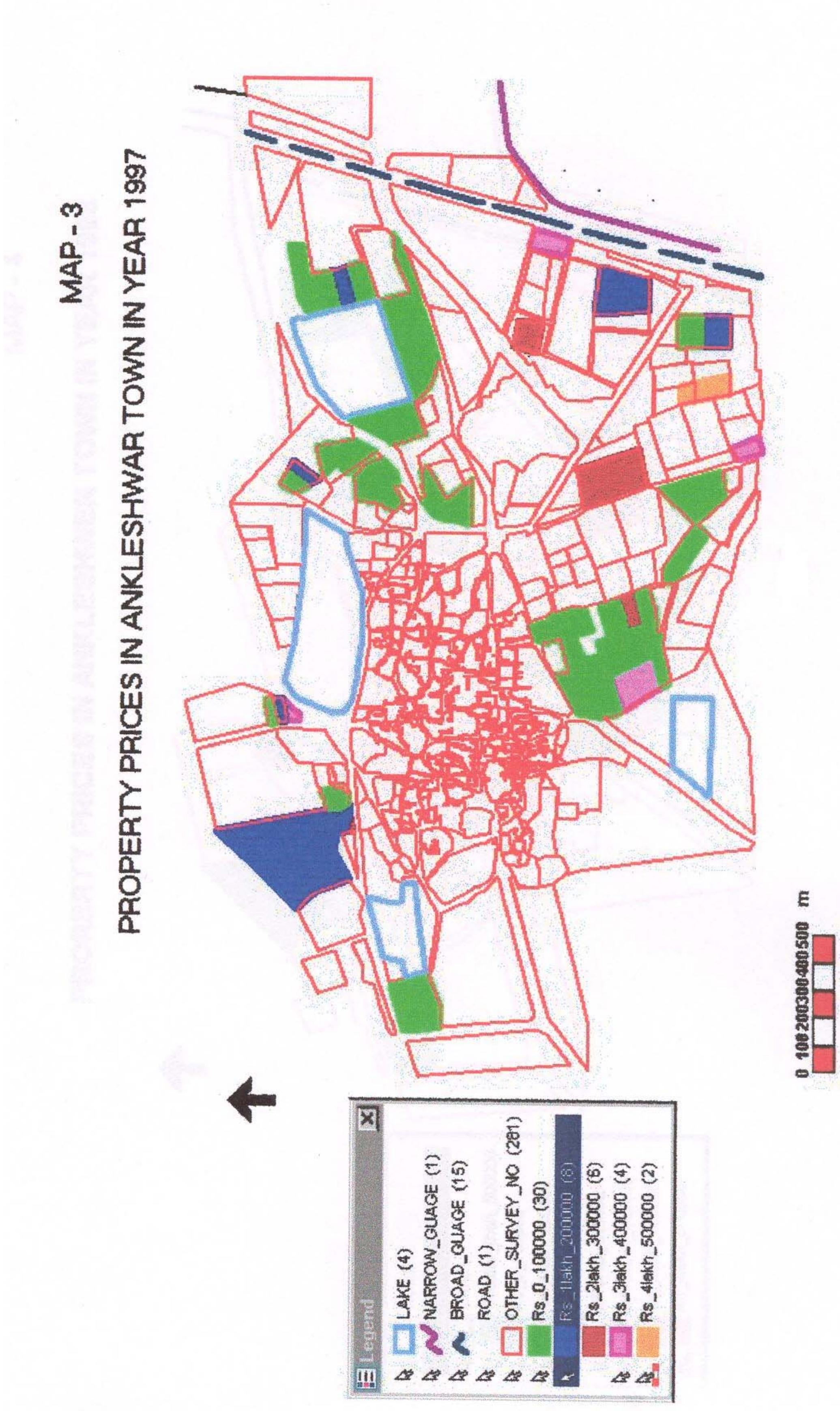
MAP-1
LAND PRICE IN ANKLESHWAR TOWN IN YEAR 2000
Legend
Buffer Zone1
Labels of BROAD_GUAGE
METER_GUAGE
BROAD_GUAGE
Greater_3001
Rs_1501_2000
Rs_2001_2500
Rs_2501_3000
Rs_1000_1500
Rs_501_1000
ROAD
LAKE
SURVEY_NO_ORDER
map3.tif

MAP No. 2

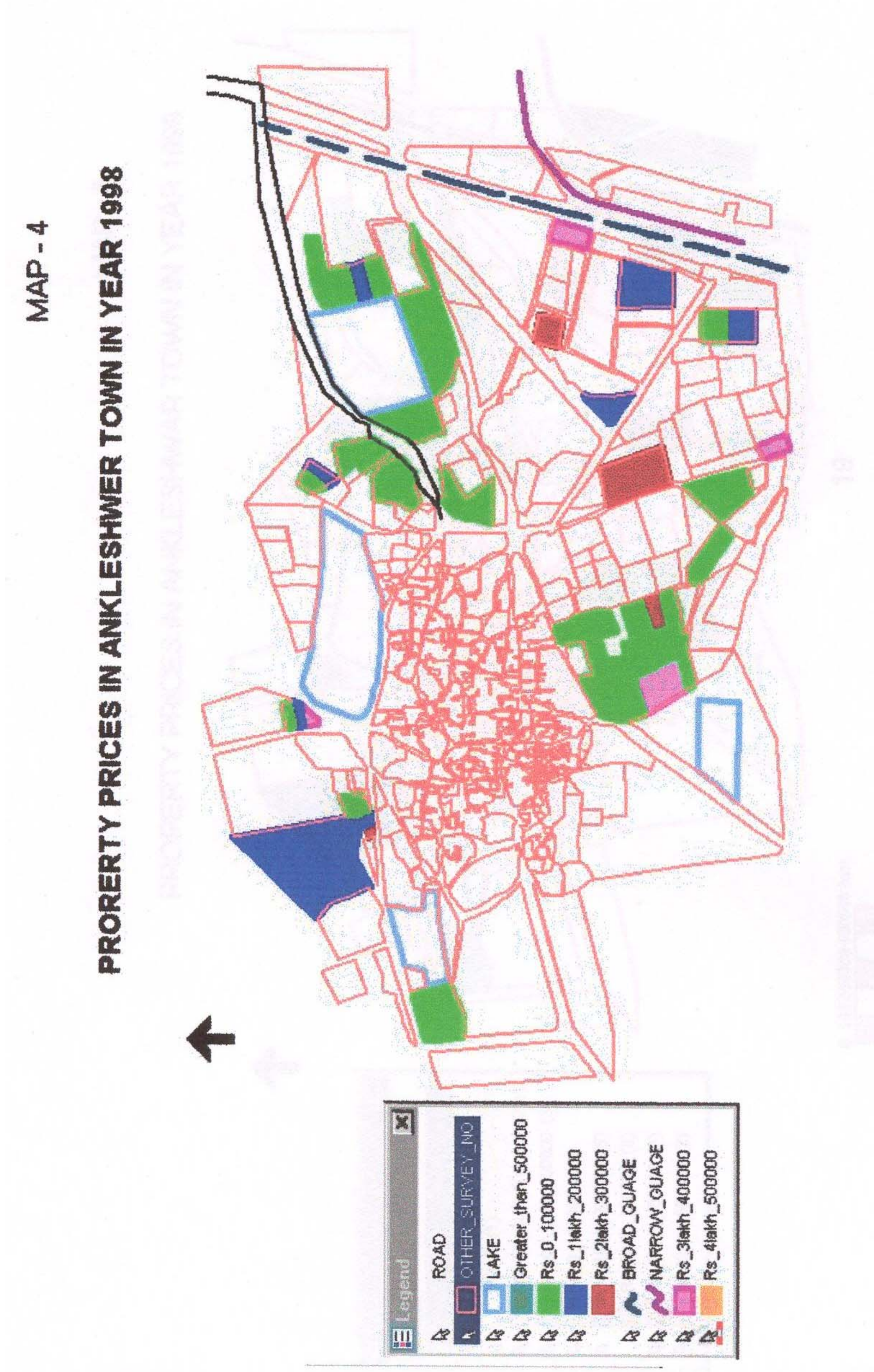


MAP - 2
PROPERTY PRICES IN ANKLESHWAR TOWN IN YEAR 1996
Legend
ROAD (1)
OTHER_SURVEY_NO (283)
LAKE (4)
Greater_than_500000
Rs_0_100000 (30)
Rs_1lakh_200000 (8)
Rs_2lakh_300000 (6)
BROAD_GUAGE (15)
NARROW_GUAGE (1)
Rs_3lakh_400000 (4)
Rs_4lakh_500000 (2)
0 100 200 300 400 500 m

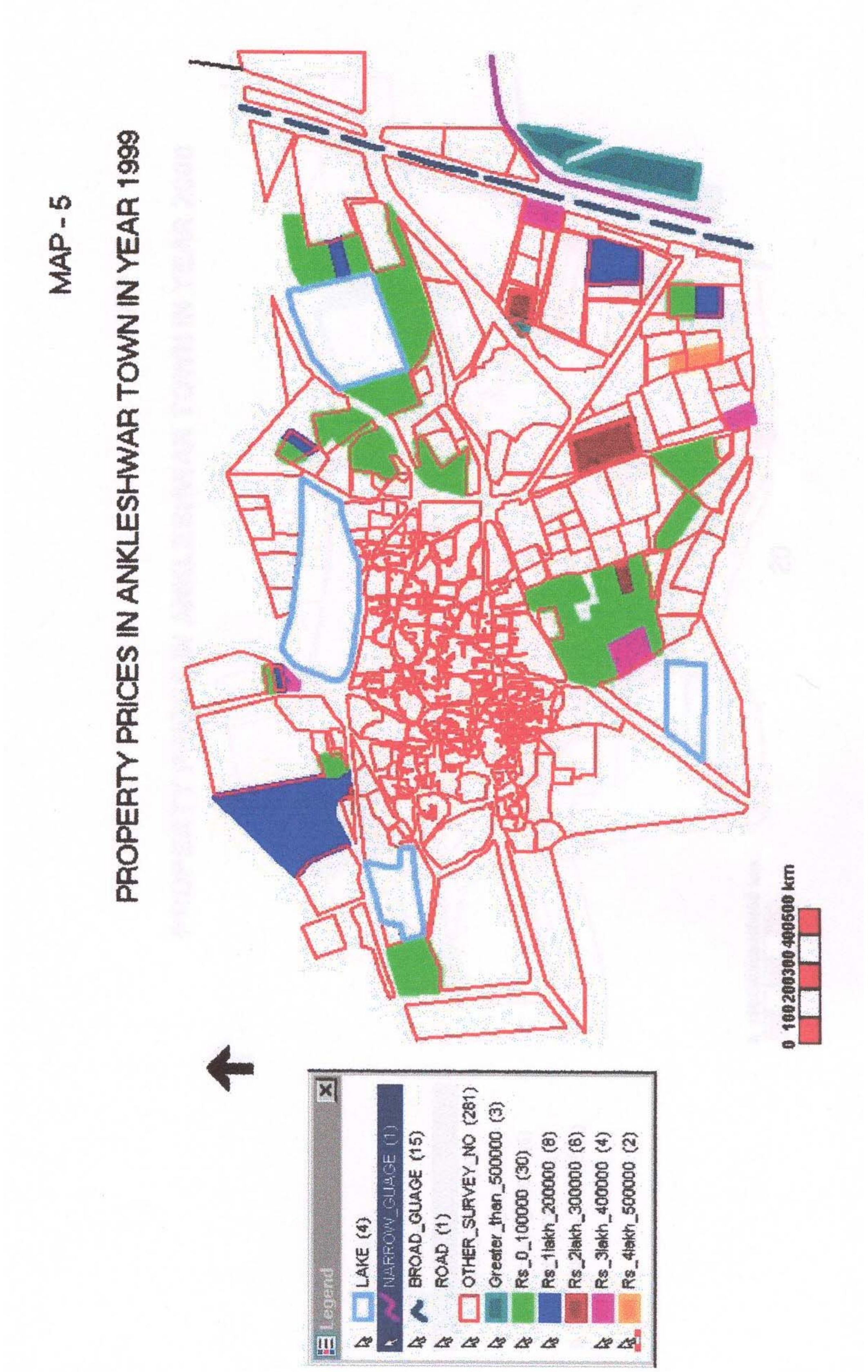
MAP No. 3


MAP - 3
PROPERTY PRICES IN ANKLESHWAR TOWN IN YEAR 1997
0 100 200 300 400 500 m
Legend
LAKE (4)
NARROW_GUAGE (1)
BROAD_GUAGE (15)
ROAD (1)
OTHER_SURVEY_NO (281)
Rs_0_100000 (30)
Rs_1lakh_200000 (8)
Rs_2lakh_300000 (6)
Rs_3lakh_400000 (4)
Rs_4lakh_500000 (2)

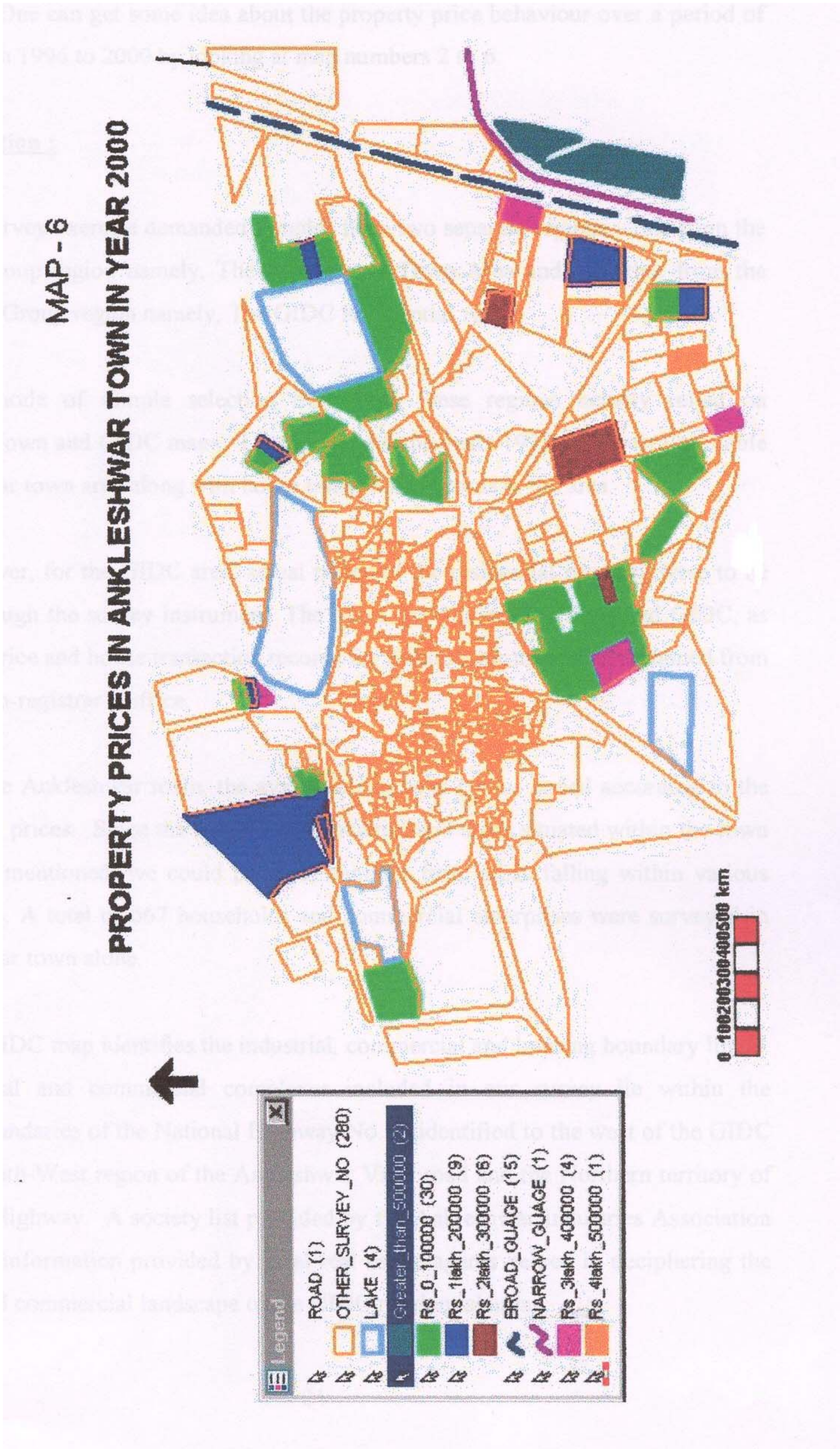
MAP No. 4


MAP - 4
PRORERTY PRICES IN ANKLESHWER TOWN IN YEAR 1998
Legend
ROAD
OTHER_SURVEY_NO
LAKE
Greater_than_500000
Rs_0_100000
Rs_1lakh_200000
Rs_2lakh_300000
BROAD_GUAGE
NARROW_GUAGE
Rs_3lakh_400000
Rs_4lakh_500000

MAP No. 5


MAP - 5
PROPERTY PRICES IN ANKLESHWAR TOWN IN YEAR 1999
Legend
LAKE (4)
NARROW_GUAGE (1)
BROAD_GUAGE (15)
ROAD (1)
OTHER_SURVEY_NO (281)
Greater_than_500000 (3)
Rs_0_100000 (30)
Rs_1lakh_200000 (8)
Rs_2lakh_300000 (6)
Rs_3lakh_400000 (4)
Rs_4lakh_500000 (2)
0 100200300 400500 km

MAP No. 6



MAP - 6
PROPERTY PRICES IN ANKLESHWAR TOWN IN YEAR 2000
Legend
ROAD (1)
OTHER_SURVEY_NO (280)
LAKE (4)
Greater_than_500000 (2)
Rs_0_100000 (30)
Rs_1lakh_200000 (9)
Rs_2lakh_300000 (6)
BROAD_GUAGE (15)
NARROW_GUAGE (1)
Rs_3lakh_400000 (4)
Rs_4lakh_500000 (1)
km

From the Map no.1 we can see that large number of land plots in Ankleshwar town were in the lowest range of Rs. 501/- to Rs. 1000/-. There were very few plots having a price of more than Rs. 3000/-. Almost all the costly plots were in the Southern part of town. One can get some idea about the property price behaviour over a period of five years from 1996 to 2000 by looking at map numbers 2 to 6.

Sample Selection

The survey exercise demanded samples from two separate regions – one from the Controlled Group region namely, The Ankleshwar Town Area and the other from the Experimental Group region namely, The GIDC Residential Area.

The mode of sample selection from both these regions heavily relied on Ankleshwar Town and GIDC maps. Land prices for the years 1995-2000 were available for Ankleshwar town area along with house transaction records in the area.

However, for the GIDC area, actual prices of the residential property were to be collected through the survey instrument. The Maps for Ankleshwar town and GIDC, as well as land price and house transaction records for Ankleshwar town were obtained from the district sub-registrar's office.

For the Ankleshwar town, the available map was colour coded according to the available land prices. Since the name of the societies and areas situated within the town were already mentioned, we could pick our samples from areas falling within various price brackets. A total of 667 households and commercial enterprises were surveyed in the Ankleshwar town alone.

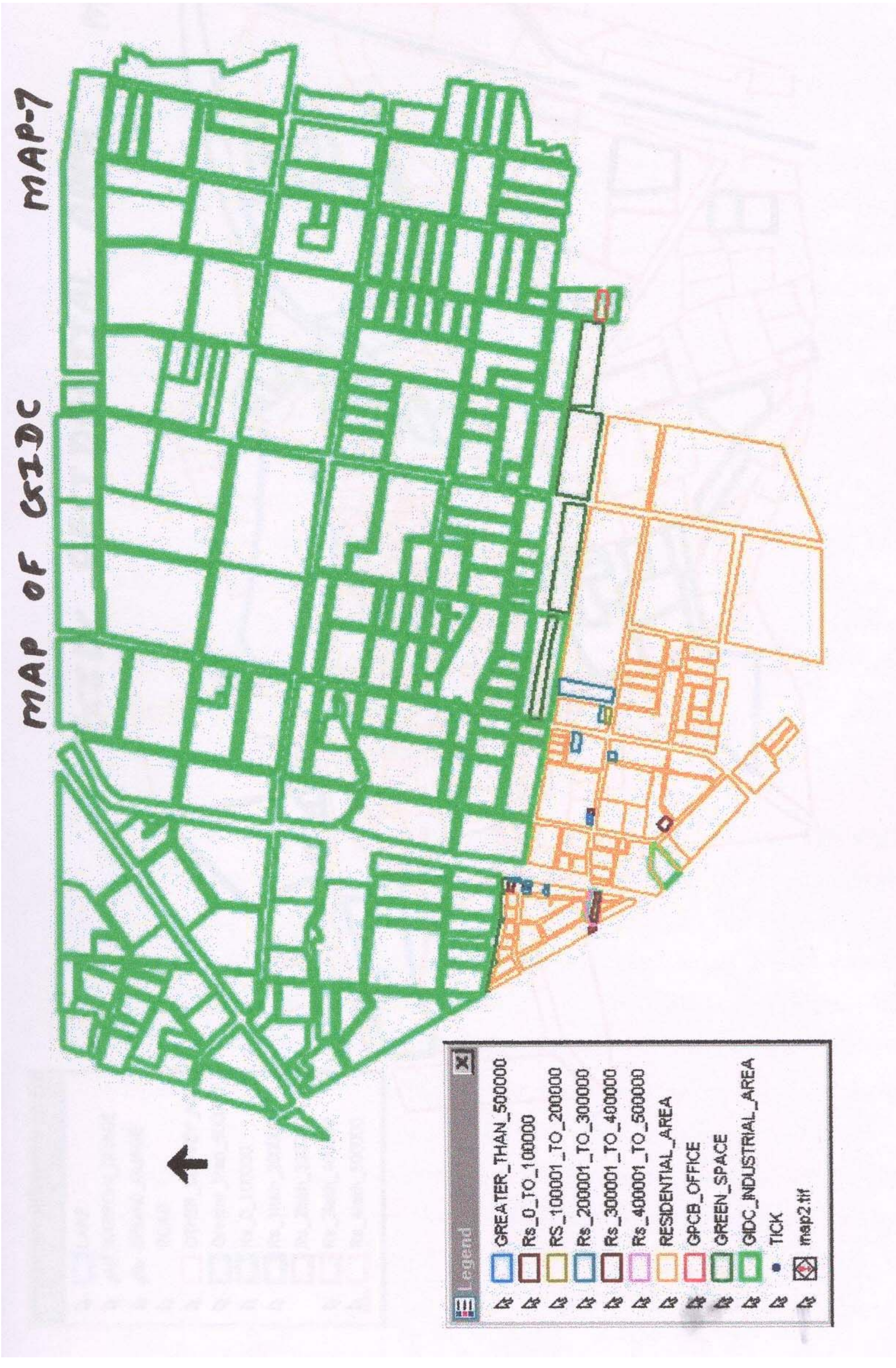
The GIDC map identifies the industrial, commercial and housing boundary limits. The residential and commercial complexes included in our survey lie within the proximate boundaries of the National Highway No. 8 (identified to the west of the GIDC Map), the South-West region of the Ankleshwar Valia road and the Northern territory of the Rajpipla Highway. A society list provided by the Ankleshwar Industries Association coupled with information provided by local real estate agents helped in deciphering the residential and commercial landscape of the GIDC residential area.

The survey exercise selected a sample of around thirty households per day from each society located in the three different areas mentioned above. We began our survey exercise from the Northern zone of GIDC eventually reaching southwest and then towards the western zone as per the GIDC map.

A total of 1253 residential and commercial samples were collected from the GIDC area.

For Ankleshwar GIDC also we used the map for the notified area to cover as large a spread as possible. Most of the time the wind direction was from South West to North East. The GIDC is spread between Valia road in the South and Rajpipla road on the north. We have taken care to get some observations from the north and south of GIDC. Majority of the houses are situated in the south. On the west is the National Highway No.8 and in the east, there are hardly any residential/Commercial premises. Sample from all the registered housing societies were collected. We were able to collect information from more than 1000 households for residential premises and more than 100 observations for commercial premises. Information regarding GIDC is given in Map no.7. The industrial units are located in the north and housing societies are in the South. Societies situated on the Rajpipla road are not shown in the map as they are not included in the Notified area. Map No. 8 gives information of the residential areas in the South of GIDC.

MAP No. 7


MAP OF GIDC MAP-7
Legend
GREATER_THAN_500000
Rs_0_TO_100000
RS_100001_TO_200000
Rs_200001_TO_300000
Rs_300001_TO_400000
Rs_400001_TO_500000
RESIDENTIAL_AREA
GPCB_OFFICE
GREEN_SPACE
GIDC_INDUSTRIAL_AREA
TICK
map2.tif

MAP No. 8


GIDC RESIDENTIAL AREA
MAP-8
Legend
LAKE
NARROW_GUAGE
BROAD_GUAGE
ROAD
OTHER_SURVEY_NO
Grester_than_500000
Rs_0_100000
Rs_1lakh_200000
Rs_2lakh_300000
Rs_3lakh_400000
Rs_4lakh_500000

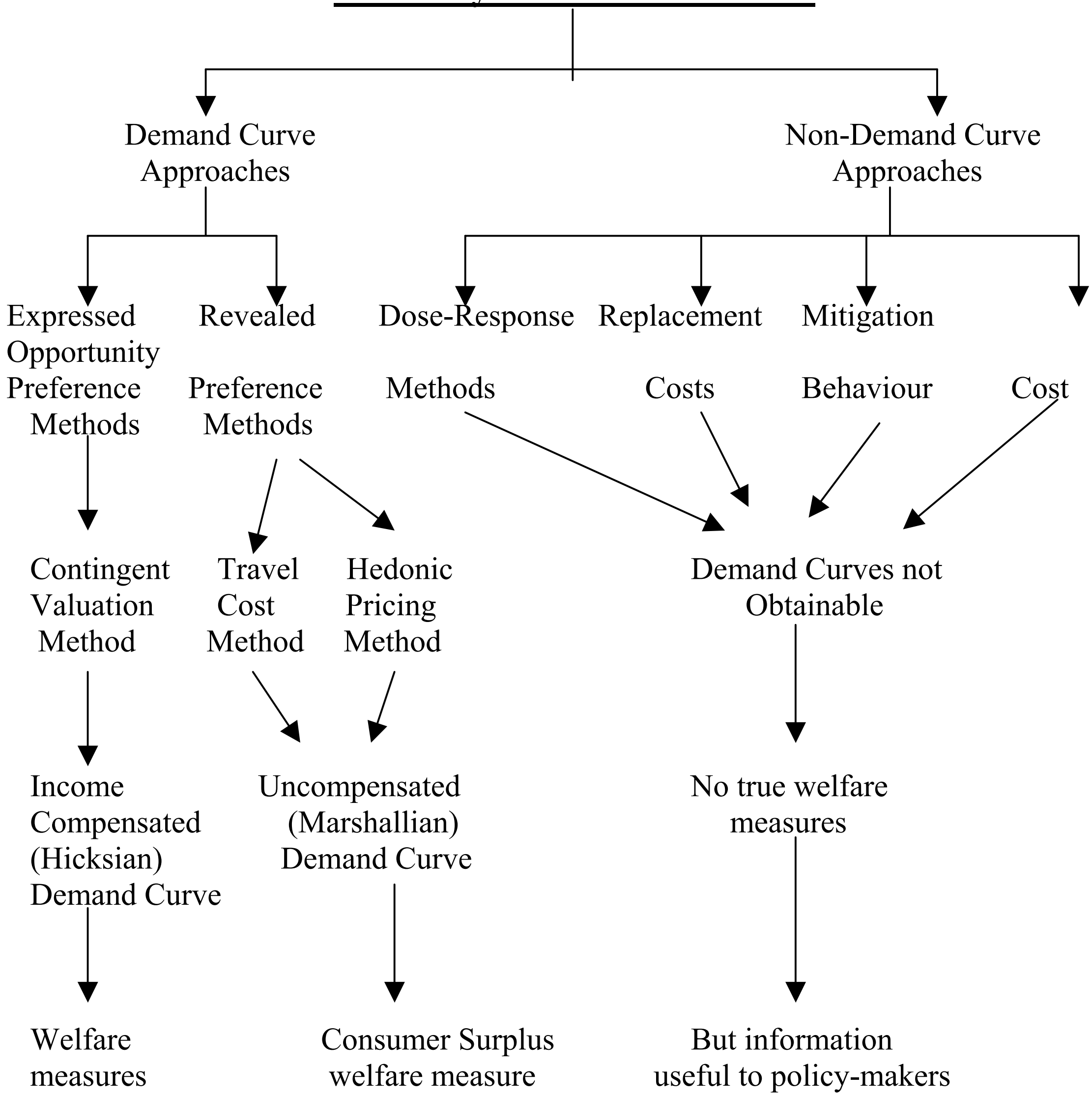
Section– III: Methodology

Environmental Valuation: Basic Theory

In the earlier section, we have brought out the need for valuing environmental resources. It is in fitness of things to be acquainted with different approaches to environmental valuation at this juncture. The original motivation for valuation of environment was to incorporate the environmental impacts in cost-benefit analysis. The cost-benefit analysis was expected to take care of the problems resulting from inefficiencies arising in the market; i.e. inefficiencies resulting from market failures. "For many environmental economists, working within the framework of neo-classical theory, environmental problems are best conceived as cases of `market failure' – the failure of actual markets to display the efficiency of resource allocation which `ideal' markets can be demonstrated to achieve" [Russell Keat, P.32, 1997] In sum, the need for economic valuation of the natural / environmental resources arises due to the failure of markets to generate true prices of the resources concerned. Market failure, in turn, leads to sub-optimal tapping of the resource for which the society at large has to pay. The purpose of economic valuation is to help estimate the true price of an environmental resource to facilitate informed choices for decision makers so that society need not lose out on welfare. Market failures, so common in environmental resources, are the consequences of externalities and undefined, diffused property rights. These problems also pose difficulties in valuation.

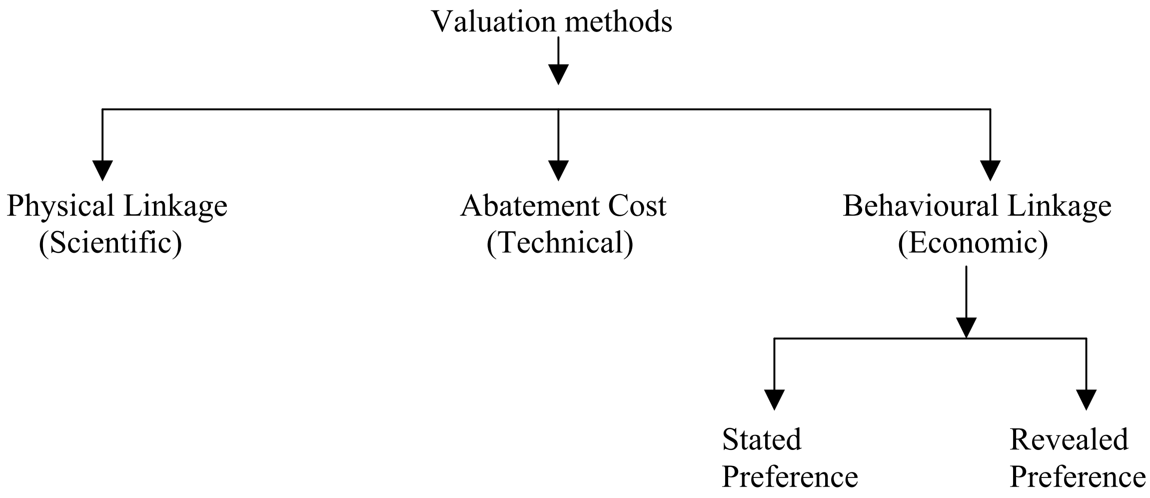
In recent years, two additional sources of demand for environmental valuation have emerged. The first is the perceived need to take account of environmental damage in measuring economic performance. Second, since the late 1980s, - valuations of environmental damage by economists were treated as admissible evidence in fixing the compensation to be paid by those whom the courts hold responsible for the damage. Thus, it is now accepted that environmental goods need to be valued. The next question that naturally arises is regarding the best method of valuing the environmental goods. We, therefore, survey different methods adapted to value environment. The basic strategy for environmental valuation is the `commodification' of the services that the natural environment provides. Various methods adopted for valuing the environment are summarized below in the form of a chart.

Monetary Evaluation Methods



The chart given above brings out the two main approaches to valuation of environment, viz. Demand Curve Approaches and Non-Demand Curve Approaches. For our study the demand curve approaches were considered to be more suitable. But, before discussing our methodology it would be interesting to survey these methods briefly. The chart given above is not the only way of classifying the approaches to valuation of environment.

United Nations classified valuation methods in the following manner.



Physical linkage methods " depend on a causal connection between environmental change and its effects on other objects, – processes, products or person" [United Nations, Vol.1, Primer, P.31, 1997]. These methods are also known as dose – response approach classified under Non-Demand Curve approaches in the earlier chart.

As against the demand curve approaches the abatement cost method attempts at valuation of environment from the supply angle. This method treats the costs of abating pollution as an estimate of the value of damage. It is also known as maintenance cost method as it tries to estimate the cost, via the damage function, of maintaining the environmental quality at a constant level. Here also we face many problems as depletion/degradation and restoration/regeneration cannot be valued through market transactions.

The first step in understanding the theoretical foundations for the techniques developed for environmental valuation, in relation to services to households, is the assumption that environmental services, or indicators relating to environmental services can be treated as arguments in well-behaved utility functions. As the conditions under which preferences can be represented by well-behaved utility functions are unlikely to be met, the standard theory of environmental valuation simply assumes the existence of the required utility functions. What needs to be obtained is a proper monetary measure of utility change, and the extent to which such measure is observable or can be approximated by measures, which are observable.

Non-market valuation techniques are used to measure changes in individual welfare resulting from alternative use of natural resources for which markets do not exist. This is done by measuring consumers surplus. There are two measures of consumer surplus viz. equivalent measure and compensating measure. The equivalent measures use the subsequent welfare level as a reference level whereas the compensating measures use the initial welfare as the reference level. Thus under equivalent measure the willingness to pay [WTP] is treated as an amount consumer is willing to pay for avoiding a less preferred situation. WTP under compensating measure is a willingness to pay for obtaining a more preferred situation. There are three methods of valuing environmental goods/services that are used for applying the Demand Curve Approach. These three methods are – Contingent Valuation Method (CVM), Hedonic Pricing Method (HPM) and Travel Cost Method (TCM). We briefly discuss these methods below.

[A] Direct Method: Contingent Valuation: [Expressed Preference Method]:

In the area of expressed [stated] preferences, Contingent Valuation [CV] is the dominant approach. CV relies on direct revealation of demand from consumers. The name literally means, "value contingent on there being a market" - if there were a market, how much would you pay for the environmental good? These values are obtained by directly questioning a sample of potential consumers of the environmental good. Thus, CV is a direct method that involves asking a sample of the relevant population questions about their WTP or WTA. The valuation is contingent on the hypothetical scenario put to respondents. Its main use is to provide inputs to analyses of changes in the level of provision of public goods/bads, and especially of environmental commodities, which have the characteristics of non-excludability and non-divisibility.

It was in 1947 that the first published reference to CVM was made by the Berkley economist, Ciricacy – Wantrup, when he wrote about the benefits arising from prevention of soil erosion. It was Davis who designed and implemented a contingent valuation survey for the first time in 1963. Davis tried to find the value of a particular recreational area to hunters and wilderness lovers by directly asking them to state their WTP for protecting this site. In sum “contingent valuation is defined as any approach to valuation of a commodity which relies upon individual responses to contingent circumstances posited in an artificially structured market”. [Seller, Stoll & Chavas, 1985, p.158]

Ruud Hoevenagel writes, in this connection, that “The principal idea underlying this method is that people have true, but hidden, preferences for all kinds of environmental goods. It is further assumed that people are capable of transforming these preferences into monetary units”. [Hoevenagel, 1994, P.195]. This method therefore tries to bring out in the open the `hidden preferences’ of people through surveys.

CVM elicits the WTP/WTA through surveys. Unfortunately, no standard approach for designing the CV surveys exists. However, there are certain elements that almost all the applications of the CV surveys incorporate. These elements are : [1] The survey must contain a clear description of the scenario that a respondent is asked to value or vote for [2] It must also have a mechanism for eliciting the value, and [3] It usually tries to get information on the socio-economic features of the respondents. It may also contain follow up questions.

The mechanism used for getting the CV from respondents takes various forms. Some of these forms are “open-ended questions (….), bidding games (….) or referendum formats (….)”, [Portney, 1994, P.6]. The CVM tries to collect the information on the value of non-market goods from the respondents. The question then arises is that can these values be used to assess damage resulting from environmental degradation. For this purpose, National Oceanic and Atmospheric Administration Panel indicated important guidelines that should be met if the CV is to be used for assessing the damage. Some of important guidelines of the panel are:

[1] CVM should elicit the value through personal interviews rather through telephone/mail.

[2] It is better to get information on WTP for preventing future incidents rather than WTA for accepting minimum compensation, after the damage is done using the CV surveys;

[3] Referendum format should be used for CV surveys.

[4] The CVM should clearly and understandably describe the scenario that is to result from the programme/policy which the respondents are expected to evaluate/vote for.

[5] There should be reminders to the respondents in the CV surveys.

[6] The respondents should also be reminded of the substitutes for the commodity being valued in the CV surveys.

[7] The CV surveys should contain follow-up questions.

If these seven important guidelines are met then only the application of CVM can be acceptable for estimating the damage.

As against Contingent Valuation Method (CVM) some economists use indirect methods [IM] that exploit data on observed actual behaviour. But, CVM has two distinct advantages over the indirect methods. First, it can deal with both use and non-use values, where as IM covers only the former and relies on the weak complimentarity assumption. Weak complementarity between Z [environmental good] and Q means that Z becomes so expensive that a consumer no longer consumes any of it, the consumer also stops caring about Z. Z and Q, thus become complements, i.e. they go together. Second, in principle, and unlike the IM, CVM answers the WTP/WTA questions that directly arrive at the theoretically correct monetary measures of utility changes. Though CVM is applicable for estimating both use-value as well as non-use value, it is most frequently applied to estimate non-use i.e. existence value. Thus, the CVM has the advantage that it has potential of valuing a variety of environmental goods. “Moreover, as the CV method is independent of an existing data set, it has great flexibility”. [Hoevenagel, 1994, P.252].

There are some quite serious disadvantage from which CVM suffers. We now, discuss some of them. There are quite a few biases that are inherent to CVM technique.

[1] The most obvious bias is termed as **‘hypothetical bias’**, which is reflected in the statement, “ask a hypothetical question and you get a hypothetical answer”. [Seller, Stoll and Chavas, 1985, P.158]. The CVM provides answers that depend upon the “state of the world” described. Estimating the extent of hypothetical bias is extremely difficult, if not outright impossible. This is so because the answers to CV surveys not only depend on the structure of the experiment but they also get affected by the “uncontrolled” factors of the future. Further, the answers are only intentions to pay and no exchange of actual money takes place. There are other biases as well.

[2] **Strategic bias:** This is a bias that results from the fact that individuals may not be truthful in answering the questions on WTP/WTA or may even try to influence the outcome. “In particular, the free-rider problem would give individuals incentives to misstate their preferences”, [Schulze, d’Arge & Brookshire, 1981, P.156].

[3] **Information bias:** The bias enters because in the CV surveys we are not exposing the respondents to real life situation and the answers are not ex-post statements. We are eliciting response to a hypothetical situation, which the respondents are made to understand and visualize. Their answers, therefore, turn out to be ex-ante responses. Thus, the results of the surveys depend upon the art of asking questions and are, thus, vulnerable to abuse.

[4] **Instrument bias:** In this case it is the mechanism through which responses are elicited that influences the final outcome. There are basically four methods of eliciting the responses regarding maximum WTP from the respondents. These methods are [1] the direct open-ended question method,

[2] the bidding game; [3] the payment card and [4] the take-it-or-leave-it method.

Direct open-ended questions will result into fewer reliable responses as compared to other methods of eliciting the responses. This is so because in real markets consumers decide the quantities to be purchased at given prices and are not used to reflect on maximum prices. Further, they have no idea about environmental goods that they are asked to value. In this case, the respondents may be offered Dichotomous-choice questions. The Dichotomous-choice questioning mode offers binary valuation. Other popular questioning modes include open-ended and unanchored payment cards. The Dichotomous choice questions while providing monetary amounts may give a value clue to the respondents and thereby affect their responses. Open-ended questions do not give us binary valuation but this method also creates concerns regarding data screening. “Open-ended questions typically result in zero bids and these bids are screened for protests and other types of invalid responses”. [Boyle & Bergstrom, 1999, P.198]. Kristrom developed a `spike' model “where respondents are allowed to have a spike at zero [the proportion of respondents with zero WTP”. [Kristrom, P.782]. This of course does not rule out the possibility of contaminating the data. As a way out Cooper and Hanemann developed “one-and-a-half bounded valuation question”. This model is similar to the spike model but in this case no further questions are asked if a respondent answers `no' to the first question regarding WTP/WTA. This reduces the risk of contamination of data. This sort of starting point biases occur if the finally reported WTP gets affected in a systematic fashion by the respondent's first bid. This is so because CV surveys frequently are nothing else but bidding game. Protest bids is not the only problem that we have to deal with in CV surveys. One my end up getting a high rate of unusable responses at the end of the day. This is so because large number of people have never stated their bids for an environmental good and they may not have well-formed preferences for such goods.

The Payment Card method offers a card with different WTP values to the respondent from which he selects his maximum WTP. This card provides a visual aid to the respondent. This method has an advantage that it is similar to direct open-ended questions and also improves the response rates for WTP. The disadvantage is that the respondent may use the values on the card as clues, which results into range bias. As against this, the Take-it-or-Leave-it method gives only one single amount to respondent and asks him whether he is WTP or not. In sum, all the four methods of eliciting maximum WTP value suffer from biases and problems.

There are other biases over an above the ones discussed above that enter the CV surveys. These biases could be sampling bias, non-respondent bias and interviewer bias.

Theoretically WTP and WTA are expected to be close to each other on account of the expected small income effects. Empirically the reverse is observed to be the case and large discrepancies between the two are observed. Kahneman & Tversky advocated `prospect theory' which tried to explain these discrepancies by arguing that respondents shift the reference point while valuing equal amount of gains and losses.

Thus, there are problems of precision and credibility of responses. Problems of precision are concerned with the variability in responses and are usually taken care of by increasing the sample size. Problems of credibility cannot be taken care of by increasing the sample size. One such problem is what is known as the "embedding effect" which was analysed systematically for the first time by Kahneman and Knetsch in 1992, "The embedding effect is the name given to the tendency for willingness-to-pay responses to be highly similar across different surveys, even where theory suggest (-----) that responses be very different". [Diamond & Hallsman, 1994, P.46]. The embedding hypothesis implies that people are not sensitive to the level of public goods.

In sum, WTP and WTA diverge from each other considerably. WTA is typically found to be three or more times larger than the WTP. Hanemann in this connection argues that this disparity involves something more than the income effect. It involves substitution effect as well. He notes that discrepancy will be larger if the substitution elasticity is lower.

The CVM has been widely used to value conservation of certain sites and species. This approach mainly concentrates on non-use value of environmental goods. CVM can also be used to estimate the damage costs of an environmental hazard, provided the conditions specified by the National Oceanic and Atmospheric Administration Panel are satisfied. Some economists also use Contingent Ranking, which is very similar to CVM. The main difference between these two methods is that in Contingent Ranking the interviewer only obtains a ranking of preferences that can be later on expressed in terms of real price. This approach is also known as conjoint analysis in which the interviewer "asks the respondent to rank a set of alternatives describing environmental qualities obtainable at certain costs". [Kristrom, P.784].

[B] Indirect Methods: [Revealed Preference Method]

On account of very many problems associated with direct methods and on account of the fact that there is no unique undisputed method of valuing environment some economists, use indirect methods of valuing environmental goods. In these methods one tries to capture the value of a non-marketed good indirectly by observing the value/price of a marketed good as a surrogate. These methods consist of two approaches, viz. Hedonic Pricing and Travel Cost. We briefly discuss these methods now.

(i) Hedonic Pricing Method [HPM] :

The HPM is an indirect method of getting the value for an environmental good by using the related market approach. Thus, it is contested that consumers choose the level of consumption of a non-market good by choosing market good that is related to the good in question. Hoevenagel has this to say for HPM, "This valuation method is based on the notion that market goods provide buyers with a variety of services, some of which may be environmental qualities". [Hoevenagel, 1994, P.258]. Thus, it is argued in this approach that the explicit price of a product captures the implicit or hedonic price of various attributes of the product. This approach, in sum, is based on the characteristics theory of value first proposed by Lancaster in 1966 and then by Sherwin Rosen in 1974. "Hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them". [Rosen, 1974, P.34].

The HPM, similar to the household production function, is based on the assumption of weak complementarity. It thus looks at differentials in property values for different locations and tries to separate out the effect of an attribute of the property on these values. It therefore becomes essential to define the market commodity, [i.e. housing] and the environmental attribute whose implicit price is required to be estimated. The hedonic price function establishes a functional relationship between the market price and the environmental attribute, i.e. air quality. The coefficient on the attribute, known as the marginal implicit price of the attribute, is estimated using multiple regression techniques. Ridker and Henning were the first to apply HPM in 1967 and they used three stages to derive the demand function for the environmental good. In the first stage hedonic price function is estimated by regressing the price of the property on different attributes including environmental good. The second stage involves an estimation of implicit price for the environmental good of our interest, and, lastly a demand curve for this attribute is derived by using soico-economic characteristics of the property owners.

The property value is affected by large number of variables which can be grouped as [a] structural or site specific, like number of rooms, built-up area, number of bathrooms, age of the house, etc. [b] Accessibility variables like distance from workplace/school/garden/market/other social amenities; [c] neighbourhood variables like crime rate, quality of school, racial composition of population, etc. [d] Socio-economic variables like income, education, size of family, number of children etc., and [e] environmental variables like ambient air quality in terms of SO2, NOx, SPM etc.

The value of a property also gets affected by expectations regarding the future real estate price movements. A whole host of variables influence property prices and rentals. The HPM tries to estimate the implicit price of these very many attributes of a property.

Assessment of HPM :- This method like any other method, is based on number of assumptions. The maximum WTP is assumed to be represented by the price paid for the house. This can happen if each household is assumed to be fully informed, is able to perceive the effects of air pollution fully and is in a position to buy the exact quantities of all the attributes of a house that it wants. That is this method assumes a freely functioning efficient market for housing.

The advantage of HPM is that it is highly intuitive. Sometimes this method is preferred over the surveys as it directly gives marginal WTP by observing the market for housing. HPM is also used for analyzing differentials in job payments resulting from different characteristics of various jobs.

There are number of limitations from which HPM suffers as a result of which researchers using this method face very many problems. These limitations are :

[1] The method is based on the assumption of equilibrium in the housing market. The housing market in fact is often distorted by government intervention. Frequently the full effect of air pollution cannot be clearly perceived and understood by households. Besides the assumption of full information it is also assumed that there are no moving or transactions costs and there is instantaneous price adjustment with changes in demand for and supply of housing.

[2] Hedonic prices will not be able to generate valid estimates of WTP for environmental quality changes if the households are not able to fully comprehend the environmental risks.

[3] If the households are forced to accept corner solutions, on account of the fact that a sufficiently large variety of goods giving us continuous spectrum

of choices may not be available, then they may not be able to actually buy the combination of characteristics they desire.

[4] The omitted variable bias may exist resulting into biased coefficient for included variables.

[5] The problem of multicollinearity is the most common problem faced by most of the researchers using HPM. Thus, it is most likely that we end up having environmental variables that are collinear forcing us to drop some of them or to estimate a separate equation for each one of them. If we do not make any adjustments for multicollinearity then we will not be able to have an acceptable estimate of implicit prices.

[6] Hedonic prices may give us an overestimation of WTP as the hedonic price not only includes the present benefits but also includes the valuation of stream of expected future benefits.

[7] Economic theory specifies no particular form of HP function. The HPM requires a fairly complicated empirical model to be able to estimate the implicit prices of the attributes from the market good. This is an important issue as the choice of the functional form influences the implicit price of the environmental good of our interest.

[8] Since all the required information may not be readily available the researcher has to go in for data collection. In this regard, Sahu, Nayak, Maharana and Nayak observe, “Moreover, while collecting data regarding property values, we must see that they are from actual market. Since only a small percentage of the total owner-occupied housing stock may be sold per year, collection of large enough sample data may be difficult”. [Sahu et.al., 2000, P.21].

[9] Another limitation of this method is that it does not estimate the non-use value of an environmental good.

Inspite of these difficulties people have used HPM to estimate the implicit price of clean air. This method is not as popular as CVM.

Hugo van Zyl, Thomas Store and Anthony Leiman reviewed a study by Asabere that used the HPM for determining the Land Value in Accra, the capital of Ghana. Asabere [1981] used a value equation incorporating both demand and supply side of the land market. This study used six sets of variables, viz. [I] access variables; [ii] government zoning variables; [iii] culturally rooted variables [iv] time scale variables; [v] site services variables and [vi] Variables of lot size.

This study did not have any environmental good as one of the variables whose implicit price was to be estimated.

Piyush Tiwari and Hiroshi Hasegawa have studied the Mumbai housing market, covering a period from 1989 to 1995. They observed that the supply of houses in Mumbai is inelastic. The inelastic supply of houses gets reflected into the fact that even dilapidated houses are not withdrawn from the market. Tiwari and Hasegawa applied two models, one with explicit time dummy variable and another strictly cross-sectional model. They use the data available with "the largest house-mortage company in India, for the period 1989-1995" [Parikh & Hasegawa, 2000, P.152] to develop house price indices for Mumbai. They made interesting adjustments to reported value of the house to estimate the proportion of money paid in cash. In other words, they made adjustments for under-reporting of the value of houses. Theirs "is the first initiative to develop house price indices for owned houses in any city in India. A comparison of the hedonic model with explicit time dummy and the cross-sectional hedonic model indicate superiority of the latter for Mumbai". [Tiwari & Hasegawa, 2000, P161]. Thus, they used hedonic pricing model for Mumbai. But, they also did not address the problem of estimating the impact of air pollution on property value as captured by the implicit price of clean air reflected in the hedonic price function.

In another interesting study for Bombay Metropolitan Region, Piyush Tiwari and Jyoti Parikh attempted to build the demand function for houses. They estimated the demand function of housing in a two-step econometric exercise. "The first step estimates the hedonic price index for different regions in Bombay, and in the second stage the demand for housing is estimated as function of economic and household characteristics". [Tiwari & Parikh, 1997, P.295]. According to them only two housing-demand studies have been undertaken in India, one was in 1980 and another in 1989. They used the data available in the survey conducted by the Operational Research Group, Baroda, for households in Bombay. They estimated the hedonic price function by taking rent as a dependent variable and log [Rent] was regressed upon number of housing characteristics. These characteristics were classified as Locational Variable [minimum travel distance from the Victoria Terminus and the Church Gate]; Shelter Related variables [size of unit, number of rooms, type of building, and age of the building]; and Amenities [availability of water, power and toilet facilities within the premises]. For estimating the housing demand function they used Housing expenditure, Neighbourhood characteristics [dummy for the mother tongue] and, / Household characteristics [household size, number of married couple, years of stay, income, commitment to city, Employment status, years of employment and crowding] as independent variables. They concluded by observing that "marginal propensities to consume housing for both owners and renters in Bombay are almost the same for the two groups. Typical cross-section income elasticities are around 0.3 for both owners and renters, although there is a weak tendency for renter elasticity to be slightly higher". [Tiwari & Parikh, 1997, P.314]. This is an interesting study but this study, also like the one undertaken by Tiwari & Hasegawa, did not take environmental quality as one of the characteristics of houses.

An interesting study undertaken by Madhu Verma under the World Bank Aided India : Environmental Management Capacity Building Technical Assistance Project Scheme is one of the two studies that have come to our notice that used HPM and an environmental attribute, for any city in India. This study incorporated the nearness to Bhoj lake as an environmental attribute and concluded that people are ready to pay around 50% more for a property that is on the lake side. As against this, we are trying to capture the effect of air pollution on property price/rent as air pollution does result into damage to property as seen in the discolouration of property and corrosion of metal. We have come across a recent study undertaken by Murty, Gulati and

Banerjee that comes very close to the present study. These authors addressed themselves to the problem of estimating household's marginal willingness to pay function for air quality using hedonic property price method. They estimated marginal willingness to pay function for air quality for the two cities of Delhi and Kolkata. This is what they have to say in this connection, "Given the price of a product as a function of its characteristics, by differentiating this function with respect to a characteristic, one could derive the consumer marginal willingness to pay for that characteristic". [Murty, Gulati, & Banerjee, 2003, p.3]. This study is directly relevant to our project as it also used perception about air quality as one of the explanatory variables in their hedonic property price function. They used monthly rent as their dependent variable. From this equation, they derived the marginal willingness to pay function. "The marginal willingness to pay for unit changes in the concentration of SPM or implicit marginal price for environmental quality is estimated using the following expression.

$$\frac{\partial\,(\text{Monthly Rent})}{\partial\,(\text{SPM})} = [\text{Coefficient of SPM – in Eq. 7}] \times \frac{\text{Monthly Rent}}{\text{SPM}}$$

$\downarrow$

(i.e. hedonic price function)

The household marginal willingness to pay function for the reduction in SPM is estimated by regressing the implicit marginal prices on income, education and other socio-economic variables and SPM concentration (the inverse of the environmental quality)". [Murty, Gulati & Banerjee, 2003, p.11, & p.15]. Taking this approach into consideration we have also tried to estimate the marginal willingness to pay function in our study.

In sum, we have come across only three published studies that use HPM in the property market for India. Only one of them has taken air quality as one of the variables influencing property prices. It, thus, appears that ours is the first study to apply HPM incorporating air pollution as a characteristic of housing, for Ankleshwar GIDC. We now briefly discuss the Travel Cost Method as an indirect method of valuing environment.

(ii) <u>Travel Cost Method : [TCM]</u>:

It is also an indirect method of deriving a demand curve through revealed preference approach. The TCM is used for valuation of a recreation site. "With this method, demand curves are estimated for the recreation site using travel costs as a surrogate for the price of the site". [Seller, Stoll and Chavas, 1985, P.157]. Thus, TCM estimates the amenity value of outdoor recreation sites. This method is based on the assumption that people will keep on visiting a site till the marginal value of the last trip equals the travel costs. TCM consists of two stages. "In the first stage, the number of visits to a site is regressed on own travel costs, the travel costs to substitute sites […], the households income and a set of preference and behavioural variable [….]. In the second stage, the value of the site is obtained by calculating the area under this visitation trip curve, above the mean travel costs'. [Hoevenagel, 1994, P.259]. The TCM is most effectively applied when visitors to a recreation site travel from a wide range of distances. This method is not appropriate for studying environmental degradation and the costs associated with such degradation. Like any method the TCM also has quite a few limitations from which it suffers.

[1] **Time Costs:** Costs incurred in terms of travel time assumes that the visitor does not enjoy travelling. If the visitor enjoys the scenic beauty while travelling then the time spent to reach the site will be a benefit and not a cost.

[2] **Multiple Visit Journeys:** It is quite possible that an individual may not visit only one site but may visit number of sites on the way then it will be very difficult, if not outright impossible, to apportion the time for each and every site that he has visited and estimate the travel cost for a particular site.

[3] **Substitute Sites:** An individual may keep on visiting a given site repeatedly not because he values it very much but may be because there are no substitute sites available for outdoor recreation. In such a case we may end up overestimating the value of a given site.

[4] **House Purchase Decisions:** It is quite conceivable that an individual values a given site so high that he purchases a house near the site, with the

effect that his travel cost turns out to be very low. Under such a circumstance we would have a considerable underestimation of the value of that particular site.

[5] **Non-paying Visitors:** Quite frequently, people, staying nearby, may just walk down to the recreation site. This will underestimate the value of that particular recreation site.

[6] **Functional Form :** Economic theory does not specify any functional form to be used to study the relationship between visits and travel costs. The choice of functional form does influence the results, making them suspect.

[7] **Use-value Alone :** the TCM restricts itself to the use-value only and ignores the existence or non-use value of the recreation site.

[8] **Data Requirement:** TCM requires huge primary and secondary data on the recreation site, distance, time, value of time, existence or otherwise of substitute sites etc.

It, of course, has the advantage that this method attempts to measure benefits by observing the market behaviour.

Having discussed the three methods that can be used to value environmental goods through demand approach we now discuss our methodology and data collection in the next section. Since we are not addressing ourselves to valuation of recreational site we will not use TCM.

Section–IV: Data Collection and Analysis

(i) Data Collection

"Revealed Preference techniques are not controlled experiments, but they still almost always require survey work since they depend on non-market behaviour; just as Stated Preference techniques require detailed surveying."

(Bockstael Nancy and Kenneth McConnell in J. A. Herriges and C. L. Kling, 1999, pp.29)

The need for undertaking the primary survey, therefore, arose from the use of these twin techniques, namely, Hedonic Property Value Method (Revealed Preference technique) and Contingent Valuation Method (Stated Preference technique), in the valuation of environmental quality (here Air quality) in an industrially developed township of Ankleshwar situated in the Bharuch district of Gujarat.

The study area chosen qualifies as what Hamish Main and Stephen Wyn Williams would like to call, a Marginal Urban Environment, a common feature in many of the industrial townships/cities in the Third World. As they put it, "Marginal Urban environments are sited in and/or around negative externalities. These negative externalities are natural or man-made features of urban environments (eg. Industrial production sites) that make nearby residence unattractive because they entail actual or potential ongoing problems for local residents (for eg. Airborne pollution, Waterborne pollution, crowds of workers, noise) and/or threats of disaster (for eg. Gas leak/explosion/epidemic)." (Main H. and S. Williams, pp.571)

Our survey aims at tracing the behavioral impacts (on residential housing decisions) of an environmental change (here, air quality). The behavioral response has been gauged within the hedonic property value framework, wherein, the varying prices of property (residential and commercial) form our Dependent Variable. This Dependent Variable is a functions of the Structural (eg. Plot-size, number of rooms, bathrooms etc. of the property), Accessibility (accessibility to amenities like schools, parks, transport, communication services, safe neighborhood etc.) and Environmental (namely, availability of Ambient air quality) characteristics in a given locality. Environmental amenities/characteristics are a locational feature and hence, theoretically, should get reflected in the price of the land alone. However, in real market situations, the price of the land is embedded in the structural characteristics of the house and hence the observed market price is the price of the land and the house together (Freeman, 1993, pp.375). Even if we are not considering the pollution effect, secondary sources of characteristic-wise data for residential properties are unavailable requiring primary survey of the actual sales price of a residential/commercial property along with its characteristics.

Although a number of environmental economists have attempted combining revealed and stated preference techniques, [see Adamowicz, J. Louviere, M. Williams (1993), Darling (1973), McConnell, Weninger and Strand (1999), Englin and Cameron (1996)], the basic idea underlying this survey strategy needs some explanation. Explaining the difficulties in welfare analysis by employing revealed preference techniques, Bockstael and McConnell (1999) argue that there are numerous hedonic studies that seek only to establish that housing values vary with environmental amenities, *without* attempting to value the change in the environment. An obvious solution provided by them is to combine contingent behaviour with actual behaviour, that is, combining questions (in the survey) about what individuals have done (indicating revealed preference experiment- observed behaviour) *along with* questions about what they would do (Stated preference experiment – contingent behavior). The use of the contingent behavior in the survey helps in deciphering the link between the environmental change and the behavior, which is never made explicit under the revealed preference framework.

The Survey Method

The industrial town of Ankleshwar has been divided into two broad categories as per the requirements of our study: one is The GIDC Notified Area which formed our Experimental Group and the other is The Ankleshwar Town Area which formed our Controlled Group.

The housing demands in the GIDC area primarily cropped up from the large number of employees working in the estate. The residential area of GIDC has over the years become a dense landscape of low cost housing units (as provided by the GIDC), Company quarters and Colonies as well as Private Housing societies. Basic amenities like drinking water, drainage and sanitation, schools and parks etc. are available; however, the area's proximity to the GIDC industrial zone made it extremely vulnerable to the onslaughts of air pollution. Respondents in this area suffered from respiratory problems (with cough and cold being a common ailment especially among children), stench (from the nearby industrial units), alongwith visibility problems (due to smog and gas in the atmosphere) particularly during the monsoon and the winter season. The Area is a composition of both, lower middle to upper-middle income categories with education levels (particularly of the head of the household) ranging from Secondary to Higher Education. The Ankleshwar Industrial Estate (AIE) is primarily considered an employment-base and hence most of the employees working within the estate preferred to live on rent rather than buy property and settle down on a permanent basis. In the private housing colonies however one found plenty of examples of people who were settled in the area for quite some time now.

The Ankleshwar Town, on the other hand, is made up of mainly private settlements, planned housing societies are however few and unplanned, haphazard residential colonies are a common sight. Basic amenities like drainage, sanitation, drinking water, availability of recreational facilities like cinema halls, parks and educational facilities like schools, colleges are either scarce or unavailable. The town is far from the industrial site of GIDC and has noticeably cleaner air as compared to the GIDC residential area.

Other than these two areas, Bhavna Farm, situated near/on the Rajpipla Highway formed our semi-target group and also an important area as our pilot tests focused on this area for pre-testing the questionnaire (survey instrument). The importance of this area is further accentuated by the fact that the societies/residential units fall in the wind direction from the industrial zone of the GIDC. Respondents in this area suffered from both the lack of basic amenities like clean drinking water and experienced, corrosion of iron fittings such as grills, vehicles and health related problems (eg. Skin infections, respiratory problems etc.) due to air pollution.

The Pre Testing Phase

The questionnaire was first tested in the Bhavna Farm Area for about thirty households. The user values for air quality were important. Educational levels and Incomes of the respondent were added in the final questionnaire. What was interesting to note were positive responses from the lower income households in this area in terms of our hypothetical market scenario questions gauging the willingness to pay in order to curb or lessen air pollution.

Thus, before collecting the data a questionnaire was canvassed for a pilot survey covering about 30 households. Based on our experience of the pilot survey the questionnaires were changed and finalized. In the pilot survey we tried to ask open-ended questions for WTP and WTA but the respondents had no idea, not even a rough one, about what to state as their WTP. Based on their suggestion and the experience of field investigators it was finally decided to go in for close-ended/dichotomous questions. The respondents after looking at various brackets for WTP/WTA decided to give an amount for WTP/WTA which was not necessarily in the specified brackets.

The Survey Instrument

Of late the industrial recession in the estate has brought about a negative impact on the demand for housing. Though air pollution, was something the residents in this area could not deny, they still however maintained that it is the employment opportunities in the GIDC coupled with provision of basic amenities and infrastructure that made the estate attractive at least for a temporary working period.

The survey was divided into : Questionnaire for the GIDC Residential and Commercial Area, for the Ankleshwar Town plus a questionnaire for the Real Estate agents with a purpose of professional assessments regarding the behaviour of the housing market in Ankleshwar town and GIDC. We, thus, had three sets of questionnaire - one for GIDC residents, one for Ankleshwar town residents and one for Real Estate agents.

The Secondary Sources of data that helped in our primary survey include the following:

(a) Society List for the GIDC region from the AIA office.

(b) GIDC and Ankleshwar Town Maps from the District Sub-Registrar's Office.

(c) Data on Land prices for the Ankleshwar Town as well as records of residential properties transacted for the years 1995-2000 for the same area.

(d) Air quality data for two monitoring stations situated in the industrial/commercial and Residential region of the town, eg, Durga Traders and Rallis India; only for a limited number of years.

(e) CPCB publications as well as independent air quality monitoring by the Environmental Engineering Laboratory, M. S. University of Baroda and also conducted by the CPCB zonal office in Baroda were relied upon for air quality data.

The Questionnaire for the GIDC Residential Area

The head of the household (that is, the earning member of the family) was taken as a representative for the household being surveyed. The first section of the questionnaire, therefore, related to the socio economic characteristics of the household namely family size, sex of the respondent, income, and education level. For the commercial enterprises additional information pertaining to the size of their commercial enterprise, number of employees, and annual turnover were also asked. The second section studied the structural characteristics of the Residential/Commercial Property (eg. Built up Area, number of Rooms, Bathrooms, storehouse area) alongwith information regarding year and cost of construction, Purchase and Rentals etc. Perception regarding the change in property prices in the three areas namely, Ankleshwar Town, GIDC Notified Area and Bhavna Farm backed up by estimated increases/decreases in the prices of their own residential/commercial units were gauged. The distance from residence to work, accessibility to the nearest school, market place, garden, theatre formed the third section of our questionnaire.

The environmental amenities in the locality were traced through questions on perceptions towards air pollution in the area, the need to keep doors and windows closed on account of air pollution as well as the reasons influencing shifts in residential locations.

The subsequent questions aimed at gauging the respondent's perception about the behaviour of property prices in the GIDC area and the reasons behind the behaviour. Although most of the respondents agreed to declining industries and lower opportunities as one of the main reasons for the decline in property prices, air pollution (along with water pollution) ranked a close second in the respondents' list of important factors leading to a fall in the residential property prices.

Maintenance costs incurred by the respondents were mainly recorded in terms of painting and repair / maintenance bills.

Finally, the hypothetical segment of our questionnaire needs some elaboration into the method of conducting the survey.

Both WTA and WTP questions were used to elicit monetary values for air quality. The questionnaire depicted a close- ended format, however, during the field survey open- ended method of depicting hypothetical market scenarios to the respondents proved more effective. Two separate hypothetical scenarios were verbally provided by the field investigators conducting the survey:

(1) For the WTA question, the respondents were given a situation of rising air pollution due to increased industrialization, which showed up in their monthly/annual medical expenditure. Given the compensation vehicle (here medical bills) the idea was to trace the respondent's pecuniary attitude towards an arrangement where the government of Gujarat would be ready to compensate, that is, pay up the medical bills of the respondents in a given area. Apart from already mentioned monetary values in the questionnaire an open-ended format where respondents could mention their *own* monetary amounts as compensation was followed. The respondents were asked whether they were WTA a given amount as compensation for a 50% increase in air pollution. If they answered affirmatively then the amount was further reduced. This was done up to a point where they answered in the negative to a given amount as a compensation. Alternatively, they were asked to specify an amount below which they were not willing to go. This gave us their minimum WTA for a 50% deterioration in air quality.

(2) For the WTP question, a hypothetical situation of a Non Governmental Organization working for a reduction in air pollution in the respondents' residential locality was given and they were asked their willingness to share a part of the costs that the NGO incurred for reducing air pollution in their locality. Once again, the monetary amounts though were clearly mentioned in the questionnaire, expressed preferences were collected through bidding upward/downward the monetary amounts as stated by the respondents in order to reach a more or less accurate elicited amount. This gave us their maximum WTP for a 50% improvement in air quality.

Questionnaire for Ankleshwar Town

The controlled group questionnaire followed the same questionnaire format however the section on hypothetical markets was revised. Open-ended format of investigating the households was used for eliciting monetary amounts for both WTA and WTP questions. The WTA format was revised to include the contingent situation wherein air pollution levels were to rise as high as that of GIDC and the likely compensation expected by the respondents under such a kind of a situation. While the WTP question evaluated the importance of comparative levels of clean air in Ankleshwar town through the monetary amounts people would be willing to pay to maintain the current levels of air quality.

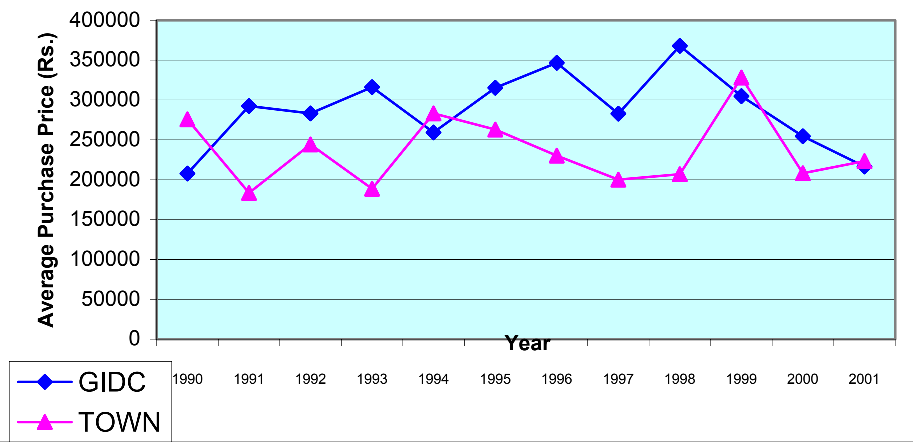
Questionnaire for Real Estate Agents

One of the most difficult parts of the survey was tracking down the real estate agents. The questionnaire was primarily aimed at tracing the important peak and trough property price years in the township alongwith areas with high (favorable) property prices. Information pertaining to the Black-white ratio in the residential and commercial property segment were collected. The behavior of real estate prices in the important residential and commercial localities in Ankleshwar as a whole, i.e. GIDC & town taken together, since the time of inception of GIDC till the present times with causes and impact of the behaviour were recorded.

Before we analyse our data in terms of socio-economic characteristics of our respondents, it would be interesting to get an idea about the property price behaviour and air pollution behaviour. This is done with the help of three graphs covering a period of 12 years, i.e. from 1990 to 2001, and observing the price behaviour of property alongwith the changes in air quality.

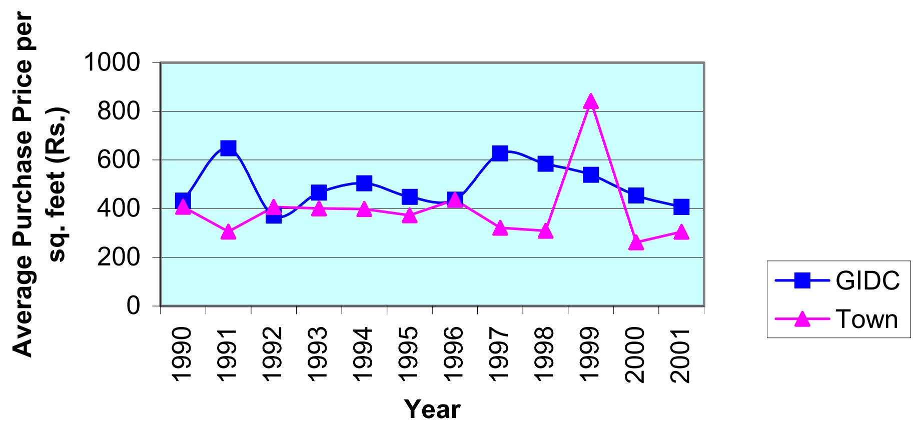
Graph No.1 shows the behaviour of average purchase price of residential property in Ankleshwar GIDC and Town. These are the mean values of residential property prices that were quoted in our questionnaire by the respondents from GIDC and Town. It can be readily seen from this graph that the average prices of houses in these two areas have not shown much of a link. That is the peaks and troughs for GIDC did not match those for the town. The highest average price for property in GIDC was registered in 1998 and the same in Ankleshwar town was in the year 1999. On account of the industrial recession, the property prices continued to fall after 1998 in GIDC. This was not the case for town, where property prices, on an average, seemed to be moving up in 2001. A note of caution that these are average purchase prices as reported by our respondents and the size of the property does influence the price of the property. There are, of course, many other factors that influence property prices, size being just one of them. We, therefore, thought it appropriate to look at the behaviour of property prices per square feet of built-up area.

GRAPH : 1. Average Purchase Price of Residential Property in GIDC & Town of Ankleshwar



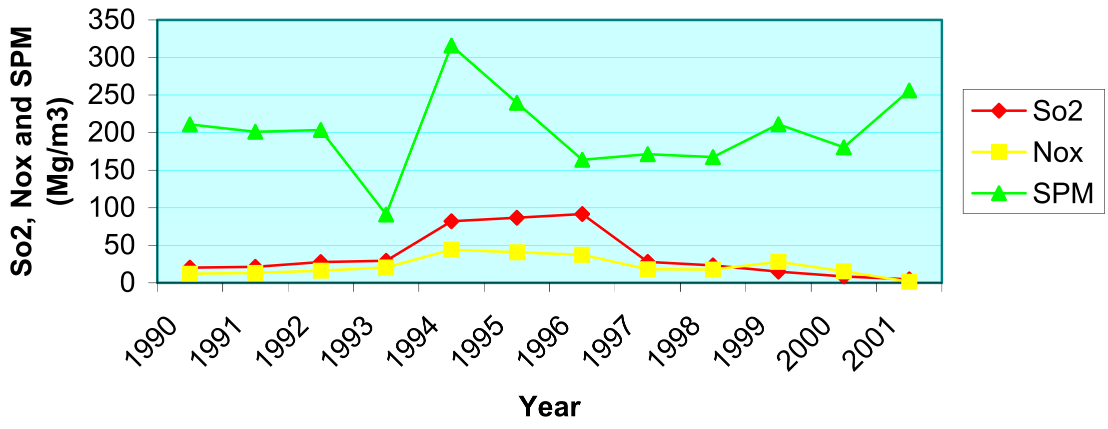
Graph No.2, gives us the information regarding property prices per square feet of built-up area in GIDC and Town. The general trend of price behaviour is not expected to be different in graph-2 as compared to graph-1. Comparing these two graphs we notice that in 1990 the average price of a house in Ankleshwar town was much higher than the one in GIDC (graph-1), but the average price per square feet of built-up area (graph-2) turned out to be marginally lower in the town as compared to the one in GIDC. It is only in 1999 that the average price per square feet of built-up area was way higher in the town as compared to GIDC (ignoring the years 1992 where the difference was marginal). The property price in the year 2001 was marginally higher in the town as compared to the GIDC. This was not the case for the price per square feet of built-up area, which turned out to be much lower in town in comparison to GIDC, in 2001. In sum, we can conclude that on an average residential property was costlier in GIDC as compared to Ankleshwar town.

GRAPH : 2. Average Purchase Price per sq. feet of Built-up Area of Residential Property in GIDC & Town of Ankleshwar



Graph No.3 shows the concentration of three air pollutants, viz. SO_2, NOx & SPM, in Ankleshwar GIDC over a period of 12 years. These are the values that we got from our consultant, Dr. N. M. Bhatt. After 1996 Sulfur Dioxide (SO_2) and Nitrogen Oxide (NOx) showed no signs of rising. This was mainly on account of industrial recession and should not be treated as an effective control of air pollution. SPM did show some increase in 1999 and 2001. SPM is not necessarily a result of industrialisation as we come across instances, like Rajasthan, where SPM concentration is very high but industrialisation is not much to write about. This is not to say that SPM is not an air pollutant resulting from faulty industrial policy. From 1990 to 1996 SO_2 and NOx show a rising trend and from 1997 they show a declining trend. Looking at all the three graphs together we notice that after 1996 the property prices in GIDC and the concentration of SO_2 and NOx have shown a clear tendency to fall. This further supplements our argument that falling property prices in GIDC were not the result of rising air pollution but the result of industrial recession. We failed to see any falling tendency on the part of property prices in Ankleshwar town after 1996. We may end up getting an absurd result where improvement in air quality results into loss of property value in GIDC. Any way, as noted earlier the relationship between property price and air pollution is not expected to be very strong. It is expected to be a weak relationship useful in showing the direction rather than magnitude of the impact of air quality on property price. This relationship is studied econometrically in a later part of this section. But, before that, a discussion on the socio-economic background of our respondents.

GRAPH : 3 Concentration of So2, Nox and SPM in Ankleshwar GIDC



(ii) Data Analysis Socio-economic Characteristics of the Respondents :

The GIDC Ankleshwar Region

It would be of interest to get an idea about certain features of our sample from different parts of GIDC. From the information collected it seems clear that GIDC is divided clearly into two zones of North and South in terms of socio-economic features of the respondents.

Table-4 brings out interesting features of our respondents in terms of their socio-economic and housing characteristics. On an average the houses in North of GIDC were marginally smaller in size in terms of built up area; had less number of rooms, bath rooms and toilets; were built at much lower cost of construction; purchased at lower prices; fetched lower rents and had lower expected prices; as compared to houses in the South of GIDC. The maximum purchase price for a house in South of GIDC was Rs.21,50,000 and the minimum was just Rs.14,000. As against this the maximum and minimum prices of houses in North of GIDC turned out to be Rs.4,50,000 and Rs.35,000, respectively. The average price of a house in South was higher than that in the North of GIDC.

Majority of our respondents were residing in the South of GIDC. Looking at the socio-economic variables we note that on an average respondents residing in the north of GIDC had a much lower annual income [lower than Rs.58,000] as compared to residents of the South of GIDC [slightly more than Rs.1,00,000]. Further, residents of the north of GIDC on an average had marginally larger size of family and larger number of children. One also observed a considerable concentration of single room houses in the north and these residents did complain about severe problems of air pollution at night, particularly after mid-night, when the industrial units released gases illegally.

Similar exercise was undertaken for the commercial premises as well. Majority of the observations were from the South of GIDC and only two were from the North of GIDC. So the comparison between these two regions makes no sense.

Table-4: Shelter and Socio-economic characteristics of household for Ankleshwar GIDC Residential Property

	No. of Observations *		Mean		Median		Std. Deviation	
	South	North	South	North	South	North	South	North
I. Shelter Characteristics								
Built-up area (sq.ft)	834	33	626.84	610.79	600	480	410.29	426.96
No. of Rooms	952	34	3.3	2.41	3	2	1.01	1.13
No. of Bathroom	893	30	1.23	1.07	1	1	0.55	0.25
No. of Toilets	890	29	1.19	1.07	1	1	0.5	0.26
Const. Cost (Rs.)	76	14	524934.2	121798.2	332500	50000	568552.5	133831.2
Purchase Price (Rs.)	468	15	288275.6	148000	271500	140000	168539.9	105843.6
Rent (Rs.)	346	9	2010.1	1077.78	2000	1000	871.96	960.18
Exp. Price Rs.	767	29	340545	169655.2	275000	110000	338408.7	172506.1
Age of House (Yrs.)	629	22	10.53	9.77	7	7.5	9.67	6.44
II. Socio-Economic Characteristics								
Size of Family	949	35	4.06	4.97	4	4	1.42	2.27
No. of adults	926	34	2.59	3.26	2	2	1.13	1.71
No. of Children	760	27	1.82	2.19	2	2	0.8	0.83
Annual Income (Rs.)	654	21	103158.7	57676.19	72000	36000	91316.25	53724.87

* These are the number s who answered relevant questions in our sample.

Proportion of House Holds

	South	North
Who are		
(1) Owners	57.49	62.5
(2) Tenants	42.51	37.5
With		
(1) Higher Education	65.9	26.5
(2) Secondary	29.6	58.8
(3) Primary	3.3	11.8
(4) Illiterate	1.1	2.9

According to the GIDC map, our household survey divided the GIDC survey region into North Zone and South Zone.

The Household samples collected from the North zone consisted of societies/housing colonies near/on the Rajpipla Highway, commonly known as the Bhavna Farm Area. Though they were minority in terms of the sample size in our entire GIDC household sample, the Socio Economic features of this zone does deserve a notice:

(a) Bhavna Farm is a landscape of mainly clustered low income (marginal) dwellings. Basic quality of life suffered due to irregularity or unavailability of amenities like Drinking water (which was mostly brought from nearby factories or all the way from GIDC), sanitation and drainage facilities, good quality schools and colleges, parks, communication and transport infrastructure like well maintained roads (and streetlights for the night), public transport utilities etc.

Mostly industrial workers working in the industrial estates of GIDC and Panoli lived here with a handful of self employed individuals working in their own or rented shops.

The low-income dwellings in the Bhavna farm Area, which we referred to above, included the housing colonies in Shantinagar (part I and part II), Patelnagar housing colony and marginal dwellings opposite Shantinagar Part II.

(b) The Middle Income housing societies (e g Girnar society, Sauramya society, Sonam society) had access to facilities like drinking water, drainage and sanitation alongwith non-availability or non-accessability of the rest of the amenities listed above.

(c) Problems regarding air and water were clearly visible in this area, like irregular and polluted water supply, respiratory problems among family members (particularly children), high levels of corrosion of iron fittings like grills on the windows of the residential units, vehicles etc. with cases of decolorizing and chipping of the paint of the houses located in this area.

(d) The recessionary tendencies in the industrial sector (and therefore in the commercial sector) made respondents in this area pessimistic about the future of GIDC regarding its potential to generate work opportunities.

(e) The mean income level of this area was found to be abysmally low at Rs. 57,676 per annum. Most of our respondents were found to be employed in multiple occupations. Due to the closure of a number of industrial units, the unemployed industrial workers earned a living by working as rickshaw drivers, shopkeepers, etc.

(f) The average family size consisted of two adults and two children with a meager 2-5 per cent of our sample opting for the joint family system of living.

(g) About six out of ten respondents in our household sample, had 10+2 education levels, while a handful of nine respondents (out of a total sample of thirty five from this area) had education beyond the 10+2 level.

The South Zone in our Survey sample consisted of the GIDC residential area which was initially formed out of the housing needs of employees employed in different industrial units of the estate. Well maintained structured private colonies and apartments, Company Bungalows, Old and New Colonies belonging to the GIDC were homes to the industrial officers, Chief Executive officers, owners of industrial units and industrial workers. Growing employment potential combined with a well defined package of basic amenities such as housing, schools, maintained drainage, commercial complexes etc. has drawn large crowds of employees from the nearby villages, cities like Vadodara, Surat and Bharuch as well as from states like U.P., Bihar and Rajasthan.

Our household survey clarified the fact that most of these employees were 'temporarily settled', barring a few (who owned industrial units in the estate), and had plans to settle down in their home towns eventually. The respondents owning a business enterprise/industrial unit with more or less permanent plans of settlement in GIDC preferred to live in joint families, while the 'temporarily settled' preferred the usual nuclear family of four (Two adults plus two children).

The Mean Annual Income for the GIDC residential area worked out to be Rs.1,03,158 per annum with 65 per cent of the respondents in the total sample (Total: 969) possessing higher educational qualifications. Their higher levels of education made them enthusiastic respondents to our survey.

Responses from the survey indicated that many of these respondents had bargained better quality living in their home-states/native places for higher employment opportunities in the estate; these respondents found the present levels of living recreationally, health-wise and aesthetically deficient. However due to the onset of recessionary tendencies in the industrial sector with a large number of closed units, the people in this area were seriously questioning the economic health of the estate and the feasibility to stay back with the looming industrial uncertainty.

Commercial establishments in our already identified North and South zones were primarily located within or as extension of different residential societies and housing colonies in the GIDC area. A total of 140 commercial enterprises entered our study from this area. Besides this, fifty respondents in our study had a commercial enterprise housed within their residential units. The commercial undertakings were fundamentally run by men possessing high educational qualification (beyond the 10+2 level). Mean annual income for the commercial complexes worked out to be Rs. 1,34,693 per annum while in the case of those owning a commercial enterprise within the residential domain average income turned out to be Rs.1,26,929 per annum. The recessionary trends have hit these commercial enterprises in the form of poor demands generated in the region.

Ankleshwar Town

Situated within the administrative domain of Ankleshwar Nagarpalika, Ankleshwar town is characteristic of the 'old city' temperament complete with innumerable *galis* and spatial problems. With many of the dwellings as old as the city itself, new residential and commercial blocks have mushroomed within the already congested and unplanned locale of the township.

With infrastructural facilities, like roads, communication access, under developed the town had provisions for basic amenities like drainage (pit wells are used to serve residential drainage needs) and sanitation, educational facilities like schools, colleges and recreational attributes like parks, theatres as well as medical facilities, which were either haphazardly managed or absent.

Table-5 : Shelter and Socio-economic characteristics of house holds For Ankleshwar Town Property

	Residential				Commercial			
	No of obs-erva-tions	Mean	Median	Std.Dev.	No of obs-erva-tions	Mean	Median	Std.Dev.
I. Shelter Characteristics								
(1) Built-up area (sq.feet)	55	659.35	500	531.49	106	358.87	160	501.48
(2) No of Rooms	556	2.98	3	1.03				
(3) No of Bathrooms	545	1.06	1	0.25				
(4) No of Toilets	543	1.05	1	0.24				
(5) Construction Cost (Rs.)	146	219931.5	150000	273262.2	24	126875	70000	122321.9
(6) Purchase	285	221793	150000	228428.3	60	172358.3	100000	193870.5

Price (Rs.)								
(7) Rent P.M.(Rs.)	135	971.67	1000	580.45	38	1145.21	1000	1042.11
(8) Expected Price (Rs.)	520	393483.7	300000	408815.3	102	467544.1	300000	724242.2
(9) Age of House (Years)	453	12.89	11	11.69	91	16.88	11	19.8
II Socio-economic Characteristics								
Size of family	556	4.64	4	1.78	43	4.91	5	1.49
No. of adults	556	3.07	3	1.38	43	3.16	3	1.11
No. of Children	423	2.03	2	1	37	2.03	2	0.69
Annual Income (Rs.)	537	75351.98	60000	71792.68	101	90404.95	54000	94870.86

Proportion of Households		
	Residential	Commercial
Who are (1) Owners (2) Tenants	 67.86 32.14	 61.22 38.78
With (1) Higher education (2) Secondary (3) Primary (4) Illiterate	 35.30 47.80 11.90 5.00	 26.20 52.30 15.00 6.50

People residing in Ankleshwar town, unlike GIDC, were more or less permanent residents and were in the productive age group of 25-45 years with a meager spread of aged and dependent residents. As per our survey, the total number of family members in a single family unit varied from four to six members, ranging from two to four adults and two to three children. The area was a reasonable mix of low to high income residents primarily in the income range of Rs. 60,000-Rs. 1,20,000 per annum., wherein, a good fifty two per cent of our sample (total sample: 560) were employed with the GIDC or Panoli industrial estates. About twenty six per cent of our sample had their family business or commercial centers run by them. Education levels of the residents as well as of the owners of commercial enterprises were mostly till the Higher Secondary level.

No information on air pollution for the town was available and it is expected to be less polluted as compared to GIDC. We have collected information from respondents from Ankleshwar town where around 700 households were interviewed. To get an idea about the differences of respondents from these two regions we give below the average values for some of the shelter [i.e. structural] and socio-economic variables.

Table-6 : Shelter and Socio-economic characteristics of respondents from Ankleshwar Town and Ankleshwar GIDC, for Residential Property

Characteristics	Ankleshwar			
	No.	Town	No.	GIDC
[I] Shelter				
(1) Built-up area [sq.feet]	55	659.35	925	625.68
(2) No. of Rooms	556	2.98	1039	3.26
(3) No. of bath rooms	545	1.06	972	1.22
(4) No. of Toilets	543	1.05	968	1.18
(5) Construction cost (Rs.)	146	2,19,931.50	97	4,39,228.60
(6) Purchase Price (Rs.)	285	2,21,793.00	505	2,82,138.60
(7) Rent per month (Rs.)	135	971.67	379	1,969.08
(8) Expected Price (Rs.)	520	3,93,483.70	838	3,33,094.30
[II] Socio-economics				
(1) Family size	556	4.64	1040	4.97
(2) No. of Children	423	2.03	831	1.85
(3) Annual Income (Rs.)	537	75,351.98	713	1,02,797.80

This table brings out interesting features of the two groups of respondents in terms of their shelter and socio-economic background. Respondents of the GIDC, on an average, had more number of rooms to live in but a smaller built up area. The average cost of construction in GIDC was much higher than that of the town. This may be partly on account of the fact that there were some bungalows of CEOs in GIDC, which were very costly. Interestingly, the differential in purchase price was not so pronounced as differential in construction cost between town and GIDC. One of the reasons for this could be that costly bungalows in GIDC may not have been sold but may have been occupied by owners themselves, or may be they were owned by the companies and given as free accommodation to their managerial staff. The rent in GIDC was much higher than that in the town. This was on account of the fact that almost all of the tenants in GIDC were working in GIDC. Further, the infrastructural facilities in terms of school, playground etc. were considered to be better in GIDC than in the town. So people working there did not mind paying higher rent and staying there. As against this, there were large numbers of commuters who did not stay in GIDC but worked there. This has been observed from another GIDC study undertaken by this author under a different scheme, where primary data on commuters to GIDC were collected. Majority of the commuters interviewed gave pollution in GIDC as the most important reason for not staying there. This aspect cannot be captured by the present study.

Expected price of residential property, on an average, turned out to be lower in GIDC as compared to the town. The main reason behind this seemed to be the industrial recession presently experienced in GIDC. There was not much of a difference between these two groups of respondents in terms of family size and number of children. But, the differential in terms of annual income was quite considerable.

Within Ankleshwar town, we had two groups of respondents, viz. Residential and commercial property owners/tenants. We had a total of 779 respondents from Ankleshwar town out of which 660 and 119 were for residential and commercial property, respectively.

The ownership pattern between respondents for residential property and for commercial property was quite different. About 68% of the respondents for residential property were the owners. These figures for respondents of commercial property came out to slightly more than 61%.

Continuing our comparison of respondents from Ankleshwar GIDC and Town, we notice that their perceptions regarding price behaviour of real estate and levels of pollution are also quite different. This information is given below in a tabular form.

Table-7: Perceptions regarding price trends of real estate and levels of pollution of respondent from Ankleshwar Town & GIDC

		Respondents from			
(I)	Trends in price of real estate	GIDC		TOWN	
		No.	[%]	No.	[%]
	Increase	260	27.7	430	76.8
	Decrease	437	46.5	33	5.9
	Remained Same	243	25.9	72	12.9
	Total	940	100.0	535	100.0

(II)	Level of Pollution				
	Unbearable	230	21.8	58	10.5
	Tolerable	609	57.6	209	37.8
	Moderate	218	20.6	286	51.7
	Total	1057	100.0	553	100.0

(III)	Mean WTA	Rs. 5268.83	Rs. 23537
	Mean WTP	Rs. 2498.44	Rs. 8453

(IV) Is town less polluted than GIDC

Yes	-----	-----	552	99.1
No	-----	-----	5	0.9
Total	-----	-----	557	100.0

Table-7 brings out very interesting differences in perceptions of respondents from these different, but geographically close, areas. A very large percentage, viz. about 47%, of respondents from GIDC who were owners/tenants of residential property felt that the real estate prices showed a downward trend in their area. Opposite was the case for respondents from Ankleshwar town who, viz. around 77%, felt that the real estate prices in their area exhibited an upward trend. Similar was the story of their perceptions regarding levels of pollution in their area. Hardly 20% of the respondents from GIDC felt that the level of pollution in their region was moderate. As against this, more than 50% of the respondents from Ankleshwar town perceived the level of pollution in their region to be moderate.

The respondents from Ankleshwar town were also asked to reflect on the level of pollution in Ankleshwar town as compared to GIDC. Almost all [99.1%] of them considered the level of pollution in town to be lower than that in the GIDC.

The perceptions regarding price behaviour of real estate as reported by our two groups of respondents were also compared with that of real estate agents who were in the business of buying and selling of property. From amongst 29 real estate agents 14 were residing in GIDC and 15 in the town. 31 of the real estate agents answered the question regarding price trends of real estate. Majority of them, i.e. 18 [58.1%], opined that the real estate prices showed a downward trend. Just 7 of them felt that these prices had increased and the remaining 6 felt that they remained the same. The most important reason for a decrease in real estate price was stated to be industrial recession.

Upon an informal inquiry from some of real estate agents we were told that the ratio of black to white payment was around 20:80 in GIDC and around 40:60 in town. When the question was formally asked in the questionnaire majority of them, i.e. 7 out of a total of 13 who answered the question, gave us the ratio of 40:60. There was not much of a difference in terms of property, i.e. whether residential, commercial or industrial, or in terms of area, i.e. whether GIDC or town in the black : white ratios. Majority, (i.e. 18 out of a total of 24 who answered this question) of the real estate agents opined that this ratio of black to white payment had come down over the last five years. This was on account of tax benefits offered by the government and on account of greater loan facilities made available to the buyers of real estate.

The real estate agents were also asked to give their opinion about the behaviour of relative price of real estate in Ankleshwar town as compared to GIDC. Only 9 of the 30 [29%] who answered this question thought that the relative price of real estate in Ankleshwar as compared to GIDC declined over a period of time. 11 of them thought that this ratio had increased and the remaining ten felt that it had remained the same. The real estate agents were also asked to give us the years during which the real estate prices reached their peak/trough, unfortunately only a few, about 4 to 6, of them answered this question.

Section–V: Findings and Results

We now observe frequency distribution regarding the variables in which we are interested. Earlier we observed certain characteristics of our respondents. We know that we have a total of 1063 respondents as households answering questions relating to residential property either as owners or as tenants. Out of these 969 resided in the South and 35 in the north of GIDC. The need for a frequency distribution arises because some of our variables are qualitative in nature. The frequency distribution of these qualitative variables is given below in Table – 8.

Table –8: Frequency Distribution of Some of the Qualitative Variables of Residential Property Owners / tenants of GIDC

	Variable	Frequency
I: Sex :		
01.	Males	585
02.	Females	478
	Total	1036
II. Education :		
01.	Illiterate	12
02.	Primary	37
03	Secondary	323
04.	Higher education	677
05.	Total	1049
III : Year of Construction :		
01	1920 to 1974	18
02.	1975 to 1990	192
03.	1991 to 2001	465
	Total	675
IV: Ranking*		
[a] Ankleshwar town		
	Ranked – 1	53
	Ranked -2	819
	Ranked - 3	150
[b] Ankleshwar GIDC Notified area		
	Ranked – 1	945
	Ranked -2	63
	Ranked - 3	14
[c] Bhavana farm		
	Ranked – 1	26
	Ranked -2	132
	Ranked - 3	864

*** Ranking is for property price increases Rank-1 price increases-high**

Rank-2 price increases-moderate
Rank-3 price increases-low

Table-8: [Contd…]

	Variable	Frequency
V :Perception of Pollution:		
[a]	Unbearable	230
[b]	Tolerable	609
[c]	Moderate	218
	Total	1057
VI: Ready to accept higher level of Pollution:		
[a]	YES	253
[i]	Little more	200
[ii]	Twice the existing level	28
[iii]	More than twice	4
	Total	232
[b]	NO	801
[a] + [b]		1054
VII : Who is Responsible for High Pollution:		
[a]	Government of Gujarat	146
[b]	GPCB	170
[c]	Local Industries	252
[d]	Local People	10
[e]	All of the above	125
	Total	703
VIII : Forced to keep doors / windows closed on account of pollution		
[a]	Yes	664
[b]	No	377
	Total	1041
If Yes then		
[i]	After midnight	70
[ii]	From 9 p.m. onwards	193
[iii]	Morning hours 4 to 5 a.m.	29
[iv]	Early evening hours 7 p.m.	19
[v]	Morning & Night [Whole day & night]	104
	Total	415
IX: Has respondent moved?		
[a]	Yes	941
[b]	No	86
	Total	1027
If Yes then:		
	From less polluted area	
	[i] Inside GIDC	212
	[ii] Outside GIDC	617

	From more polluted area [i] Inside GIDC [ii] Outside GIDC	 6 23
	Total	871

Table-8 : [Contd…]

	Variable	Frequency
X : Reasons for moving to present area:		
[a]	Bought own house	28
[b]	Low price/rent	25
[c]	Better facilities	15
[d]	Near to workplace	500
	Total	568
XI : Has the price of his property fallen?		
[a]	Yes	668
[b]	No	351
	Total	1019
Reasons for the fall :		
[i]	[a] High level of air pollution [b] Water pollution [c] Noise pollution	50 20 4
[ii]	Declining industries	223
[iii]	Market tendencies	37
[iv]	Combination of above reasons with air pollution as one of them	183
[v]	Combination of above reasons excluding air pollution	138
	Total	655
XII : WTA compensation for an increase in pollution:		
	0	854
	Less than Rs.10,000	8
	Rs.10,000 [Median]	123
	More than Rs.10,000	64
	Total	1049
XIII : WTP for an reduction in pollution:		
	0	480
	Less than 5,000	256
	Rs.5,000 [Median]	143
	More than Rs.5,000	122
	Total	1001
If WTP then for how long?		
	Once in a life time	74

	Pay as long as work is being done	342
	For one year only	27
	2 to 3 years	41
	5 years atleast	23
	Total	507

Table-8: [Contd…]

XIV: A specific concern given highest rank of ONE:

		Frequency	Total No. who Renked this concern	Percentage of Total
[i]	Nearness to place of work	179	887	20
[ii]	Nearness to school	179	910	20
[iii]	Air pollution	162	885	18
[iv]	Availability of pure drinking water	156	898	17
[v]	Quality of Construction	140	888	16
[vi]	Crime rate	122	898	14
[vii]	Nearness to market place	98	905	11
[viii]	Age of the house	76	868	9
[ix]	Noise pollution	65	872	7
[x]	Nearness to hospital/nursing home/ Dispensary	60	850	7
[xi]	Nearness to bus stand/highway/railway Station	54	864	6
[xii]	Availability of domestic help	43	857	5

Note: WTA = Willingness To Accept, WTP = Willingness To Pay

Each concern was to be ranked on a scale of 1 to 12. Scale 1 being the most important concern while buying a house.

Table – 8 brings out very interesting information regarding the perception and features of our respondents who were either owners or tenants of a residential property. We have selected 15 qualitative variables. First of all we observe that majority of our respondents were males and majority of the respondents had gone beyond secondary level of education.

We know that Ankleshwar GIDC was set up around 1970s and took about 3-4 years before going full steam. It is also known that economic reforms started in 1991. Some of the houses that were built in Ankleshwar [what is now known as GIDC] date back to as early as 1920s. So we have prepared frequency distribution for the year of construction for the house for three time segments, viz. from 1920 to 1974, 1975 to 1990, and 1991 to 2001. Most of the houses were built during the last decade.

Respondents had fairly good idea about the area where property prices had increased considerably. We took Ankleshwar town, Ankleshwar GIDC and Bhavana farm area [area that is North East of GIDC and which falls in the wind direction] Rank 1 implied that the property prices had increased considerably; Rank 2 implied moderate increase and Rank 3 implied hardly any increase in property prices.

Majority of the respondents gave Rank 1 to GIDC, 2 to Ankleshwar town and 3 to Bhavana farm area. This is consistent with our earlier observation in Section II that respondents residing in North of GIDC were relatively poorer, had smaller houses, etc. So, an area that suffered more from air pollution also experienced very low, if at all, increase in the property prices.

Large number, viz. 609, thought that air pollution was Tolerable in the Ankleshwar GIDC and even a larger number, i.e. 801, refused to accept any increase in air pollution. Those few, viz. 253, who were ready to accept more air pollution agreed to only a little more than the existing level – definitely not more than twice the existing level. Inquiring upon who was responsible for this environmental mess – and if we consider only a single item not combination of two/three items – then we notice that majority of the respondents considered local industries to be responsible, followed by GPCB and GOG, for this mess.

A very large proportion of respondents, i.e. about 64%, said that they were forced to keep their windows/doors closed on account of air pollution. A large number of those who said that they had to keep their doors/windows closed on account of air pollution also said that either they had to keep them closed after 9 p.m. or throughout the day and night. The perception of respondents regarding air pollution was based on their experience of living in a polluted area.

About 941 from amongst 1027 respondents who answered the question regarding their moving into Ankleshwar GIDC said they had moved and the remaining 86 of them responded in the negative. Out of these 941 a total of 871 answered the question regarding moving from less polluted to more polluted area and vice versa. 218 of these respondents moved within the GIDC area out of which 212 moved from a less polluted area to a more polluted area. The sole important reason for moving was that the new residence was nearer to their work place. Thus the distance from residence to workplace emerged as the most important reason for people to move from less polluted to more polluted area within the GIDC.

About 66% of the respondents felt that their property prices have fallen in recent years. The most important single reason for this was the industrial recession experienced in recent years. Thus 223 out of a total of 668, who thought the price of their property had fallen, gave declining industries in the GIDC as the single most important reason, followed by air pollution. A large number of them gave more than one reason for this fall in property prices. If we look at the number of people who have combinations of reasons including air pollution then it turns out be 183. As against this the number of people who gave combinations of reasons but did not include air pollution as one of them was 138. In sum, air pollution turned out to be one of the important reasons for fall in property prices as perceived by our respondents.

Another interesting thing brought out in this table is regarding WTA and WTP. There were a large number, (854) of respondents who have given zero as their WTA a compensation for a 50% increase in air pollution. In other words, about 81% of our respondents believed that they had enough of air pollution and would not accept any addition to its level. As against this, 480 (i.e. about 48%) respondents gave zero as their WTP for a 50% reduction in air pollution. 265 respondents were WTP Rs.5000/- or more for an improvement in air quality. From 507 respondents who answered the question on the length of the time for which they were WTP, 342 (about 67%) said that they were WTP as long as the air quality kept on improving.

Finally, we had asked the respondents to rank a given characteristic of a property on a scale of 1 to 12, scale of 1 being the most important concern while buying a house. All the respondents did not rank all the twelve concerns. In table-8, section XIV we have summarized our findings regarding scale 1 given to different concerns while buying a house. 887 respondents ranked Nearness to place of work as one of the concerns; out of these 179, i.e. about 20%, gave rank 1 to this concern. Similar was the case of nearness to school. From amongst a total of 885 respondents who answered the question regarding ranking of air pollution 162, i.e. about 18%, gave it the highest rank of 1 as a concern while buying a house. Thus, air pollution came out to be an important consideration for those who were buying a house in Ankleshwar GIDC.

Willingness To Accept (WTA) and Willingness To Pay (WTP)

Another indicator of existence of pollution as a problem in GIDC is the residents' willingness to accept and willingness to pay. Surprisingly a very large proportion [854 out of 1049, i.e. 81%] of our respondents gave 'nil' [zero] as their WTA compensation for an increase in air pollution by 50%. Agreed an increase of 50% is not only very large but is equally vague and means different things to different people. But in absence of large number of monitoring centers giving reliable data and not much of a support from the GPCB, a large enough increase may convey the implications of additional air pollution to our respondents. But, such a high proportion of people refusing to accept any compensation for additional pollution does convey an idea about the magnitude of the pollution problem experienced by these respondents. As against this, a relatively much smaller proportion, i.e only about 48% of the respondents registered a zero WTP. These zero responses were mainly 'protest zeroes' as noted above. Majority of the respondents who were willing to pay for a reduction in air pollution by 50% were willing to keep on paying as long as the work of reducing pollution continued. These responses did show that people had an idea about what they wanted and also had some idea about the effect of air pollution on their property and on their health. We did collect some information on health but did not use it because the responses were not very clear and secondly we were not to attempt to estimate the environmental cost in terms of its impact on human health. In fact that is not issue towards which this study is geared.

In sum, with the help of a very simple technique of frequency distribution we got an idea about our respondents' perception, observation and experience regarding air pollution and property prices. At the end of the day we feel that air pollution did emerge as an important area of concern for the residents of Ankleshwar GIDC. Now we use more sophisticated econometric technique, and observe our results, i.e. estimating the hedonic price function. But before we discuss our results, we would discuss our findings on WTP and WTA.

Our main focus was on the respondents who either owned or rented a residential property. There were other two groups of respondents, viz. who own / rent commercial premises and those who used the residential property for commercial purpose as well.

First of all we observe our findings regarding WTP for reducing pollution by 50%. Our findings are given below in a tabular form :

Mean Value for [Residential Property]:

[1] WTP

		North	South	Total
a.	all	2960.67	4779.81	4800.27
b.	Owners	2754.62	5167.85	5206.54
c.	Tenants	4300.00	4338.48	4322.84

[2] WTA

a.	All	12583.33	29110.50	28343.59
b.	Owners	7600.00	31756.88	30058.82
c.	Tenants	37500.00	26225.81	26070.31

[3] Rent

	Tenants	1077.78	2010.10	1969.08

[4] Ratio of Mean WTA to mean WTP

a.	All	4.26	6.09	5.90
b.	Owners	2.76	6.15	5.77
c.	Tenants	8.72	6.04	6.03

WTP for a 50% reduction in air pollution, by the owners of residential property is expected to be higher than those by the tenants. Loss of property value will be a matter of greater concern for owners as compared to tenants. This expectation was violated for tenants residing in North of GIDC, who were willing to pay more than 1.5 times the WTP of the owners. This result is mainly on account of small number of observations with 35 respondents from North out of which the number of tenants was just six. This very small number of observations gave us a rather distorted picture. The socio-economic characteristics of residents of North and South were quite different. On the whole, residents of North of GIDC were relatively poor, had slightly smaller houses, larger families, lower property prices, lower rents and experienced a higher level of air pollution. On account of these factors the WTP for the residents of North would be lower than those for the residents of South of GIDC. Similarly their WTA compensation for additional amount of pollution would be higher than those for the residents of South of GIDC. This was borne out, to a certain extent by our data given above.

Majority of our respondents considered pollution to be an important problem. Large number of respondents did register "Protest zeros" in terms of WTP. Most of them held local industries and Gujarat Pollution Control Board [GPCB] responsible for the environmental mess created in Ankleshwar GIDC. Some of the respondents registered a zero WTA on the ground that pollution, as it is, was pretty high and not even a marginal increase in it was acceptable to them.

Another problem with WTP and WTA data as noted earlier, was that of protest zeros. These protest zeros were ignored affecting our number of observations adversely. A look at the ratio of mean WTA to mean WTP for these groups of respondents will tell us whether the differentials were substantial or just marginal that can be explained by income effect. The ratio of WTA/WTP turned out to be as high as around 7 in some cases. Such a large discrepancy cannot be explained by income effect alone. These ratios were extremely high. These high ratios may be due to “weak” experimental features such as hypothetical payments, student subjects, or elicitation questions that are not incentive – compatible”. [Horowitz and Mc Connel, 2001, P.1]. The hypothetical nature of payment, that is not incentive –

compatible and no experience of handling non-market goods on the part of our respondents remained with us as problems of serious nature. Further we have not tried to incorporate the vehicle for payment collection, which is an important factor influencing people's WTP. In the survey it was found that most of the respondents held the GOG and the local industries to be responsible for the environmental mess created in GIDC. They, therefore, were not ready to contribute anything to the government. During interviews majority of the respondents were willing to pay if the responsibility of cleaning up the environmental mess was given to NGOs. We have also estimated the income elasticity of willingness to pay. The difference between average WTP and average WTA has also been observed.

Horowitz and Mc Connell surveyed 45 studies undertaken by different authors regarding WTA and WTP. One of the reasons for high WTA/WTP ratios was considered to be on account of experimental designs. In this connection they observed that, "…., high WTA/WTP ratios are not the result of experimental design features that would be considered suspect, even apart from their WTA/WTP results". Regarding the pattern of these ratios they wrote, "…. The ratio is highest for public and non-market goods, next highest for ordinary private goods, and lowest for experiments involving forms of money". [Horowitz and Mc Connell, 2001, P.2]. The mean WTA/WTP ratio has an implication for environmental policy. These authors also felt that WTA, rather than WTP, was acceptable to most of the policy analysists for environmental goods as the appropriate measure of benefits. This is so because, they argued that, in all probability environmental quality can only deteriorate.

We in this study tried to compare mean WTA and mean WTP by regions of GIDC, i.e. North and South, and observed the ratios of mean WTA/mean WTP and median WTA/Median WTP. We also calculated the income elasticity of WTP for these two regions. Mean WTP was also compared with mean rent, for the tenants residing in GIDC. Since the number of tenants in North is around 12 only, region wise comparison is not warranted.

Table–9: Values for Income Elasticity of WTP

Respondent category	No. of Observation	Income Elasticity for WTP
[I] All [N + S]		
[a] Residential	467	0.535
[b] Commercial	59	0.256
[c] Residential cum Commercial	16	0.670
[II] All Residential		
[a] North of GIDC	11	0.649
[b] South of GIDC	429	0.513
[III] Ankleshwar Town Residential	191	0.101
Ankleshwar Town Commercial	34	0.015

Figures given above show that the income elasticity of WTP was less than unity for all categories of our respondents. From amongst the respondents in GIDC it is the group that used its property for both residential as well as commercial purposes that had the highest income elasticity for WTP [i.e. 0.67]. Of course, the total number of respondents who answered the questions relating the WTP and income was very small. There were in all 467 respondents who owned / rented residential property and have answered these questions and the income elasticity for them turned out to be a low figure of 0.54. Within the group, there were those who resided in GIDC. The residents of north suffered from air pollution to a greater extent as compared to those residing in the South of GIDC. The residents of north had shown a higher income elasticity of WTP as compared to the residents of South. Of course the number of observations for north is extremely small. In sum, the income elasticity of WTP is consistently less than one.

Ankleshwar town is expected to be not much polluted and people therefore may not be WTP for a reduction in air pollution. The income elasticity of WTP is thus expected to be much lower for Ankleshwar town as compared to Ankleshwar GIDC. This was borne out by our results as well.

We observed differentials between residents of GIDC and Town, not only in terms of their perceptions, but also in their WTA and WTP. Here it is required to clarify that the questions asked to the two groups were not identical. The question asked to the respondents from GIDC was that how much they would be WTA for an additional amount of air pollution? Large number of them did not want even a marginal increase in air pollution and their WTA was Rs.Zero. Majority of the respondents who were WTA additional amount of air pollution wanted the air pollution to increase marginally. Regarding their, WTP they were asked the amount they were WTP for a 50% reduction in air pollution. Most of the respondents registered 'protest zero' as their WTP. Majority of the respondents who were WTP positive sums of money were willing to pay as long as the work of reducing air pollution continued. The respondents from Ankleshwar town were asked to state their WTA if the level of air pollution in the town was raised to the level prevailing in GIDC. Similarly, they were asked to state their WTP for maintaining the existing level of air quality in Ankleshwar Town. The figures for WTA were for compensation on account of worsening of the air pollution scenario. But, the figures for WTP were for improving the air pollution situation for respondents from GIDC and for maintaining the existing level for respondents from Ankleshwar town.

Hedonic Pricing Method

As noted earlier our main purpose in this study is to estimate environmental cost expressed in terms of loss/lower growth of property value by using the HPM. We had two different types of householders – one those who were the owners of their house and those who rented the house. Owners pay for the capitalized value of the property and tenants pay for the services enjoyed from the property. It, thus, becomes necessary to treat them separately.

The price/rent of a house depends on number of variables. These variables are usually categorized into five groups, viz. [I] Structural i.e. site specific; [ii] Accessibility; [iii] Neighbourhood; [iv] Socio-economic, and [v] Environmental variables.

In structural [site specific] variables we included [1] Built-up area, [2] Number of rooms [3] Number of bathrooms [exclusive of number of rooms]. [4] No. of toilets [exclusive of number of rooms and number of bath rooms] [5] Age of the house [6] Expected price, [7] Cost of construction, and, [8] Perception in terms of rising property prices for two areas of Bhavana farm [which falls in the wind direction i.e. N.E. of G.I.D.C.], and Ankleshwar G.I.D.C. Most of these variables were correlated resulting into the problem of multicollinearity. We first of all prepared a correlation matrix for these independent structural variables with purchase price to see which variables needed to be excluded from our regression exercise.

There were seven Accessibility variables for which data were collected. These variables were distance from residence to [1] work place; [2] school; [3] market place; [4] garden, [5] theatre, and, [6] Time taken to reach the workplace, as well as [7] Travel expenses. Here too a correlation matrix was first prepared for selection of variables to be included in the regression exercise.

The neighbourhood variables would, usually, consist of quality of school, crime rate in the area, racial mix of the population, etc. In our study we have not included the neighbourhood variables.

There can be large number of variables that may be included in the group of socio-economic variables. We have included [1] Income; [2] Education, [3] Family size; [4] Number of adults in the family; and, [5] Number of children in the family, in the group of socio-economic variables. The same procedure for selection of variables in the case of multicollinearity was adopted here as well.

Finally, we come to the group of environmental variables. It has already been noted above that data on air pollution were the hardest to come by. There are three pollutants, Sulphur Dioxide (SO2), Nitrogen Oxide (Nox) and Suspended Particulate Matter (SPM), for which data over the last twelve years were available.

No data for different areas of the GIDC, and Ankleshwar town are available. We have, therefore, collected information on the perception of people regarding pollution. There were number of questions through which this information was solicited from the respondents. The respondents were asked to state whether pollution in the area of their residence was unbearable; bearable or moderate; whether they had to keep the windows and doors of their houses closed, particularly at night, and the reasons thereof including pollution, whether they had to incur higher maintenance cost, i.e. whether their house needed frequent coloring, replacement of pipes etc. and the reasons thereof, including air pollution. Further, the respondents were also asked to rank on a scale of 1 to 12 their concerns about 12 different characteristics while buying a house. These characteristics are: Nearness to – [1] School; [2] Work place; [3] Market place; [4] Bus stand / highway / railway station; [5] Hospital / Nursing home / dispensary; [6] Crime rates prevailing in the neighbourhood; [7] Quality of the house; [8] Age of the house; [9] Air pollution; [10] Noise pollution; Availability of; - [11] Pure drinking water, and [12] Domestic help. Unfortunately, almost all the environmental variables are qualitative and subjective in nature. We do not mean to say that subjective elements have no role to play in deciding what is the price that a household should pay for a house.

Before we fitted the Hedonic Price function we looked at the correlation matrix taking four dependent variables, individually, and the four sets of independent variables separately. The four dependent variables were – Purchase price; Ln purchase price, Rent, and Ln Rent. The absolute figures told us how the levels of price and rent were associated with structural [site – specific]; accessibility; socio-economic; and, environmental variables. The logarithmic values of purchase price and rent gave us the rate of change in the absolute values. These correlations are given below in Table – 10.

Table-10: Correlation Matrix of GIDC Ankleshwr for Purchase Price, Ln Purchase Price, Rent, Ln Rent with Socio-Eco, Structural, Accessibility and Environmental Variables

	Purchase Price	Ln Purchase Price	Rent	Ln Rent
(I) Socio-Eco. Variables				
Annual Income	.139**	.201**	.178**	.125*
Size of Family	-.006	-.103*	.145**	.100*
No. of Children	-.118*	-.204**	-.070	-.048
(II) Structural Variables				
Built-up area sq.ft.	.329**	.433**	.152**	.140**
No. of Rooms	.564**	.573**	.469**	.360**
Age of House	-.224	-.327**	-.082	-.102
Bathroom	.541**	.460**	.419**	.272**
Toilets	.520**	.420**	.366**	.238**
Expected Price of house	.710**	.547**	.362**	.174**
Maintance cost	.202**	.178**	.167**	.068
(III) Accessibility Variables				
Dist. From residence to work place	-.006	.022	.036	.064
Travel Expenditure	.125**	.154**	.010	-.160**
Time taken to reach work place	-.007	-.015	.019	.095*
Dist. from residencde to School	-.061	-.088*	-.014	-.068
Dist. from residencde to Market	-.041	-.077	-.044	-.049
Dist. from residencde to Garden	-.142**	-.211**	.040	-.019
Dist. from residencde to Theatre	-.142**	-.220**	.019	-.035
(IV)Environmental Variables				
Dup1=1 if perception of pollution is unberable	-.065	-.076	-.051	-.029
Dup2=1 if perception of pollution is Moderate	.115**	.098*	.057	.119*
Due2=1 if forced to keep doors/windows closed	-.018	-.004	.013	.070
Due3=1 if maintenance is for discolouration & corrossion	-.031	.003	-.104	-.155**
Due4=1 if rank of air pollution is ranked one	.022	.043	.028	-.018
SO_2	-.082	-.101	-.091	-.086
NOx	-.027	-.008	-.118*	-.097
SPM	.002	.041	-.078	-.059

Note : ** Correlation is significant at 0.01 level (2-tailed)
* Correlation is significant at 0.05 level (2-tailed)

First of all we notice that the purchase price and Ln purchase price were significantly correlated with all the six independent variables that were labeled as structural variables. Structural variables are site-specific and specify the physical characteristics of the house. The Built-up area, number of rooms (excluding number of bathrooms and toilets), number of bathrooms (excluding number of toilets), number of toilets, and expected price were positively and significantly correlated with purchase price as well as log of purchase price. The same holds good for rent and its log as well. The last structural variable was the age of the house. As expected the age of the house was negatively and significantly related with both the purchase price and its logarithm. This was not the case when rent and its log were the two dependent variables. Age of the house was negatively but not significantly correlated with the rent [and Ln Rent] of the house. We were not be able to use all the structural variables in our HP function on account of multicollinearity. This is discussed at a later stage.

Coming to Accessibility variables we note that only three variables, viz. Distance of residence from garden, Distance from theatre and Monthly travel expenditure, were statistically significantly related with Ln purchase price and purchase price. Distance from garden and distance from market were negatively and monthly travel expenditure incurred positively correlated with purchase price and its log. The other four accessibility variables were not significantly related with purchase price / Ln purchase price. The distance from school, garden and market place were positively and significantly correlated with each other. It is the time taken to reach work place that emerged as the only statistically significant variable that was positively correlated with rent of the house. In case of the log of the rent there were two variables, viz. time taken to reach the workplace and monthly travel expenditure, that were significantly correlated with it. The relationship between Travel Expenditure and log rent turned out to be negative. Of course, time taken to reach the workplace and the distance from residence to work place were positively and significantly related with each other.

There were in all six socio-economic variables that we had taken up in this study. These were [I] Annual income; Level of education of the respondent [illiterate, primary, secondary and higher] i.e. three dummy variables [ii] dus

1=1 if higher education, zero otherwise [iii] dus 2=1 if secondary education, zero otherwise, and [iv] dus 3=1 if primary, zero otherwise; [v] size of the family and, [vi] number of children in the family. Log of purchase price was positively and significantly correlated with annual income and higher education completed by the respondent. It was negatively and significantly correlated with secondary education completed by the respondent and number of children in the family. The remaining two variables did not have significant correlation with Ln purchase price. Similar was the story in regard to purchase price, except that it was not significantly correlated with number of children. The observation for rent in this regard is slightly different from that one for purchase price. Income did not emerge as a significant variable for rent, though it was significant with a positive correlation with log of rent. The two statistically significant variables for rent were higher education [positive correlation] and primary education [negative correlation]. The four significant variables for Ln rent were annual income and higher education [both with positive correlation], and, secondary and primary education [both with negative correlation]. The remaining two variables were not significantly correlated with Ln rent. Such correlations were not a matter of great surprise as the four independent variables of income and three educational dummies were significantly correlated with each other. Similarly, family size and number of children were correlated with each other as well as with different levels of education. They were not significantly correlated with annual income of the respondents.

The last groups of variables were environmental variables, which are nothing else but perception regarding and data on air pollution. In this connection, we note that "To date there is no commonly accepted index for the general phenomenon called air pollution". [Ridker and Henning, 1967, P.248]. The three objective measures of air pollution we have taken up are SO2 which is known to damage freshly applied paint and cause it to lake off more easily, resulting into decolouration of property. Another two pollutants for which data were available are the Suspended Particulate Matter [SPM] and NOx. We would like to draw the attention again to the fact that data for SO2, SPM and NOx were not available for different centres in Ankleshwar GIDC. The data used here are the time series data covering about a decade, viz. from 1990 to 2001. In sum, we have five perception variables and three physical variables in this regard. The five perception variables are – [I] dp1 =1 if perception of pollution is unbearable, 0 otherwise; [ii] dp2 =1 if perception of pollution is moderate, 0 otherwise; [iii] due 2 =1 if forced to keep doors/windows closed, 0 otherwise; [iv] due 3=1 if reason for maintenance cost is decolouration and corrosion of metal and [v] due 4=1 if air pollution is ranked one while purchasing a house, 0 otherwise.

None of these five had a significant correlation with Ln purchase price, which was not the case for other three dependent variables considered in this study. Thus, the purchase price was positively and significantly correlated with the perception of air pollution as moderate. The other variables had expected signs but were not statistically significant.

Ln purchase price and purchase price were negatively, though weakly, correlated with dummy for perception of air pollution as unbearable; dummy for the variable forced to keep doors/windows closed; and dummy for maintenance cost on account of decolouration and corrosion of metal [no correlation of this variable with Ln purchase price]; and positively and weakly correlated with the dummy for the variable rank one given to air pollution while purchasing property. Thus, the relationship between purchase price/Ln purchase price and those perception variables were as expected. These relationships are also expected to be weak in a country like ours where employment and nearness to workplace/school etc. are more important than air pollution. People do not mind living in a polluted environment if complaining about pollution means being out of employment. Inspite of this situation, we did find a positive and a strong relationship between peoples' perception of pollution as moderate and purchase price, Ln purchase price and log of rent. This means that people do not mind paying a higher price / rent for areas that they think are moderately polluted.

When we take physical data on air pollution into consideration then we have to take only those houses that were purchased between 1990 and 2001 into consideration - all the observations outside this time frame have to be dropped reducing our number of observations. First, we have taken unadjusted [i.e. without residualisation] independent variables and take those independent variables that were not interrelated for seeing the relationship of these variables with the purchase price of property. After this exercise was done, we "residualise" the interdependent variables and see which one of the two excercises gives us better results.

After scrutinizing and tabulating collected information on large number of variables we prepared a correlation matrix for a total of 24 independent variables covering all the observations. The air pollution related information included here was only in terms of perception and experiences of our respondents. Table-11, given below, brings out clearly the fact that there was a problem of multicollinearity. Thus, we observe that annual income was significantly correlated with educational levels, built-up area number of rooms, number of bathrooms and toilets [excluding number of rooms;], age of the house, expected price of the house, etc. The level of income and higher level of education completed were significantly and positively correlated. The negative significant correlations among different levels of education capture the negative correlation between incomes secondary/primary level of education. A negative, but a weak, relationship was observed between income and family size, as well as between income and number of children. As expected, a strong positive correlation existed between income on the one hand and number of rooms/bathrooms/toilets/expected price on the other. Interestingly a strong positive correlation existed between income and distance from workplace, implying that people who can afford to stay in a cleaner environment would not mind commuting a longer distance to work and incurring higher transport cost. Negative correlation between income and distance from residence to garden indicated that if people can afford then they would like to stay near garden. People with higher income did spend a larger amount on the maintenance of their property. A positive correlation existed between the respondents' experience of keeping their doors/windows closed on account of air pollution and discolouration of building and corrosion of metal forcing them to incur higher maintenance cost. In sum, the correlation matrix given in Table-11 brings out interesting relationships among independent variables.

As mentioned above in using the Hedonic Pricing Method we have to face the problem of multicollinarity. To take care of this problem we have made adjustments as done by Ridker and Henning in their article entitled "The Determinants of Residential Property Values with Special Reference To Air Pollution". They first of all run a regression without making adjustments for multicollinearity. But two independent variables, viz. [dummy for Illinois and Missouri, and SUL [Sulfaction levels] were found to be correlated. Rather than dropping one of the variables, they made adjustments. They replaced ILL by RILL. RILL, in other words, is actual ILL "corrected for' SUL. The observations on RILL are, of course, simply the residuals from this auxiliary regression, and the adjustment may therefore be referred to as "residualization". [Ridker & Hennin, 1967, P.252]. We have also gone in for "residualization". In sum, we have used both the models i.e. one without residualization and the other with residualization.

We had first of all taken up a simple model where log of purchase price / Ln rent was regressed upon the four sets of independent variables taking every set individually. Then we took these dependent variables and saw their relationship with adjustment wherever necessary. Finally, we selected two/three variables from each set of independent variables for final regression equation using both unadjusted as well as adjusted variables. An attempt was also made to fit a logit model taking the view of the property price having fallen as the dependent variable and annual income/purchase price as independent variable. The idea was to see whether the perception of people regarding the property price behaviour gets affected by their income or by the price at which the property was purchased.

Table-11 : Correlation Matrix for all Samples for independent variables (Resi. + Comm. + Resi.&Comm.) Including So2,Nox, SPM

	Annual Income	Family Size	Higher Edu.	Secondary Edu	Primary Edu.	No. of Children	Built-up area
1	2	3	4	5	6	7	8
Annual Income	1.000						
Family Size	-0.055	1.000					
Higher Edu.	0.191**	-0.174**	1.000				
Secondary Edu.	-0.160**	0.169**	-0.904**	1.000			
Primary Edu.	-0.100*	0.003	-0.245**	-0.105**	1.000		
No. of Children	-0.128*	0.705**	-0.202**	0.135**	0.102*	1.000	
Built-up area	0.510**	0.047	0.095*	-0.044	-0.072	-0.079	1.000
No of Room	0.373**	0.163**	0.203**	-0.134**	-0.080	-0.004	0.499**
Age of house	-0.189**	0.057	0.009	-0.020	-0.029	0.017	-0.304**
Bathrooms	0.382**	0.124**	0.091*	-0.087*	0.023	-0.055	0.504**
Toilets	0.366**	0.168**	0.074	-0.077	0.040	-0.009	0.446**
Exp. Price of house	0.328**	0.057	0.142**	-0.113*	-0.048	-0.063	0.404**
Dist. to work place	0.081	-0.041	0.099*	-0.074	-0.039	-0.021	0.040
Travel Exp.	0.119*	0.024	0.102*	-0.083	-0.035	-0.015	0.005
Time to reach work place	0.015	-0.035	0.014	0.015	-0.059	-0.014	-0.083
Dist. to school	0.000	0.061	-0.016	0.035	-0.029	0.016	0.075
Dist. to market	-0.006	0.069	-0.081*	0.085*	0.022	-0.028	0.056
Dist to garden	-0.090	0.030	0.023	-0.032	0.048	0.077	-0.058
Dist. to theotre	-0.076	0.012	-0.056	0.039	0.068	0.043	-0.060
Maint. Cost	0.131*	0.057	0.021	-0.007	-0.031	0.072	0.217**
Unberable pollution	0.005	-0.009	-0.024	0.007	0.050	0.023	0.007
Moderate pollution	0.075	0.036	0.052	-0.015	-0.070	-0.022	-0.028
Forced windo/door closed	0.061	-0.070	0.056	-0.030	-0.040	0.002	0.034
Reason maint. Decol. & corrosion	0.030	-0.015	0.047	-0.026	-0.069	-0.095	0.037
So2	-0.019	0.028	0.000	0.018	-0.063	0.004	-0.021
Nox	-0.037	-0.006	0.055	-0.023	-0.080*	-0.072	0.047
SPM	-0.032	0.013	0.004	-0.006	0.043	0.077	-0.035

Table–11 : [Contd…]

	No. of room	Age of house	Bathrooms	Toilets	Exp. Price of house	Dist. to work place	Travel Exp.
1	9	10	11	12	13	14	15
Annual Income							
Family Size							
Higher Edu.							
Secondary Edu.							
Primary Edu.							
No. of Children							
Built-up area							
No of Room	1.000						
Age of house	-0.194**	1.000					
Bathrooms	0.500**	-0.166**	1.000				
Toilets	0.502**	-0.137*	0.937**	1.000			
Exp. Price of house	0.441**	-0.136*	0.560**	0.460**	1.000		
Dist. to work place	0.013	0.003	-0.017	-0.009	0.000	1.000	
Travel Exp.	0.114*	-0.046	0.088	0.100*	0.236**	0.153**	1.000
Time to reach work place	0.006	0.022	-0.071	-0.053	-0.049	0.595**	0.131**
Dist. to school	0.014	0.002	0.179**	0.218**	0.081	0.011	0.052
Dist. to market	-0.011	-0.068	0.074	0.027	-0.014	0.063	-0.010
Dist to garden	-0.165**	-0.029	-0.080	-0.061	-0.087	-0.064	-0.016
Dist. to theotre	-0.171**	-0.045	-0.022	-0.030	0.049	-0.086*	-0.003
Maint. Cost	0.162**	-0.001	0.183**	0.183**	0.330**	-0.018	0.070
Unberable pollution	-0.085*	-0.060	-0.021	0.015	-0.056	0.073	0.045
Moderate pollution	0.098*	0.125*	-0.025	-0.009	0.029	-0.036	0.080
Forced windo/door closed	-0.043	-0.150**	-0.070	-0.046	-0.009	0.061	0.061
Reason maint. Decol. & corrossan	-0.068	-0.020	-0.026	-0.070	0.015	-0.015	-0.030
So2	0.052	0.157**	-0.033	-0.032	-0.032	0.087*	0.132**
Nox	0.052	0.067	0.009	-0.015	-0.037	-0.059	0.081
SPM	0.013	0.033	0.024	0.032	0.029	-0.053	0.081

Table–11 : [Contd…]

	Time to reach workplace	Dist. to school	Dist. to market	Dist. to garden	Dist to theoter	Maint. cost	Unberable pollution
1	16	17	18	19	20	21	22
Annual Income							
Family Size							
Higher Edu.							
Secondary Edu.							
Primary Edu.							
No. of Children							
Built-up area							
No of Room							
Age of house							
Bathrooms							
Toilets							
Exp. Price of house							
Dist. to work place							
Travel Exp.							
Time to reach work place	1.000						
Dist. to school	-0.006	1.000					
Dist. to market	-0.032	0.132**	1.000				
Dist to garden	0.020	0.211**	0.211**	1.000			
Dist. to theotre	-0.005	0.191**	0.204**	0.821**	1.000		
Maint. Cost	-0.040	0.019	-0.001	-0.031	-0.051	1.000	
Unberable pollution	0.031	0.033	0.008	0.100*	0.100*	-0.032	1.000
Moderate pollution	0.043	-0.039	-0.022	0.007	0.011	-0.018	-0.229**
Forced windo/door closed	0.092	0.037	0.029	0.077	0.096*	-0.030	0.151**
Reason maint. Decol. & corrossan	-0.077	-0.004	0.016	0.025	-0.006	0.034	-0.013
So2	-0.052	-0.015	0.017	-0.048	-0.073	0.046	0.000
Nox	-0.071	-0.020	0.023	-0.032	-0.071	-0.015	0.044
SPM	-0.017	-0.005	-0.038	0.074	0.062	0.062	0.015

Table–11 : [Contd…]

	Moderate pollution	Forced winod/door closed	Reason maint. Decol. & corrossen	So2	Nox	SPM
1	23	24	25	26	27	28
Annual Income						
Family Size						
Higher Edu.						
Secondary Edu.						
Primary Edu.						
No. of Children						
Built-up area						
No of Room						
Age of house						
Bathrooms						
Toilets						
Exp. Price of house						
Dist. to work place						
Travel Exp.						
Time to reach work place						
Dist. to school						
Dist. to market						
Dist to garden						
Dist. to theotre						
Maint. Cost						
Unberable pollution						
Moderate pollution	1.000					
Forced windo/door closed	-0.082*	1.000				
Reason maint. Decol. & corrossan	-0.124**	0.081	1.000			
So2	0.020	-0.053	-0.013	1.000		
Nox	-0.053	-0.020	0.043	0.807**	1.000	
SPM	0.013	-0.004	0.058	0.044	0.057	1.000

Note: ** Correlation is significant at 0.01 at the level (2-tailed)
* Correlation is significant at 0.05 at the level (2-tailed)

The Table-11 clearly brings out the correlation between independent variables. Most of the Socio-economic variables were interrelated and they were correlated with other groups of variables like structural variables. We, therefore, had to drop some of these variables and make adjustments for some of them.

On account of the problems of multicollinearity, we after trying more than 20 regressions selected very few independent variables for our hedonic price functions. The regression results are summarized below in a tabular form in Table-12.

There are four broad groups of regression equations. We have taken all the four dependent variables, viz. Purchase price, Ln Purchase Price, Rent, and Ln Rent, one after the other in each equation. Within a group of equations we have run regressions for all the respondents of GIDC and respondents from South of GIDC, separately. The reason for doing so is that the socio-economic characteristics of respondents from South and from North of GIDC were quite different. Further, the number of observations for the North of GIDC was rather small and thus it was not possible to run regressions. The first set of regressions include two socio-economic, one structural, one accessibility and one air pollution related variables. In these equation actual data on SO2, NOx, and, SPM were not included.

The second set of regressions includes two additional variables on SO2 and $(SO2)^2$ over and above the five independent variables included in Set(I). This set (II) covers a period of 11 years from 1990 to 2001.

Set III and IV of regression equations make adjustment for collinearity between annual income and number of rooms. The Pearson Correlation Coefficient between these two independent variables had a value of +0.371, which was significant at less than 1% level. It would therefore not be proper to include both these variables in a single equation. At the same time it was not advisable to leave out one of the variables as this would result into a biased estimate of the included regressor. It is therefore better to make adjustment whereby a new variable that was corrected for the effect of income is included in the number of rooms. The adjustment is referred to by Ridker and Henning as “residualization”. Thus the variable “number of rooms adjusted for income” is the residualized variable that was included in the equation after the effect of income was taken out. The new variable Adjusted Number Rooms [room] was created by using values arrived at by regressing number of rooms on annual income [Income]. As a result of this residualization the regression coefficient of income was expected to change. In sum, regression equation Sets I & II use number of rooms as a regressor alongwith annul income and sets III & IV used residualized number of rooms along with income as regressors.

These results are summarized below in Table – 12 : First of all we discuss the four regression equations given in [I]. Looking at the values of the adjusted R2 we notice that the independent variables selected had a better explanatory power for log of Purchase Price as compared to purchase price and for Rent as compare to log of Rent. Thus, bout 42% of the variations in purchase price differentials [as compared to 37% for the purchase price levels] were explained by these variables. As against this, more than 34% of the variations in actual rent were explained by these variables. The explanatory power of these variables was just 22% in the case of rent differentials. On the whole these variables taken together were more effective in explaining purchase price behaviour rather than the behaviour of rent. Interestingly, the three statistically significant variables for purchase price and Ln purchase price were annual income, number of children and number of rooms. For the variations in actual rent paid per month the significant variables turned out to be annual income, number of rooms, and distance from residence to school. Thus, while purchasing a house the distance from residence to school was not an important consideration, but it turned out to be an important consideration while renting a house. This may be on account of the fact that buying a house is a lifetime commitment and children are expected to grow up and be out of schools, which is not the case when a house is being rented. A fourth variable emerged as a statistically significant [at around 11% level] variable when Ln Rent was taken as the dependent variable. This variable was due 3, which is a dummy variable for reasons to incur maintenance cost. This dummy takes a value equal to one if the reason for incurring maintenance cost is discoloration and corrosion of metal, which are the result of air pollution. Thus, the rent differentials were inversely and significantly related with the phenomenon of discoloration and corrosion of metal. Similar were the results for respondents from South of GIDC. But, in this case the dummy variable due 3 turned out to be much more significant for explaining rent differentials. This makes sense, as we know that the respondents from South came from a more favourable socio-economic background as compared to those from the North.

The second set of regression equations have two additional variables, viz. SO2 and $(SO2)^2$. It has been a usual practice to consider the purchase price/rent to be a non-linear function of air pollution. Further if we wish to build up the demand function for clean air then we need to have a non-linear function. The second set had a better explanatory power for variations in rent and in the log of rent as compared to the first set.

Table-12: Regression Equations

Regression Equation No.	Dependent Variable	No. of Observation	Constant	**Independent Variables**							
				Annual Income	No. of Children	No. of Room	Distance from residence to school	Due3=1 if maint. Is on account of discol. & corrosion	So2	So2 Square	Adjusted R Square
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(I)All GIDC											
1	Purchase Price Sig.	250	21847.21 (.535)	.160 (.094)	-18285.35 (.071)	91190.311 (.000)	-753.129 (.862)	12960.02 (.375)			.370 (.000)
2	Ln Purchase Price	250	11.187 (.000)	7.281E-07 (.054)	-.101 (.012)	.388 (.000)	-1.57E-02 (.359)	3.095E-02 (.591)			.417 (.000)

	Sig.										
3.	Rent Sig.	154	824.473 (.008)	4.175E-03 (.000)	-36.342 (.629)	380.948 (.000)	-165.439 (.011)	-183.928 (.133)			.341 (.000)
4	Ln Rent Sig.	154	6.909 (.000)	1.856E-06 (.038)	-5.279E02 (.433)	.249 (.001)	-1.77 (.002)	-.176 (.108)			.220 (.000)
		GIDC (South)									
5	Purchase Price Sig.	233	23400.868 (.524)	.186 (.062)	-19243.20 (.069)	89933.137 (.000)	674.184 (.890)	19085.84 (.213)			.362 (.000)
6	Ln Purchase Price Sig.	233	11.142 (.000)	7.627E-07 (.042)	-9.54E-02 (.017)	.388 (.000)	-7.28E-03 (.692)	8.062E-02 (.161)			.432 (.000)
7	Rent Sig.	142	862.098 (.007)	4.212E-03 (.000)	-29.861 (.690)	375.172 (.000)	-187.505 (.012)	-169.291 (.172)			.322 (.000)
8	Ln Rent Sig.	142	7.144 (.000)	1.584E-06 (.035)	-7.62E-02 (.162)	.222 (.000)	-.208 (.000)	-.202 (.025)			.273 (.000)
(II) All GIDC											
9	Purchase Price Sig.	79	-100249.1 (.352)	.332 (.161)	20592.129 (.433)	94254.573 (.000)	767.765 (.940)	51791.430 (.135)	1412.787 (.681)	-23.292 (.475)	.267 (.000)
10	Ln Purchase Price Sig.	79	11.092 (.000)	1.511E-06 (.038)	3.754E-02 (.640)	.359 (.000)	-9.262E-03 (.753)	8.877E-02 (.399)	2.005E-03 (.848)	-5.173E-05 (.603)	.389 (.000)
11	Rent Sig.	117	1034.856 (.018)	4.988E-03 (.000)	-2.834 (.973)	301.143 (.002)	-102.089 (.178)	-321.671 (.023)	-1.009 (.939)	-1.284E-02 (.922)	.349 (.000)
12	Ln Rent Sig.	117	7.360 (.000)	2.111E-06 (.004)	-6.05E-02 (.292)	.149 (.024)	-.149 (.005)	-.256 (.008)	-4.502E-03 (.615)	3.188E-05 (.722)	.280 (.000)
GIDC (South)											
13	Purchase Price	71	-111758.9	.518 (.067)	27636.24 (.374)	81621.112 (.001)	2472.584 (.815)	63870.783 (.095)	2422.658 (.515)	-32.315 (.359)	.232 (.000)

	Sig.		(.331)								
14	Ln Purchase Price Sig.	71	11.057 (.000)	2.057E-06 (.007)	8.036E-02 (.327)	.307 (.000)	7.537E-03 (.787)	.187 (.064)	4.554E-03 (.642)	-8.079E-05 (.384)	.422 (.000)
15	Rent Sig.	109	708.00 (.108)	4.994E-03 (.000)	35.073 (.674)	340.140 (.001)	-119.648 (.138)	-258.556 (.069)	-9.915 (.466)	-.121 (.374)	.343 (.000)
16	Ln Rent Sig.	109	7.072 (.000)	2.098E-06 (.001)	-3.37E-02 (.492)	.183 (.002)	-.139 (.004)	-.199 (.018)	5.287E-03 (.507)	-6.791E-05 (.396)	.316 (.000)

Regression Equation No.	Dependent Variable	No. of Observation	Constant	Independent Variables							Adjusted R Square
				Annual Income	No. of Children	Adjusted No. of Room for Income	Distance from residence to school	Due3=1 if maint. Is on account of discol. & corrosion	So2	So2 Square	
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(III)All GIDC											
1	Purchase Price Sig.	250	236950.88 (.000)	.499 (.000)	-18285.35 (.071)	91190.311 (.000)	-753.129 (.862)	12960.02 (.375)			.370 (.000)
2	Ln Purchase Price Sig.	250	12.288 (.000)	2.173E-06 (.000)	.101 (.012)	.388 (.000)	-1.57E-02 (.359)	3.095E-02 (.591)			.417 (.000)
3.	Rent Sig.	154	1905.603 (.000)	5.594E-03 (.000)	-36.342 (.629)	380.948 (.000)	-165.439 (.011)	-183.928 (.133)			.341 (.000)
4	Ln Rent Sig.	154	7.615 (.000)	2.783E-06 (.001)	-5.28E-02 (.433)	.249 (.001)	-.177 (.002)	-.176 (.108)			.220 (.000)
GIDC (South)											
5	Purchase	233	231829.38	.521 (000)	-19243.2	89933.137	674.184 (.890)	19085.835			.362 (.000

	Price Sig.		(.000)		(.069)	(.000)		(.213)			)
6	Ln Purchase Price Sig.	233	12.244 (.000)	2.208E-06 (.000)	-9.54E-02 (.017)	.388 (.000)	-7.28E-03 (.692)	8.062E-02 (.161)			.432 (.000)
7	Rent Sig.	142	1926.834 (.000)	5.609E-03 (.000)	-29.861 (.690)	375.172 (.000)	-187.505 (.012)	-169.291 (.172)			.322 (.000)
8	Ln Rent Sig.	142	7.776 (.000)	.2.413E-06 (.001)	-7.62E-02 (.162)	.222 (.000)	-.208 (.000)	-.202 (.025)			.273 (.000)
(IV) All GIDC											
9	Purchase Price Sig.	79	167245.34 (.050)	.683 (.002)	20592.129 (.433)	94254.573 (.000)	767.765 (.940)	51791.430 (.135)	1412.287 (.681)	-23.292 (.475)	.267 (.000)
10	Ln Purchase Price Sig.	79	12.110 (.000)	2.847E-06 (.000)	3.754E-02 (.640)	.359 (.000)	-9.76E-03 (.753)	8.877E-02 (.399)	2.005E-03 (.848)	-5.173E-05 (.603)	.389 (.000)
11	Rent Sig.	117	1889.499 (.000)	6.109E-03 (.000)	-2.834 (.973)	301.143 (.002)	-102.089 (.178)	-321.671 (.023)	-1.009 (.939)	-1.284E-02 (.922)	.349 (.000)
12	Ln Rent Sig.	117	7.783 (.000)	2.666E-06 (.000)	-6.05E-02 (.292)	.149 (.024)	-.149 (.005)	-.256 (.008)	-4.50E-03 (.615)	3.188E-05 (.722)	.280 (.000)
GIDC (South)											
13	Purchase Price Sig.	71	119881.78 (.201)	.822 (.002)	27636.24 (.374)	81621.12 (.001)	2472.584 (.815)	63870.783 (.095)	2422.658 (.515)	-32.315 (.359)	.232 (.000)
14	Ln Purchase Price Sig.	71	11.929 (.000)	3.200E-06 (.000)	8.036E-02 (.327)	.307 (.000)	7.537E-03 (.787)	.187 (.064)	4.554E-03 (.642)	-8.079E-05 (.384)	.422 (.000)
15	Rent Sig.	109	1673.910 (.000)	6.261E-03 (.000)	35.073 (.674)	340.140 (.001)	-119.648 (.138)	-258.556 (.069)	-9.915 (.466)	-.121 (.374)	.343 (.000)
16	Ln Rent	109	7.590 (.000)	2.778E-06	-3.37E-02	.183 (.002)	-.139 (.004)	-.199 (.018)	5.287E-03	-6.791E-	.316 (.000

	Sig.			(.000)	(.492)				(.507)	05 (.396)	)

Note: Adj. Room = Room- Room and Room = 2.838+3.725E-06 Income

With the introduction of So_2 and $(SO2)^2$ as additional variables for explaining variation in actual purchase price, annual income and number of children lost their significance and the number of rooms emerged as the sole significant variable. For the log of purchase price, alongwith the number of rooms, the annual income also turned out to be a significant variable. These regression equations were a better fit for log of Purchase Price and actual monthly rent as compared to actual purchase price and Ln Rent. For rent annual income and number of rooms had positive and significant association and the reason for maintenance being discoloration and corrosion of metal had a negative and significant association with rent. An additional variable with a negative impact emerged as a significant variable for explaining variation in rent differentials. This variable was distance from school. Similar were the findings for respondents from South of GIDC. It is interesting to note that the variables due 3 =1 if the reason for maintenance cost is discoloration and corrosion of metal had positive and significant association with purchase price and Ln purchase price, but had a negative impact on rent and Ln rent. This is understandable because owners who have purchased expensive houses would also spend more on their maintenance. Tenants have no such incentives, and would offer lower rents if the property needs frequent colouring and maintenance on account of air pollution. The rest of the results can readily be seen from the results given in Table - 12.

Annual income and number of rooms were positively correlated resulting into multicollinearity. As noted above we have made correction for this by going in for residualisation. The regression equation used for residualisation is given at the end of the table. From the effect of number of rooms on purchase price/Ln purchase price/rent/Ln rent, we have taken out the effect of annual income on this independent variable. The explanatory power of our regression equations is not expected to change but the regression coefficient for income is expected to change as its effect captured in number of rooms is corrected for. This is what is brought out in the third set of our regression equations. With this correction annual income turned out to be a more significant variable. The rest of the regression coefficients did not change.

In sum, when we try to explain the price behaviour of a property we have to bear in mind the fact that it is the set of characteristics of the property and not that of its occupant/ owner that determines the property value. But, it is quite possible that characteristics of property are either not available or are highly inter-dependent. In such a situation characteristics of the owner/occupant are used as proxies for physical characteristics of the property. We, therefore, have included socio-economic characteristics of owners/tenants in our group of explanatory variable. Alongwith these physical characteristics of a property the neighborhood and environmental characteristics also influence the property prices. But in case of environmental variable, i.e. air pollution, we have an "a prior expectation that the impact of air pollution on property value [as judged in terms of the partial correlation coefficient or the standardized beta weights] is likely to be small relative to that of other variables". [Ridker & Henning, 1967, P.247]. This is what our results brought out. The regression coefficients of SO2 were all statistically insignificant. But the impact of air pollution captured indirectly in the maintenance expenditure incurred on account of discolouration and corrosion of metal, in some cases, did turn out to be significant. This got reflected in either higher maintenance cost on account of air pollution or lower rent offered. We tried different regressions taking different environmental variables but the results were not encouraging and two variables from this group, viz. due 2 =1 if forced to keep doors/windows closed on account of air pollution, zero otherwise; and, due 3 =1 if maintenance cost is on account of discolouration and corrosion of metal, zero otherwise; turned out to be statistically significant. On account of their interdependence we have taken only due 3 in the final sets of regressions.

Since our dependent variables – purchase price, Ln purchase price, Rent and Ln Rent – were not significantly related to environmental variable we thought of introducing a different dependent variable. This variable is named Relative

Value of the real estate. This variable was derived from the two variables of purchase rice and built-up area.

In other words, Relative Value is defined as a ratio of purchase price per square feet to average purchase price per average square feet. That is –

Relative Value = Purchase price per square feet of built-up are divided by Average purchase price per average square feet of built-up area.

This relative value was regressed on two variables that turned out to be significant. Using step-wise regression we got the following result :

Relative Value = 0.586 + 0.376 (age)* - 0.235 (SO_2)*

* Significant at 1% level Adjusted R^2 = 0.155

This equation indicated that the relative value of a property was adversely affected by the concentration of SO_2. The effect that was not captured in actual purchase price got reflected in the relative value of the real estate.

Since one of the environmental variables, viz. SO_2, turned out to be a significant negative influence on relative value of a property we thought it worth its while to try out other functions. Using the models adopted by Murty, Gulati and Banerjee discussed above we also fitted a hedonic property price function and used the regression coefficient of SO_2 estimated from this function to estimate the marginal willingness to pay function. We have used two independent variables in this exercise. These two variables were log of rent and log of purchase price. On account of the fact that the data on air pollution were available only for 11 years, our number of observations was reduced considerably. Faced with this additional problem alongwith the problem of multicollinearity we selected only five independent variables for the estimation of hedonic property price function and marginal willingness to pay function. The results of our exercise are given below in Talbe–13.

Table-13: Hedonic Price Functions Using OLS :

Regression Equation 1

Ln (Rent) = 3.058 + .354 Ln (No. of rooms)* + .071 Ln (Dist. to work) + .004 Ln (Perception) - .026 Ln (SPM) + .011 (Zone dummy)

Adj. R^2 = 0.126

* Significant at 1% level

Regression Equation 2

Ln (Rent) = 2.979 + .350 Ln (No. of rooms)* + .064 Ln (Dist. to work) + .011 Ln (Perception) - .088 Ln (SO_2)** + .007 (Zone dummy)

Adj. R^2 = 0.133

* Significant at 1% level
** Significant at 11% level

Regression Equation 3

Ln (Purchase Price) = 4.916 + .533 Ln (No. of rooms)* + .075 Ln (Dist. to work) + .021 Ln (Perception) + .031 Ln (SPM) - .082 (Zone dummy)

Adj. R^2 = 0.264

* Significant at 1% level

Regression Equation 4

Ln (Purchase Price) = 5.176 + .543 Ln (No. of rooms)* + .960 Ln (Dist. to work) + .017 Ln (Perception) - .107 Ln (SO_2)** - .080 (Zone dummy)

Adj. R^2 = 0.275

* Significant at 1% level
** Significant at 9% level

Note : [1] Perception variable is an ordered variable ranging from 1 to 3, which was used to rank the perception of respondents regarding air pollution in their locality. Higher the rank better will be the quality of air. There are three categories of perception that are given below with their rank in the bracket.

Unbearable (1)
Bearable (2)
Moderate (3)

[2] Zone dummy is the variable for North and South of GIDC.

Zone dummy = 1 if South of GIDC
Zone dummy = 0 otherwise

Table-13 gives four Hedonic Price Functions that take two structural characteristics, viz. Number of rooms, and Distance from residence to workplace; and three environmental characteristics, viz. perception of people regarding pollution in their area, SPM/SO_2, and dummy for zone of the GIDC; into account. Regression equations 1 and 2, take monthly rent as the dependent variable. Whereas regression equation 3 and 4 take purchase price as the dependent variable. The independent variables are the same for equations 1 and 3, where alongwith other four independent variables SPM is taken as an additional variable. The only difference between equations 2 and 4 is that instead of SPM we have, taken SO_2 as one of the independent variables.

These four equations show that number of rooms turned out to be the most important variable explaining variations in both rent as well as in purchase price. Thus, we notice that larger the number of rooms higher will be the price/rent of the house. Second important negative influence on rent and purchase price differentials turned out to be the concentration of SPM. These four regressions are different from the earlier equations in terms of the selection of independent variables and dependent variables. In these equations, we have used only the log values of purchase price and rent. Earlier alongwith log values the absolute values of purchase price and rent were also used. Further, we have taken only physical and environmental variables into consideration here.

The regression equations 1 to 4 were used for estimating the Marginal Willingness to Pay for clean air (i.e. the implicit marginal price of clean air) functions. The regression coefficients for SPM estimated in equations 1 and 3 were used to estimate the implicit marginal price (i.e. marginal rent / marginal purchase price of a house) for SPM.

Similarly, equations 2 and 4 were used to estimate the implicit marginal price for SO_2. Here we have to bear in mind the fact that higher the concentration of SPM / SO_2, lower would be the quality of air. Thus, concentration of SPM / SO_2 is the inverse of air quality.

The implicit marginal prices for clean air were obtained by taking the derivative of hedonic price functions with respect to SPM / SO_2. These derivatives are given below:

$$\frac{\partial\,(\text{Rent})}{\partial\,(\text{SPM})} = -.026\,\frac{(\text{Rent})}{(\text{SPM})}$$ from equation 1 and used in equation 1 (a)

$$\frac{\partial\,(\text{Rent})}{\partial\,(SO_2)} = -.088\,\frac{(\text{Rent})}{(SO_2)}$$ from equation 2 and used in equation 2 (a)

$$\frac{\partial\,(\text{Purchase Price})}{\partial\,(\text{SPM})} = -.031\,\frac{(\text{Purchase Price})}{(\text{SPM})}$$ From equation 3 and used in equation 3 (a)

$$\frac{\partial\,(\text{Purchase Price})}{\partial\,(SO_2)} = -.107\,\frac{(\text{Purchase Price})}{(SO_2)}$$ From equation 4 and used in equation 4 (a)

The absolute value of implicit marginal prices for a reduction in SPM / SO_2 (i.e. for an improvement in air quality) were then regressed on some of the economic, structural and environmental variables to estimate the Marginal willingness to Pay Functions. These functions are given below in Table – 14.

Table-14: Marginal willingness to Pay Functions Using OLS

Regression Equation 1 (a)

Ln (Marginal Rent) = - 17.367 + .307 Ln (income)* + .007 Ln (Dist. to work) +

.106 Ln (Perception)** + 4.934 Ln (SPM)* - 5.200 Ln $(SPM)^2$ *

- .009 (Zone dummy)

Adj. R^2 = 0.242

* Significant at 1% level ** Significant at 9% level

Regression Equation 2 (a)

Ln (Marginal Rent) = - 0.869 + .165 Ln (income)* + .016 Ln (Dist. to work) +

.039 Ln (Perception) - .970 Ln (SO_2)* + .128 Ln $(SO_2)^2$

- .010 (Zone dummy)

Adj. R^2 = 0.754

* Significant at 1% level

Regression Equation 3 (a)

Ln (Marginal Purchase Price) = - 0.796 + .275 Ln (income)* + .058 Ln (Dist. to work) + .006 Ln (Perception) + .722 Ln (SPM) - 1.074 Ln $(SPM)^2$ + .093 (Zone dummy)

Adj. R^2 = 0.181

* Significant at 1% level

Regression Equation 4 (a)

Ln (Marginal Purchase Price) = 2.574 + .151 Ln (income)* + .009 Ln (Dist. to work) + .001 Ln (Perception) - .319 Ln (SO_2) - .554 Ln $(SO_2)^2$ ** + .054 (Zone dummy)

Adj. R^2 = 0.783

* Significant at 1% level ** Significant at 6% level

From these results, we observe that income had a positive and a significant impact on marginal willingness to pay for an improvement in air quality in all the four regression equations. These are expected results.

Marginal willingness to pay, expressed in terms of marginal rent, is positively and significantly associated with SPM concentration. Higher the concentration of SPM poorer will be the quality of air. This shows that as SPM concentration was reduced, i.e. as air quality is improved, people were willing to pay less and less additional amount of money. That is their marginal willingness to pay fell with improvement in air quality. Such a result implied diminishing marginal utility for air quality. Coefficient of SPM square gave us the curvature. Perception of people regarding pollution in their area was positively associated with their marginal willingness to pay for an improvement in air quality. But, in this case we have to remember that the ranking of an area is positively related with air quality. Thus, higher the rank given to an area better will be the air quality of that area. The positive regression coefficient in this case is not indicative of diminishing marginal utility for clean air. This relationship was expected to hold good only where the air pollution was very severe and people would be willing to pay more as the quality improves, upto a point. The perception variable had positive signs in all the four regression equations but it turned out to be significant only for the first regression equation.

Concentration of Sulfur Dioxide (SO_2) was negative and significantly related with the marginal willingness to pay expressed as marginal rent. Thus, lower the concentration of SO_2 higher was the additional rent that people were willing to pay. That is better the quality of air more were the people willing to pay an additional rent.

Neither of the three environmental variables, viz. perception, SPM and SO_2, turned out to be significant for marginal willingness to pay expressed as marginal purchase price. Though these variables did not explain the variations in marginal willingness to pay of our respondents, SO_2 atleast turned out to be a significant variable influencing, negatively, the rent/purchase price of a property.

In sum, our results and findings show that the exercise undertaken here did bring out the fact that air pollution had an adverse impact on property value.

Section–VI: Recommendations

The present study is an attempt to estimate the environmental cost of industrialisation as expressed in terms of loss of property value on account of air pollution resulting from industrial development. Based on our experience and our findings following recommendations are put forward.

1 The first recommendation is that reliable data on air pollution and property should be collected. In order to undertake any exercise in the field of environmental economics all the researchers feel frustrated over the fact that no reliable data are available on environmental pollution. The first and the foremost requirement is establishing number of monitoring centers for air/water quality measurements. Compulsory auditing of industrial units in terms of pollutants emitted per unit of output, total volume, etc. should be introduced and records must be maintained.

2 It is not enough to maintain records and monitor ambient air/water quality from a much larger number of monitoring centers but these data should be easily available. Fear from public litigation and "environmental terrorism" from NGOs even the published data are a rare commodity to come across. Situation in industrial estates should not be allowed to degenerate to a level where eco-terrorism has a chance to succeed.

3 Industrial units should be classified according to the type and quantity of pollutants they emit. A colour code should be adopted to identify the units that cross the permissible limits of different pollutants. Those who emit less than the acceptable quantity of given pollutants may be given green colour and those crossing limits and creating hazards may be given red colour. These colour codes should be made public and after a warning or two the colour given to an industrial unit should also be made public. This would exert pressure on these units from fear of having adverse public opinion. This knowledge will make it

possible for people to select a site for their house where they are not forced to keep the windows and doors closed.

4 Common Effluent Treatment Plant [CETP] is supposed to cater to the needs of small/medium industrial units as these units do not have the wherewithal to install treatment plants on their own. There are number of problems here. One, these CETPs may not be able to meet the requirements of treating considerable amount of wastes generated by these industrial units. Two, quite frequently various types of effluents generated by different units cannot be mixed/treated together in CETP. Dr. N. M. Bhatt, in our consultations with him, brought it our notice that even if there is no capacity constraint in CETP two different effluents being treated together may have some chemical reaction, which may be hazardous. So depending on the type of effluents we have to have different treatment plants. Third, the fees charged for using CETP are according to the quantity of wastes treated. It is usual practice for some of the industrial units in GIDC to send only a small part of their effluents to CETP and to dump illegally large part of their effluents at night. Residents of GIDC have also complained that they experience a sudden increase in air pollution after mid night when pollutants are illegally emitted in the air. In a poor country like ours, people have to suffer from air/water pollution, as the alternative to this is remaining unemployed. This illegal dumping of pollutants and release of gas increased the levels of air pollution forcing them to keep their doors and windows closed. The effect of air pollution on property price can be indicated by looking at the average purchase price per average built-up area between north and south of GIDC. North East of GIDC falls in the wind direction and suffers air pollution more intensely as compared to South. The ratio of average purchase price per average built-up area for south and north turned out to be 1.9. This means that on an average property price per square feet in south was almost twice of that in the north. A better and a cheaper CEPT should reduce the incentive to dump wastes illegally resulting into less of stench and other pollutants emerging from such dumps being emitted.

Illegal release of gases at night must be stopped so the values of the property in the north of GIDC are protected.

5 Even poor people were willing to pay for an improvement in air/water quality. A temptation to gain few bucks did not make them accept a marginal deterioration in air quality. These were the costs that were not incorporated in our cost calculations while planning our industrial strategy. Unfortunately, the WTP was also not captured in our hedonic price function as all the regression coefficients for air pollution turned out to be statistically insignificant. This is so because for these people having an employment, saving on transport and benefiting from other infrastructural facilities available in GIDC was more important than staying away and paying higher real estate price in cleaner environment. But, one thing came out clearly that relatively poor people lived in areas that fall in the wind direction for most of the time during a year. Their property prices were lower and as per their perceptions, they did not increase as much as in other areas in the South of GIDC. Thus, what is required is a record of property prices by regions and by air/water quality. Presently we have to rely on peoples' perceptions regarding air quality and price behaviour of real estates, as no data were readily, even after repeated efforts, available.

6 We were told by Mr. Vegada who was in charge of GPCB office at Bharuch that since last three years there was a perceptible improvement in air quality in Ankleshwar GIDC. The data supplied by Dr. N. M. Bhatt of Environmental Engineering Laboratory, M.S.U., also supported this claim. Unfortunately, this improvement was not the result of increased effectiveness of GPCB but purely on account of industrial recession experienced recently. This recession had also resulted into a decrease in real estate prices. Under such a situation if we were to run a hedonic price function we would get very disturbing picture where property prices were increasing alongwith increasing levels of pollution, and vice versa.

7 Before granting the permission to build residential housing complexes / societies the government should make it sure that alongwith human health property value is also protected in areas that fall in the wind direction. Our study has shown that relatively rich people paid a higher price for residing in a cleaner atmosphere. These price differentials between north and south was, to a certain extent, the result of differences in air quality. The government should have a clear-cut policy on housing in industrial estates.

8 Our study brought out the fact that air pollution affected prices of real estate adversely. The relationship did not come out to be strong one on account of number of factors already discussed earlier. If we wish to protect the value of real estates then we have to control air pollution. The problem here is that this is a case of asymmetric information where we cannot have a simple policy recommendation like taxation and regulation. We therefore recommend a mix of policies that include more effective controls on emissions of pollutants, moderate charges to industrial units for effluent treatment, subsidies to industrial units for installing air pollution control devices, availability of information to property owners regarding pollutants emitted to air and their effects on physical characteristics on the property, etc.

It has to be acknowledged here that Ankleshwar Industries Association is quite conscious of its responsibility and has established Ankleshwar Environment Preservation Society in 1989. This society planted trees, tried to creats awareness in the public, assisted industries in controlling air pollution and helped them in disposing of their solid and liquid wastes. It has also set up a laboratory for testing stack air and liquid effluent samples. Inspite of the efforts of Ankleshwar Industries Association there are many gaps that continue to exist even today. May be more needs to be done in this direction.

In sum, faulty industrial strategy, i.e. growth through chemicals, accompanied by corrupt, inefficient and incompetent government machinery (including GPCB) has led us to a situation where huge properties were built, environment was destroyed and at the end of the day we had recession offering us loss of environment, loss of property values, unemployment and freedom to starve. We wish we did not have the Golden Corridor, which has now turned itself into gas chamber.

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Appendix Table I : Primary Data Collected on Some Variables on Property in Ankleshwar GIDC

[includes Residential + Commercial + Residential & Commercial]

SRNO	Zone *	Purchase Price (Rs.)	RENT	Built-up Area (Sq.Feet)	Level of Education **	Year of Construction	Expected Price (Rs.)	Distance from Resident to work place (Km)	Price Trend ***	WTA (Rs.)	WTP (Rs.)	No. of Rooms	Annual Income (Rs.)	Perception of pollution ****
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2	200000		200	4		300000	2.00	1			2	60000	1
2	2	250000		400	2	1990	250000	4.00	3	10000		3		1
3	2	225000		400	1		225000	7.00	3	37500		3	120000	1
4	2		2000	400	2		150000	9.00	3			3	24000	2
5	2	137000		400	3	1991	137000	2.00	3			3	72000	1
6	2		2000	250	4		250000	2.00	3	10000	10000	3	84000	3
7	2	250000		200	4	1993	250000	4.00	3	10000	5000	3	144000	1
8	2	350000		200	2	1995	350000	4.00	3	10000		3	40800	2
9	2	250000		250	3	1994	200000	13.00	2		5000	3	144000	1
10	2	411000		975	4	1998	350000	4.00	2			4		3
11	2	450000		800	4	1999	400000	4.00	2		150	4	12000	2
12	2	150000		400	1	1985	300000	.50	1	37500		3	420000	3
13	2		1200	400	4	1985	250000	4.00	1			3	100000	2
14	2		2100	400	3	1985	300000	4.00	1			3	36000	2
15	2		350	400	4	1985	195000	1.00	1	10000	3500	3	72000	1
16	2	165000			3		250000	1.00	1			2	60000	1
17	2	200000			4		250000	2.00	3			2		2
18	2	200000			4		250000	1.00	3			3	96000	2
19	2		1900	250	4	1988	200000	4.00	3		250	3		2
20	2	250000		650	4	1992	250000	20.00	2		15000	3	100000	2
21	2		1500	250	4	1988	225000	4.00	1			3	36000	2
22	2		2500	200	4	1989	200000	2.00	2			2	48000	3
23	2	200000		120	4		200000	4.00				3		3
24	2	180000		180	4		240000	4.00	1	50000	160	3	48000	3
25	2			120				4.00			3000	3	60000	3
26	2			120			250000	4.00			4800	3	96000	3
27	2	300000		350	4	1985	350000	4.00	1		1500	3	300000	2
28	2	300000		350	2	1985	300000	1.00	3			3	24000	2
29	2		2200	200	3			1.00				2	60000	2
30	2			400	4	1980	60000	1.00	2			2		2
31	2	500000		600	4	1986	450000	4.00	3			1	36000	2
32	2	400000		600	4	1988	400000	4.00	1			4		3
33	2	180000		625	3	1995	242000	2.00	1	10000	5000	3		1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
34	2		2000	250	4	1999		2.00	3	10000	5000	3	72000	2
35	2		2200	270	4	1997	270000	3.50	3		5000	3	70000	1

36	2		2200	156		1985	150000	3.50			4800	3	96000	3
37	2		1000	120	4		200000	3.50			500	3	72000	2
38		150000		120	4	1994	200000	2.00		37500	360	2	84000	1
39	2	273000		780	4	1985	450000	3.50			1800	4	180000	2
40	2			600	3	2000	3000000	7.00	1	375000		6	300000	2
41	2	250000		925	4	1996	250000	1.00	3		15000	4	150000	1
42	2			2200	3	1994	1900000	3.00	1		3000	5	300000	3
43	2			350	2	1991	325000	1.00	1			3		3
44	2			989	4	1986	600000	3.00	3			4		3
45	2			650	4			4.00	2			4	48000	2
46	2		1000	200	4	1988	200000	2.00	1			3	36000	2
47	2		4000	110	4	1988	200000	4.00	1		5000	3	80000	3
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49	2			500	4	1989	2000000	2.00	1			6		2
50	2		3000	750	4	1980	3000000	1.00	2	10000	1250	3	125000	2
51	2		3000	670	4	1990		4.00	1			3	36000	2
52	2	100000		650	4	1980	350000	3.50	1	10000		3		1
53	2		1700	225	4	1984	200000	3.50	3			4	36000	3
54	2		2000	250	4	1985	250000	2.00	1		5000	4	180000	2
55	2	400000		1250	4	1993	400000	2.00	3			4		2
56	2			3000	4	1996	2000000	1.00	1			6	60000	2
57	2		100	600	4	1999		4.00	2			4	78000	2
58			100	600	4			4.00	1		6500	4	130000	2
29				1500	4	1990	280000	1.00	1					1
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61	2	380000		180	3		600000	2.00	3			3	60000	2
62	2			300	4		100000	4.00	2			2	100000	2
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67	2	64000		360	4	1985	70000	2.00	3			2	36000	1
68	2	108000		350	4	1985	108000	7.50	3			2	43200	2
69	2		1350	350	4			9.00	3			2	48000	1
70	2		1300	325	3			30.00	3		5000	2	60000	2
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74	2	130000		120	3	1997		1.00	2	10000	5000	2	60000	3
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79	2	400000		180	4		550000	3.50			4800	3	96000	3
80	2	350000		180	4		500000	2.00			4800	3	96000	3
81			4000	180	4		550000	4.00			12000	3	120000	3

82	2	90000		575	4	1994	225000	2.00	1			4	200000	3
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85	2		1300	120	4	2000		4.00	3	10000	10000	2	216000	3
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87	2		1100	225	3			3.50	3	10000	5000	2	72000	2
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92	2	58000		80	3	1980	50000		2			2	12000	2
93	2		1500	77	2			4.00	2	10000		2	30000	2
94		300000		120	3		300000	3.50			600	3	30000	1
95	2	300000		120	4		300000	3.50			3600	3	72000	1
96		650000		195	4		850000	3.50			1080	5	108000	3
97		350000		180	4	1989		2.00			1800	4	36000	1
98	2	250000		150	4	1985	275000	1.00	1		5000	3	36000	2
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103	2		1500	300	3	1990	120000	4.00	2			2	36000	2
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107	2		1800	300	4	1986	225000	3.50	2		3000	3	60000	2
108	2			300	4		200000	1.50		24000	650	3	84000	2
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114	2			375	4	1996	2750000	3.00	2	10000	5500	7	550000	2
115	2			1500	4	1994	2500000	75.00	3		27500	6	550000	3
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121	2	65000		600	3	1996	65000	1.00	2			3	24000	2
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129	2	100000		350	3	1989	100000	1.00	2		1500	2	60000	2
130	2	100000		600	3	1979	150000	1.50	2			3	42000	1
131	2		600	400	4			2.00	2		2400	2	48000	1
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133	2	175000		400	4	1975	400000	1.00	1			2	60000	1
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135	2		1200	250	4	1999			3	10000	5000	2		1
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137	2	100000		250	4	1981	100000	1.00	3	10000	10000	2	75000	2
138	2		70	550	4	1980	200000	1.00	1	6000	6000	3	120000	2
139	2			240	3	1998		2.00	3	37500		2		3
140	2		1400		4		200000	1.00	2			3	65000	2
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143			75	600	4	1985	180000	4.00	1	5000	2000	3	96000	2
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154	2	200000		120	4	1975	280000	2.00	3			3	240000	2
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156	2	200000		400	4	1980	280000	150.00	1		10000	3	96000	1

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167	2	300000		835	4	1997	300000	4.00	3			3	84000	3
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169	2	125000		610	3	1995	200000	2.00	3		1500	3	102000	2
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173	2			240	3	1974	100000	3.50	1			2	18000	1

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176		200000		600	3	1997	225000	3.50	1			2	36000	2
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178	2		800	100	3	1976	90000	2.00	1		500	2	36000	3
179	2	125000		387	4	1980	125000	100.00	3	37500		2	60000	3
180	2		100	150	4		200000	5.00	1		7200	2	48000	2
181	2		1500	200	4	1975	100000	1.00	3		5000	2	100000	2
182	2		600	400	4	1973	100000	2.00	1		10000	2	100000	2
183	2		1500	120	2	1975	100000	2.00	3			2	36000	
184	2	110000		120	4		125000		1			2		2
185	2		150		2	1983		2.00	1		50	2	36000	1
186	2	60000			3	1975	875000	4.00	1		2200	2	48000	1
187	2	150000		120	3	1983	925000	3.50			2200		48000	1
188	2	125000		120	4		650000	3.50				2	60000	2
189		150000		96	4			2.00		10000	1200	2	60000	3
190	2		1400	120	3	1934	90000	6.00	2		2400	2	48000	1
191	2		1500	120	4	1983		3.50	1		600	2	48000	2
192	2		2000	450	4	1996	250000	2.00	1		2000	3	120000	3
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194	2	300000		56	4	1997	400000	3.50	3	10000		2		1
195	2	500000		750	4	1995	600000	3.50	3		5000	6	100000	2
196	2		1500	800	3			1.00	3		2400	3	48000	2
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200	2			1000	4	1996	700000	2.50	3			3		3
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202			1500	650	3	1998		1.00	2			3		2
203	2	245000		615	3	1999	245000	7.00	2			3	60000	3
204		300000		500	4		350000	4.00	1			4		3
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206	2			1200	4	1996	1000000	.50	1		10000	4		2
207	2	150000		370	4	1997	120000	5.00	2		2400	2	42000	2
208	2	300000		370	4			1.00			1200		60000	3
209	2	150000		400	3	2001		1.00		10000	10000	2		3
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212	2	350000		728	4	2000	350000	2.00	3		5000	4		2
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214	2		1900	1200	3	1998	300000	6.50	3		840	3	84000	3
215	2			324	4	1999	125000	1.00	1			3		3
216	2	250000		1000	4	1999	250000	10.00	3		3000	4	60000	2
217	2	230000		560	4	2000	230000	4.00	3			3	84000	2
218	2	350000		782	4	2000	350000	3.50	3			4		3
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221				500	4	1994	300000	3.50	2			3		3
222	2	350000		600	3	1997	350000	2.00	3		5000	3	60000	2
223	2	450000		700	4	1993	750000	2.00	1			6		3
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225		350000		300	4		350000	1.00	3			2		1
226	2	130000		160	3	1998	130000	3.50	3		3600	2	72000	2
227	2	300000		835	3	1995	250000	2.00	2	10000		3	84000	3
228	2		60	650	4	1980	300000	1.00	2		1000	4	180000	1
229	2		2300	600	4	1996		4.00			1000	3	60000	2
230	2	235000		600	4	1995	235000	22.00	2			3	80000	3
231	2			960	4	1997	1000000	1.00	1		1200	4	180000	3
232	2	400000		300	4		400000	20.00	3		500	4	96000	3
233	2	120000		900	4	2000		5.00	2		6000	3	72000	3
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236	2		2000	580	4	1996		25.00	3			3	60000	2
237	2		2000	640	4	1995	250000	4.00	3			3	60000	3
238	2	450000		780	3	1995	400000	4.00	2	10000		4	72000	1
239	2	150000		640	4	1995	150000	4.00	3			3	48000	3
240	2	250000		600	3	1997	250000	4.00			12000	3	120000	3
241	2		1200	450	4	1989	200000	20.00				2	60000	2
242	2			450	4	1989	225000	25.00	1		5000	2	60000	2
243	2			450	4	1989	200000	20.00	1		5000	2	60000	2
244	2	125000		450	4	1989	200000	22.00	2	10000		2	60000	2
245	2			450	3	1989	175000	20.00	1	10000	1000	2	42000	2
246	2	260000		640	3	1995	200000	2.00	2			3	84000	3
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248	2				4	1998		2.00		10000	5000	3		3
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250	2	400000		750	4	1998		4.00	1	10000	5000	4	72000	2
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253	2		2000	750	3	1995	250000	4.00	2			4	48000	2
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258	2	365000		850	4	1998	400000	12.00	1			4		2
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262	2	300000		680	4	1996	380000	4.00	1			4	60000	3
263	2	250000		750	4	1999	250000	1.00	2			4	72000	2
264	2	340000		940	4	1998	400000	7.00	1		10000	4	130000	2
265	2		1500	500	4	1995	200000	2.00	2			3		2

266	2	345000		940	3	1995	375000	4.00	1	37500	5000	4	100000	2
267	2		1800	500	4	1995	225000	2.00	1			3	36000	2
268	2	200000		850	4	1982	225000	2.00	1			4		2
269	2		2000		4		250000	2.00	1			3	96000	2
270	2		2200	720	4		420000	4.00	1		3600	5	72000	2
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272	2		2200		4		260000	2.00	2		10000	3		2
273	2		3000	300	4	1980		2.00	1			3	60000	2
274	2	200000		450	4	1976	300000	3.50	3			4	30000	3
275	2		1000	600	4	1992	380000	18.00	1		2400	4	120000	2
276	2			550	4		750000	20.00	1			4		3
277	2				4			3.50	2	10000	1000	3	36000	2
278	2				3		200000	2.00	1	10000	3000	3	60000	2
279	2			800	3	1991	325000	20.00	1		10000	4	200000	3
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281				1300	4		450000	20.00	2		15000	4	300000	
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283	2	200000		350	4	1995	200000	1.00	3			3	42000	3
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285	2				3		350000	4.00	1			3		2
286	2				3		150000	4.00	1			3		1
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295	2		1800	500	4		200000				600	3	60000	1
296	2		1200	500	4		200000	4.00			600		36000	2
297	2			500	4		200000	4.00			360	4	48000	2
298	2		2000	625	3		300000	2.00			600	4	42000	2
299	2	75000		100	4	1975	150000	2.00	1		300	2	60000	2
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393	2	250000		225	4	1991		1.00	1	37500	5000	3		2
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552	2		2500		1			3.50	1			3		2
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841	1	200000		1200			250000	4.00	1			3	72000	1
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855	1	35000		200	3		55000	4.00	1			2		2
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948	2	275000		300	4		275000	4.00	2			3	216000	2
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1005	2	200000		600	4		250000	2.00	1		3600	3	72000	2
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1079	2	125000		150	4	1997	125000	1.00	3				108000	2
1080	2		4000	500	4	2000		3.50	2		5000		144000	1
1081	2	50000		260	3		250000	4.00	2				13200	2
1082	2	100000		150	3	1995		2.00	2				18000	1
1083	2	400000		200	2	1999	325000	2.00	3					2
1084	2		3000	250	3	1997		1.00	2					2
1085	2			250	4	1997	350000	1.00	2					2
1086	2	300000		168	4	1995		3.50	2		5400		54000	2
1087	2	150000		180	4	1995	145000	1.00	1		5000		60000	3

1088	2	150000		520	3	1998	315000	1.00	2		75			1
1089	2		1050	250	1	1986		1.00	2	10000	5000		36000	3
1090	2			100	4	1997		1.00	3		10000			2
1091	2	275000		400	4	1986	275000	1.00	3	10000	5000			3
1092	2	1750000		200	4			1.00	3		5000		36000	2
1093	2	180000		120	2	1998	180000	1.00	2	10000			270000	2
1094		150000		144	4	1995	150000	1.00	3				13200	1
1095		150000		120	3		150000	10.00					24000	2
1096	2	175000		12	3	1991	150000	4.00	2	10000	360		18000	1
1097	2			270	3	1997	100000	4.00					60000	2
1098	2				3	1999	4000	1.00	1	10000			10500	3
1099	2	160000		200	4	1998	200000	1.00	2	10000				1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1100	2	135000		150	2	1999	135000	2.00	2		5000			3
1101	2	150000		200	3	1998	200000	1.00	1					2
1102	2	120000		170	4	1999	120000	1.00	3	10000	5000		36000	2
1103	2	40000		30	4	2000	40000	4.00	3	10000			24000	3
1104	2		1500	216	4	2001		2.00			5000			2
1105			1200	150	2	2001		1.00		10000	5000		180000	3
1106	2	150000		200	3	1999	150000	1.00	3		2400		48000	2
1107	2		1500	200	4	1999	150000	1.00	3		3000		60000	2
1108	2	250000	2000	200	3	1999	250000	2.00	3					2
1109			1500	150	2	1999	50000	1.00	2					1
1110	2	2000000		100	4	2000	315000	1.00	1	10000				3
1111	2	100000		105	2	1999		2.00	2	10000				3
1112	2		2250	100	3			10.00	3	37500				3
1113			2000		3			1.00	1					1
1114	2	300000		240	3		315000	1.00	1					1
1115	2		1500	150	2		60000	1.00	1				12000	3
1116	2		2000	150	3	1997	350000	2.00	2	37500	5000			3
1117	2	350000		170	2	1997	400000	3.50	1	10000	6000		120000	3
1118	2	450000		225	3	1996	500000	4.00	2		10000		50000	3
1119	2	250000		150	4	1996	250000	2.00	3		5000		22500	3
1120		400000		150	4	1993	450000	3.50	1		1200		120000	2
1121	2	300000		270	4		450000	3.50	1		1200		75000	3
1122	2	300000		250	4	1994	450000	4.00	1		10000		90000	3
1123	2	280000		155		1994	350000	3.50	1	10000	10000		450000	2
1124	2	1200000			4	1994	1200000	3.50	3		22500		120000	2
1125	2	350000		180	4		425000	2.00	1		600		96000	3
1126	2	100000		150	4	1995	100000	40.00	3	37500			24000	1
1127	2	6000		25	4	1990	6000	1.00	2				48000	2
1128	2		3000	170	3	2000	170000	1.00	3	10000	5000		324000	3
1129	2	200000		150	2	1995	200000	3.50	3	10000	1200		288000	3
1130	2		3000	115	3	1998	#NULL!	5.50	2	10000			216000	3
1131	2	250000		400	3	1988	225000	1.00	2		2000		120000	2
1132	2		3000	400	3	1989	225000	1.00	2		5000		60000	2
1133	2	240000		400	4	1989	240000	7.00	3				60000	2

1134	2	250000		400	3	1989	250000	3.50	3	10000			18000	1
1135	2	250000		96	4	1992	350000	1.00	1		4800		96000	2
1136	2	250000		240	3	1996	350000	1.00	1		6000		120000	3
1137	2			240		1995	350000	2.00	1		960		48000	2
1138	2	275000		150		1992	350000	2.00	1		600		5400	3
1139	2	175000		120		1994	300000	2.00	1		2400		48000	3
1140	2	240000		476		1992	425000	4.00	1				48000	1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1141	2	300000		161		1997	300000	1.00	3		6000		120000	1
1142	2			176	3	1995	500000	1.00	1					3
1143	2		1300	150	4	2000	150000	2.00	1	37500	5000		108000	2
1144		100000		175	3	2000	100000	1.00	3	10000	3600		72000	2
1145	2		1800	120	3			3.50	3		780		24000	3
1146	2	180000		1100	3	1996	300000	1.00	2					2
1147	2		1200	140	3	1999		1.00	2					2
1148	2	300000		520	4	1996	200000		2					3
1149	2	150000		300	4	2000	200000	4.00	1					2
1150	2	240000		300	4	2001	225000	5.00	2					3
1151	2		2500	210	4	1995		1.00	2					3
1152	2		2000	216	4	1996	200000	1.00	2					3
1153	2		2000	200	4	1996		1.00	2					1
1154			2000	150	3	1997		1.00	3		5000		72000	2
1155		200000		200		1996	400000	1.00	1		5000			2
1156	2	120000		100	3	1997		2.00	1		1800		36000	2
1157	2		2000	240		1996		4.00	2					3
1158	2		1200	240			175000	7.00	2					2
1159	2	250000		216	3	1998	200000	1.00	2					2
1160	2	275000		240		1994	260000	1.00	2	50000				1
1161	2		2500	250	3	1997	220000	3.50	2	37500	2000			3
1162	2		2500	300	3	1995	250000	1.00	2		3000		60000	2
1163	2	250000		245	3	1999	200000	1.00	2					2
1164			1200	120		2000		4.00	3		1200		72000	2
1165	2	300000		300	3	2000	300000	2.00	3		3000		60000	3
1166	2	150000		150	4	1995	105000	7.00	2					2
1167	2	200000		275	4	1996	150000	1.00	2					1
1168	2	350000		375	3		350000	2.00	1					2
1169			700	275	4	2000		2.00	2					2
1170	2	300000		150	4	1995	250000	1.00	2					1
1171	2	500000		250	4	1994	1000000	1.00	1					2
1172	2	162500		125	3	1994	162500	2.00	3		120		60000	1
1173		280000		280	3	1999	280000	8.50	2		1800		36000	2
1174	2	405000		270	4	2001	378000	3.50	2		1800		36000	2
1175	2	250000		240	4	1998	250000	1.00	2		1200			2
1176	2	400000		400	4	1998	500000	1.00	1					2
1177	2	300000		220	4	2000	200000	1.00	2	3600	500		120000	1
1178	2		2500	200	2	1995	260000	2.00	3		5000		60000	2
1179	2	150000		200	4	1997	150000	1.00	3		500		60000	3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1180	2			250	3	1999	120000	1.00	3					2
1181	2			420	3	1990		1.00	2				60000	2
1182	2		2500	220	2		300000	7.00	2		600		420000	3
1183	2	225000		600	4	1995	225000	10.00	2		300			2
1184	2		1500	200			200000	1.00	2					2
1185	2		2000	200	3	1996	250000	4.00	2					2
1186	2		1500	220	4	1995	132000	3.50	1					3
1187	2	150000		900	4	1995	150000	2.00	3		2500		50000	2
1188	2	253000		204		1988	300000	4.00	1				600000	2
1189	2	100000		300	4	1993	150000	1.00	2				180000	3
1190	2		2000	240	3	2000		1.50			1200		48000	3
1191	2		4000		4	2000		2.00	2		650			2
1192	2	165000		88	4	1996	135000	1.00	1		3600		1200000	2
1193	2					2000	300000	2.00			850		1100000	1
1194	2	300000		200	4	1999	400000	1.00	1		1800		36000	2
1195	2	265000		230	4	1999	325000	1.00	1				270000	2
1196	2	230000		81	4	1997	250000	1.00	3		500		60000	2
1197	2	225000		180	4	1996	225000		3					2
1198	2		2000	160	4		250000	2.00	3					1
1199	1		2000	250	3	1999	225000	1.00	2					1
1200	1	163000		140	4	1997	163000	3.50	2					1
1201		175000		243	3	1994	112500		2				250000	2
1202	2		3000		3	1994	200000	1.00					48000	2
1203	2	200000		180	3	1997	200000	2.00			100		24000	3
1204	2	125000		500	3	1987	200000	3.50	3			3	36000	2
1205	2	175000		250	4	1987	200000	2.00	3			3	60000	2
1206	2	200000		200	3	1987	200000	3.50	2			3	120000	2
1207	2	215000		200	3	1986	280000	1.00	3			4	36000	3
1208	2		3000	250	3	1987	200000	1.00	2		5000	4	48000	2
1209	2				4	1994		2.00	1			3		2
1210	2	425000		1000	3	1984	300000	2.00	1		3000	6	60000	2
1211	2	425000		1000	3	1985	500000	4.00	3			6	300000	2
1212	2	525000		1000	2	1986	600000	4.00	2	10000	5000	6	240000	2
1213	2		1500	150	4	1986	150000	1.00	3			2	18000	3
1214	2		2500	600	4	1996	500000	1.00				4		1
1215	2	70000		215	3	1978	150000	2.00	2			3	31200	2
1216	2	450000		80	4	1998	500000	5.00	2		10000	4	1000000	3
1217	2	2500000		500	3	1998	3000000	1.00	2		1000	6	120000	3
1218	2	250000		600	4	1998	280000	2.00	1			3	96000	2
1219	2	800000		250	4	1996	700000	9.00	1		15000	6	300000	3
1220	2	200000		500	1	1986	200000	2.00	2			4	120000	3
1221	2		2000	280	4	2000	300000	1.00	3		3000	3	60000	2
1222	2		2000	350	3		200000	1.00	2			3		2
	1	2	3	4	5	6	7	8	9	10	11	12	13	14

1223	2			350	4	1998	2300000	1.00	2		1320	6	26400	2
1224	2		3100	1000	1		800000	1.00	2			4		2
1225	2	250000		850	4	1994	350000	1.00	1			3		2
1226	1	35000		360	4		75000	1.00	2			2		1
1227	2			800	4	1986		1.00	2			3		1
1228	2		2000	630	3	2000	250000	4.00	2			3		2
1229	1		######	850	3	1993	80000	1.00	3		3600	1	72000	1
1230	2		1000	900	3	1993	100000	1.00	2		5000	3	84000	2
1231		25000		540	3		50000	1.00	1		120	2	24000	1
1232	2		2700	1050	3	1995		7.00	2			3		2
1233	2			800	3	1992		3.50	2			3		2
1234	2			1500	4	1996	900000	3.50			10000	4		2
1235	2		2500	1500	4		325000	1.00	2		5000	3	168000	1
1236	2		160	650	4	1986	280000	1.00	2			2		1
1237	2			2500	3	1999		1.00	2			5		1
1238	2	90000		170	3	1980	70000	1.00	2			2	95000	2
1239	2		3500	1100	4	1995	25000	1.00	2	10000		4		2
1240	2	175000		900	3	2001	87500	1.00	2			2		2
1241	2		2000	600	3	1996	250000	2.00				3	36000	2
1242	2		2000	1000	4		300000	1.00	2		1200	3	60000	2
1243			1500	650	4		225000	4.00	1		20000	2		1
1244	2		2000	750	4	1992	650000	1.00	3		1500	3	180000	2
1245	2		2000	1000	4		200000	1.00	2			2		1
1246	2			1100	3	1998	375000	1.00	2			4	180000	2
1247	1			600	4	1989	100000	1.00	2		180	3	36000	1
1248	1	62500		280	4	1983	62500		2			2	25200	1
1249	1			900	4	1984	350000		2		10000	5		1
1250	1			560	3	1997	75000	1.00	2			3	27000	1
1251	1		1900	200	4	1998	150000	1.00	2		15000	2	216000	1
1252	2		1500	400	2	1994	210000	1.00	1		5000	3	60000	2
1253	2		1200	180	4			1.00	3			2		1

Note : * Indicates : 1= North Zone GIDC Ankleshwar & 2= South Zone GIDC Ankleshwar
**** Indicates : 1=Iiiliterate; 2= Primary; 3= Seecondary & 4= Higher Education.**
***** Indicates : 1=Increased; 2= Decreased & 3 = Remained Same**
****** Indicates : 1= Unberable ; 2= Tolerable & 3= Moderate**

Appendix Table II : Data on SO_2, Nox and SPM Available

Year	So2 (Mg/m3)	Nox (Mg/m3)	SPM (Mg/m3)
1	2	3	4
1990	20.30	12.10	211.00
1991	21.20	13.20	201.20
1992	27.60	16.20	203.50
1993	29.40	20.40	91.00
1994	82.10	44.00	316.00
1995	86.80	40.60	239.60
1996	91.60	37.30	163.80
1997	28.00	18.20	171.20
1998	23.30	17.60	167.50
1999	15.00	28.00	211.10
2000	8.60	15.30	180.50
2001	4.60	1.50	256.00

Appendix Table III : Primary Data Collected on Some Variables for Ankleshwar Town (includes Residential + Commercial Properties)

Sr. No.	Family Size	Level of Educa-tion *	Annual Income (Rs.)	WTA (Rs.)	WTP (Rs.)	Built-up Area (Sq.feet)	Yrs. of Constr-uction	Purch-ase Price (Rs.)	Monthly Rent (Rs.)	Expected Price of House (Rs.)	No. of Rooms	Dist. to Work Place (Kms.)	Travel Expense (Rs.)	Perce-ption of Pollu-tion**
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	3	3	36000	10000		500				200000	3	4.0	300	2
2	10	3	60000			500		150000		250000	3	1.0	350	2
3	1	2	60000			550	1991	100000		175000	3	1.0	25	3
4	7	2	50000			500	1990	125000		300000	3	4.0	400	3
5	8	3	20000			546	1980	100000		300000	3	4.0		3
6	6	3	30000			450	1910			200000	3			3
7	4	4	70000			450	1998			300000	3	4.0	300	3
8	5	1	20000			350				150000	2			3
9	7	3	25000			450				250000	3			3
10	6	3	60000			450	1980	150000		300000	3	4.0		3
11	6	3	50000	10000		330	1997	175000		250000	2			1
12	6	3	150000			330	1989	200000		300000	3			1
13	17	3	100000			320	1995	150000		300000	3			1
14	2	2	50000			320			1000	250000	3			1
15	4	3	24000	15000	5000	450	1998	85000		100000	2	2.0		2
16	5	3	48000	10000	5000	490	1981	100000		150000	2	4.0	360	2
17	5	3	60000	10000		450	1983			150000	3	2.0		2
18	6	2	40000			350	1991	50000		150000	2	1.0	125	2
19	5	2	36000			495	1995			200000	3	4.0	350	2
20	5	3	66000	37500	5000	700	1990	150000		500000	4	3.5	525	3
21	7	2	35000	10000		350	1985	100000		200000	3	4.0	350	2
22	5	3	24000	37500	5000	300	1992	100000		200000	3	2.0	150	2
23	6	3	38400	37500	5000	350	1994	90000		175000	3	2.0	350	2
24	10	3	30000	37500		560	1989			70000		1.0	180	2
25	4	2	24000	10000	5000	700	1992			200000	3	2.0	55	3
26	5	4	24000	37500	5000	495	1970			300000	4	1.0	0	3
27	3	2	18000	10000	5000	300				150000	2	8.0	75	1
28	7	3	36000	50000		500	1986			100000	3	7.5		
29	5	4	60000	10000		800	1981			400000	5	20.0	350	3
30	6	3	26400	37500	10000	650			1200	500000	3	4.0	10	3
31	4	3	60000	37500	5000	300			1400	550000	3	20.0	400	3
32	4	2	10000	37500	5000	400	1993			550000	4	1.0		3
33	5	4	36000	37500	5000	550	1996			1000000	3	10.0		1
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
34	6	3	36000	10000		1000	1989			90000	4			1
35	5	1	24000	10000		455	2000			150000	2		1000	2
36	5	2	18000	37500		400	1981	50000		100000	2	2.0	1200	2
37	6	3	50400	10000		150				150000	2	1.0	300	2
38	4	1	72000		5000	2000	1991	200000		700000	4	2.0		2
39	6	3	36000			400		75000		125000	2	4.0	250	2

40	6	3	24000			350				150000	2	1.0	35	1
41	7	2	60000	10000		400	1971	40000		100000	2	1.0	350	2
42	4	1	48000	10000		300			800	175000	2	1.0	350	2
43	7	3	12000			546	1985	120000		300000	3			3
44	15	2	150000	10000		546	1990	100000		250000	3	1.0		3
45	13	3	40000			546	1991	125000		250000	3	4.0		1
46	4	2	48000	10000	5000	120	1996			60000	1	1.0		3
47	5	4	60000	20000	2000		1986	80000		100000	2	4.0	900	
48	4	2	18000	10000		250	1991			50000	2	4.0		2
49	4	4	600000	10000	10000	2250	2000	400000		425000	5	4.0	300	3
50	5	3	42000	10000	1000	140				110000	2	2.0	300	2
51	4	2	24000	10000		250	1996	40000		60000	2			3
52	5	4	140000	10000	5000	1200	1989			200000	3	2.0	300	3
53	5	3	120000	10000	5000	500	2001			150000	3	4.0		2
54	3	4	96000			500	1996	100000		175000	3	4.0	300	2
55	3	4	72000			600			1800	200000	3	2.0		3
56	6	3	72000	6000	3000	600		150000	1600	200000	3	4.0	450	2
57	4	4	240000	10000	5000	600	1996	90000		200000	3	4.0	300	2
58	7	2	120000	10000	5000	150	1985	125000		150000	3			3
59	4	1	36000	10000		100	1991	30000		150000	2			3
60	8	1	72000		5000	100	1968	20000		200000	1	3.5		3
61	5		84000	10000	5000	360	1986			350000	2			3
62	4	4				450	1990			300000	3	10.0		3
63	4	3		37500	5000	140	1976				4	4.0	1200	2
64	5	3	84000	10000		150	1982	125000		300000	4	3.5	1250	3
65	3	4	120000		5000	460	1941	25000		200000	3	75.0	1000	2
66	4	4	48000	10000		300	1996		1000	250000	2	3.5	500	2
67	3	4	126000	1500	2000	400	1997	175000		200000	2	8.0	2000	3
68	4	3	30000	10000		200	1991		1000		3	7.0		3
69	4	4			5000	400	1981			300000	3			1
70	5	3	24000		10000	425	1990		1200		3	5.0		3
71	6	1	27000	37500	5000	600	1991	135000		350000	4			3
72	6	2	78000	37500		560	1991			500000	3	1.0	350	
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74	4	4	24000	37500	5000	560	1996			200000	2	1.0		3
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76	5	3	25000			252	1985			80000	2			3
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133	4	4	36000	50000	50000		1991			400000	3			3
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137	4	4	100000			700	1994	200000		600000	3	4.0	200	2
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158	4	3	66000	50000	10000	450	1991			300000	2	6.0	300	3
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171	3	3	36000			864	1999	225000		300000	2	2.0		3
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177	5	1			5000	1000	1990	200000		500000	3	4.0		3
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206	7	4	72000	10000	5000	550			1700	600000	3	4.0		1
207	5	3	180000	10000		900	1998	300000		400000	4			3
208	4	4	120000	10000		1200	2001	350000		550000	4	1.0		3
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211	6	3	36000	50000	10000	1400	1987			500000	4	3.5	350	3
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221	5	2	36000	50000		500	1985			100000	2	1.0		3
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253	3	3	84000			450	1988			250000	3	1.0		3
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258	5	3	30000			300	1978			200000	3			2
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267	6	4	105000	10000	5000	700			3000	400000	3	1.0	100	1
268	6	4	55000	10000		695	1979	1100000		1500000	4	1.0	1050	3
269	4	4	60000	37500		300	1989	550000		700000	2	2.0	1000	3
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281	3	4	144000		10000	2000	1994	200000		600000	5			1
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283	4	1	25000			550	1992			120000	3	1.0	55	2
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286	6	3	25000			600	1996		1200	150000	3	4.0	450	2
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290	2	3	24000	5000	500	300	1996	60000		100000	2			2
291	5	4	30000	1000	500	400	1996	74500		100000	2			2

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293	4	1	84000	10000		350			1000		2	4.0	4500	2
294	4	3	240000		20000	3600	1989	500000		1000000	5	4.0		3
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303	3	3	84000	36000		450	1998	93600		350000	2			3
304	6	1	120000			450	1998	93600		300000	2			3
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307	5	3	18000	37500		450			700	200000	3	1.0		1
308	6	3	15000	37500		225	1998		900	200000	3			3
309	3	3	36000	37500		225			1000	200000	2	2.0	1000	1
310	4	4	48000			800	1986	50000		700000	4	3.5	450	1
311	4	4	240000	10000	10000	1200			2000	1000000	5			2
312	5	4	50000			240	1999	550000		750000	4	1.0		3
313	4	3	30000	24000		450	1997	150000		400000	4	1.0		3
314	4	4	70000			900	1994	250000		800000	5	2.0		3
315	6	4	150000		5000	1000	1995	800000		950000	4	2.0	1350	2
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317	5	4	132000			1200	1993			900000	7	1.0	100	3
318	6	3	196000	30000	600	660	1978			650000	5		450	3
319	4	4	72000		240	2100	1997			600000	6	4.0	600	3
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322	7	3	48000	37500	500	225	2001		750	170000	2	1.0	300	3
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325	6	2	25000			75	1990	162000		100000	3	1.0	55	3
326	6	3	61500	10000		425	1996	170000			3	1.0	900	2
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329	4	3	36000			225		25000		400000	2			3
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361	4	4	132000	37500	5000	625	1997	350000		500000	3	4.0	1100	2
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409	4	4	72000	10000		1800	1993			250000	3	2.0	400	1
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411	6	3	110000			1700	1992	300000		500000	6	1.0	100	3
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413	12	2	48000			900	1985	80000		150000	3			3
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415	4	4	78000	10000		1100	1991	750000		100000	4	1.0	850	3
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417	6	4	72000	37500		600	1999	450000		300000	3	3.5	850	2
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428	4	4	92000	10000	5000	2000			100	150000	3	1.0		3
429	5	4	80000	10000	2000	2000			100	150000	3	1.0		3
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572		3	144000	10000		150	1980	150000		300000		1.0	650	1
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581		3	60000	50000		160	1984	25000		200000		1.0	350	2
582		3	24000			132		200000	1500	250000		1.0	350	2
583		4	24000			1500	1991	165000		200000		1.0	350	1
584		2	36000			100		100000		110000		1.5	150	1
585	4	4	84000			2500	1986	200000		1000000		10.0		3
586		2	12000	10000		50	1996			75000		1.0	35	2
587		2	12000	375000	5000	175	1991	25000		50000		1.0	150	3
588		3	42000	10000		85	2001			50000		1.0	125	3
589		4	148000	37500	5000	160	1993	50000				3.5	200	2
590	8	2	36000	10000	5000	100	2001	100000		100000		1.0		2
591		3	72000	10000		36	2001	25000		30000		1.0		2
592		2	165000	37500		150	1986	20000		150000		1.0	600	3
593		4	38000	10000		125	1991		100	200000		1.0	450	2
594		4	48000	50000		60	1991	50000		100000		1.0	150	2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
595		3	35000			80	1991		1000	250000		1.0		2
596		3	50000			80	1986	1000000		800000		1.0	20	2
597	6	3	12000	37500	5000	225	1997	100000		150000		1.0		1
598	4	3	30000	37500		100		47000		100000		1.0		1
599		2	25000	10000		150	1996		2200	4500000		1.0	35	1
600		3	25000			180	1983		500	300000		1.0	500	1
601	4	3	12000			25						1.0	25	1
602		3	25000			300	1993		2000	200000		1.0	35	2
603		4	10000	10000	5000	800	1999		1000	400000		1.0	480	2
604		3	40000					50000				2.0	600	2
605		4	60000	10000	5000	100	1996		800	100000		1.0		2
606		3	120000	10000	5000	400	2001	550000		700000		2.0		1
607		3	60000			144	1995	70000		100000		1.0		3
608	3	4	40000	50000		150	1981		250	300000		1.0	600	3
609	6	2	15000	10000	5000	150	1983		150	300000		1.0		3
610	6	4	60000	50000		225	1995			200000		1.0		3
611	5	3	24000	50000	10000	600			500	500000		3.5	550	3
612		4	120000	10000	5000	80	1998	500000		700000		1.0	500	2
613		3	108000	10000		204	1989	750000	500	30000		2.0	150	1
614		3	288000	37500		270	2001	500000	1200	750000		1.0	1350	3
615		1	48000			700	1988	200000	3000	700000		2.0	1500	3
616	7	3	240000			1000	1989	300000	4000	850000		1.0		3
617	5	4	180000	37500	10000	1600	1985	50000		1750000		2.0	300	1
618	3	3	84000		5000	600	1986	100000		500000		3.5	750	2
619	6	4		10000	5000	1000	1990	400000		1500000		4.0	4500	2
620		3	30000	10000		100	1998	60000		50000		1.0	325	3
621	7	3	50000			400	1992			200000				1
622	2	3	54000	50000		484	1996			300000		1.0		3
623	4	4	40000			90			1000	200000		1.0		3
624	4	3	20000	50000		72			1500	200000		1.0		3
625		4	14400	37500	5000	10	1999	42500	1000	40000		1.0	425	3
626	4	1	25000			20	1998	3000		5000		1.0	25	2
627		3	20000			120	1996			100000		1.0	35	1
628		3	40000			300	1930		23	112000		1.0	25	2
629		3	180000	10000	5000	400	1900	250000	25	150000		1.0	425	2
630		4			10000	425	1980	400000		400000		1.0	1100	2
631		3	252000	3500		200	1986	95000		100000		2.0	300	3
632		3	180000			150	1982	80000		50000		2.0	600	1
633		2	108000	10000		180	1997	55000		40000		1.0	55	3
634		3	35000			250	1996		250	400000		2.0	400	2
635		3	550000		5000	128			350	225000		1.0		2
636		3	15000			30	1999	7000		10000		1.0	55	1
637		3	15000			100	1955		350	77500		3.5	350	18
638	5	4	25000		5000	110	1997	150000		200000		1.0		3
639	4	3	48000			600				1100000		1.0	1000	3
640	5	3	350000			1700	1900			300000		2.0	1200	3
641	4	2	12000	375000	20000	34	1998			150000		1.0		3
642	5	3	120000	375000	20000	80	1996			150000		1.0		3
643	3	3	35000	10000	10000	600		33000		40000		1.0		1
644	4	1	240000	25000		200	1989	60000		200000		1.0		3
645		4	50000	10000	5000	500	1999			400000		1.0		2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
646		3	100000	10000	5000	500	1997		2000			2.0	300	2
647		3	20000			100	1996	300000		500000		2.0		1
648		1	20000	5000	500	48			150	125000		1.0		2
649	3	3	150000			150	1975		2000	600000		2.0		1
650	3	4	300000	10000	5000	144	1974	100000		300000		1.0	400	3
651		4				300	2001		2000	400000		2.0		2
652		4	200000	37500	5000	800	1999		2000	550000		4.0	900	1
653		3	70000			400	1966	29000		900000		1.0	1750	1
654		3	20000			300	1996	30000		500000		1.0	50	2
655		3	200000		5000	350	1971		4000	1000000		1.0	1000	3
656		4	17500	10000		300	1976			300000		2.0	65	2
657		2	20000			300	1976		400	500000		1.0	50	3
658		1	54000	10000		585	1948	20000		100000		2.0		3
659		1	150000		5000	90	1921	100000		1000000		2.0		3
660		3	270000			72	1956	50000		1200000		3.5		3
661	2	3	42000		10000	200	1941	40000		5000000		1.0		3
662		3	200000			1500	1961			2500000		1.0	60	1
663		2	108000			150	1969		150	70000		2.0		2
664	4	4	60000			150	1986		300	250000		1.0	25	2
665	4	3				135			1200	150000		1.0	60	3
666	7	2	420000	10000	5000	80	1968		20			.5		1

Note : * indicates 1= Illiterate; 2= Primary edu.; 3= Secondary and 4= Higher education.
** indicates 1= Unberable; 2= Tolerable and 3= Moderate.

Appendix Table IV : Primary Data Collected on Some Variable from Real Estate Agents

SR. No.	Normal black & white ratio GIDC Ank. indus- trial units	Normal black & white ratio Town Ank. reside- ntial house	Normal black & white ratio Town Ank. commer- cial premises	Normal black & white ratio Town Ank. indus- trial units	Behavi- our of property price in Ank. Town compared to GIDC Ank.	Landmark years of peak price GIDC Ankleshwar	Landmark years of trough price GIDC Ankleshwar	Landmark years of peak price Ankleshwar Town	Landmark years of trough price Town Ankleshwar
1	10	11	12	13	14	15	16	17	18
1		40 : 60	30 : 70	40 : 60	Decreaded	1992-97	1998-02	1992-97	1998-02
2		40 : 60	40 : 60		Stagnent	1992-97	2000-02	1992-97	2000-02
3					Stagnent	1992-95	2002	1992-95	2002
4		40 : 60	40 : 60	40 : 60	Decreaded	1997-99	2002	1997-99	1998-02
5					Increased	1993-95	1998-02	1996-95	2000-01
6					Stagnent	1992-95	2000-01	1995-95	2000-01
7	40 : 60				Stagnent	1992-95	2000-01	1992-95	2000-01
8	30 : 70	40 : 60	40 : 60	40 : 60	Increased	1995-96	2000-01	1995-96	2000-02
9	40 : 60	40 : 60	40 : 60		Increased	1998-99	2000-02	1998-99	
10					Decreaded				
11	40 : 60				Increased	1990-95	1999-02		
12	40 : 60	40 : 60	40 : 60	40 : 60	Increased				
13						1996	2002		
14					Increased	1996-97	2002		
15					Stagnent	1995	2002	1995	2002
16	20 : 80				Decreaded	1995	2002	1995	2002
17	40 : 60				Decreaded	1991-92	2002		
18					Increased	1995	1998-02		
19		40 : 60	40 : 60	40 : 60	Stagnent	1994	1999-01		
20					Increased	1994-97	1998-01		

21					Decreaded		2002		
22	40 : 60	40 : 60	40 : 60	40 : 60	Decreaded	1998	2002	1998	2002
23					Stagnent	1994-97	1998-00	1992-97	2000
24					Increased	1997-98	2002	1997-98	2002
25	60 : 40	60 : 40	60 : 40	60 : 40	Increased	1994-95	2002		
26					Stagnent	1992-95	2002		
27	30 : 70	30 : 70	30 : 70	30 : 70	Stagnent	1994-95	1999-00	1999-95	1999-00
28					Stagnent	1990-95	1998-02	1990-95	1998-02
29	20 : 80	20 : 80	30 : 70	20 : 80	Decreaded	1985-92	1993	1985-92	1993
30		20 : 80	20 : 80	20 : 80	Decreaded	1995-97	2002	1995-97	2002
31					Increased	1995-97	2002	1995-97	2002

Appendix Table IV : Primary Data Collected on Some Variable from Real Estate Agents [Contd.]

SR. No.	Openion of Respondant about property price*	Behaviour of construction activity in Ank. over five years**	Average cost of acquiring residential property in Ank. on Govt. land Rs. per sq. feet	Average cost of acquiring commercial property in Ank. on Govt. land Rs. per sq. feet	Average cost of acquiring residential property in Ank. on Pvt. land Rs. per sq. feet	Average cost of acquiring commercial property in Ank. on Pvt. land Rs. per sq. feet	Normal black & white ratio GIDC Ank. residential house	Normal black & white ratio GIDC Ank. commercial premises
1	2	3	4	5	6	7	8	9
1	Decreased	Stagnent					40 : 60	
2	Decreased	Stagnent	750	1500			50 : 50	50 : 50
3	Decreased	Stagnent	700	1000	800	1200		
4	Decreased	Booming	700	1000	1200	2500		
5	Decreased	Stagnent	500	900				
6	Decreased	Stagnent	400	800	400	800		
7	Decreased	Booming	275	700	275	450	40 : 60	40 : 60
8	Stagnent	Booming	500	1000	450	850	30 : 70	30 : 70
9	Decreased	Stagnent			350	300	40 : 60	40 : 60
10	Increased	Moderate						
11	Increased	Stagnent	55	55	90	138	40 : 60	40 : 60
12	Increased	Moderate					40 : 60	40 : 60
13	Increased	Stagnent				1000		
14	Increased	Moderate						
15	Stagnent	Booming	425	1000	500	1100		
16	Stagnent	Stagnent	400	850	400	850	20 : 80	20 : 80
17	Decreased				700	700	40 : 60	40 : 60
18	Stagnent	Stagnent	450	1100				
19	Stagnent	Stagnent			450	1500		
20	Decreased	Moderate	500	1000	500	1000		
21	Increased	Moderate			212	1200		
22	Decreased	Moderate	300	700	300	750	40 : 60	40 : 60
23	Decreased	Moderate	100	150	100	150		
24	Increased		700		700			
25	Stagnent	Booming					60 : 40	60 : 40
26	Decreased	Moderate			400	800		
27	Decreased	Stagnent	500	800	500	800	30 : 70	30 : 70
28	Decreased	Stagnent	600	1000	600	1000		
29	Decreased	Moderate	300	225	700	500	20 : 80	30 : 70
30	Decreased	Stagnent	750	1200				
31	Decreased	Stagnent	700	1000				