HAZARDOUS WASTE MANAGEMENT PROJECT FORMULATION STUDY IN GUJARAT, INDIA

STUDY REPORT

MARCH 2010

ENGINEERING AND CONSULTING FIRMS ASSOCIATION, JAPAN
EX CORPORATION ENVIRONMENTAL AND URBAN PLANNING, RESEARCH AND CONSULTING
JAPAN DEVELOPMENT INSTITUTE

Pictures

Contents

List of Tables

List of Figures

Abbreviations

3R	:	Reduce, Reuse and Recycle
ADB	:	Asian Development Bank
AOTS	:	Association for Overseas Technical Scholarship
CETP	:	Common Industrial Effluent Treatment Plants
CFC	:	Common Facility Center
CPCB	:	Central Pollution Control Board
DFC	:	Dedicated Freight Corridor
DMIC	:	Delhi Mumbai Industrial Corridor
DMICDC	:	Delhi Mumbai Industrial Corridor Development Corporation
ECFA	:	Engineering and Consulting Firms Association
ESM	:	Environmentally Sound Management
FDI	:	Foreign Direct Investment
FY	:	Fiscal Year
GDP	:	Gross Domestic Products
GEPIL	:	Gujarat Enviro Protection & Infrastructure Limited
GIDB	:	Gujarat Infrastructure Development Board
GIDC	:	Gujarat Industrial Development Corporation
GMB	:	Gujarat Maritime Board
GNP	:	Gross National Products
GOG	:	Government of Gujarat
GPCB	:	Gujarat Pollution Control Board
GSP	:	Gross State Products
GSPC	:	Gujarat State Petroleum Corporation
IFC	:	International Finance Corporation
IL&FS	:	Infrastructure Leasing & Financial Services Limited
ITI	:	Industrial Training Institute
JBIC	:	Japan Bank for International Cooperation
JDI	:	Japan Development Institute
JICA	:	Japan International Cooperation Agency
JODC	:	Japan Overseas Development Corporation
JPY	:	Japanese Yen
LNG	:	Liquefied natural Gas
METI	:	Ministry of Economy, Trade and Industry
MOU	:	Memorandum of Understanding
MSW	:	Municipal Solid Waste
NOC	:	No Object Certificate
PDF	:	Project Development Fund
PPP	:	Public Private Partnership
SME	:	Small and Medium size Enterprises
SIDBI	:	Small Industries Development Bank of India
SIR	:	Special Investment Region
SPCB	:	State Pollution Control Boards
TA	:	Technical Assistance
TSDF	:	Treatment, Storage and Disposal Facilities
UNEP	:	United Nations Environment Programme
UNIDO	:	United Nations Industrial Development Organization
USD	:	United State Dollar

インド・グジャラート州産業廃棄物処理事業案件形成調査　日本語要約

１．　調査概要

本事業は、インドのグジャラート州において有害産業廃棄物に係る協力事業の案件形成を図るものであり、有害廃棄物等の排出状況についてのインベントリー調査、課題の整理、現地ニーズの把握を主に行った。

グジャラート州はインド国内でも急速に経済成長を遂げる州のひとつで、有数の産業集積が進んだ州である（以下は主要業種の州内業種別の割合、全国でのシェア）。特に、石油化学、化学工業・製薬業等のシェアが高く、素材産業の集積も顕著となっている。

また、同州はデリー・ムンバイ間産業大動脈構想の対象地区となっている。

Sector	Share in Gujarat (%)	Share in India (%)
Refined Petroleum	30.8	38
Chemicals including Pharma	26.7	30
Engineering	9.5	7
Food and Beverages	9.2	9
Metallurgical	7.4	11
Textiles	7.2	15
Non-metallic mineral	2.4	12
Plastics	1.9	10
Paper	1.2	11

Source: Industries Commissionerate, Industries in Gujarat 2007

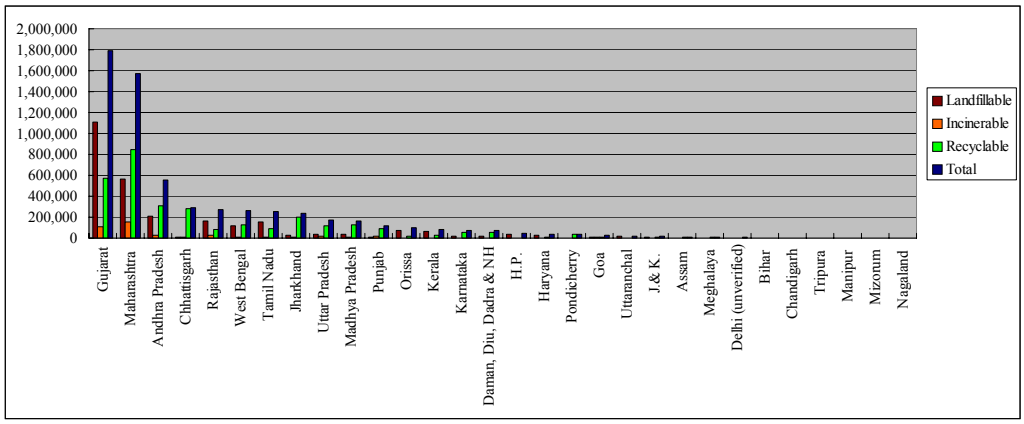
２．　調査結果

（１）インベントリー調査

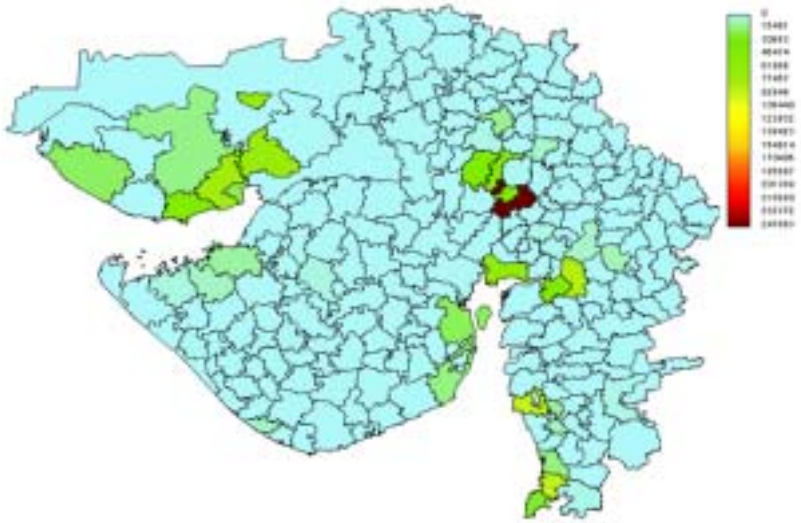
グジャラート州では前述の通り産業集積が進んでいることを背景にインド全州でも最も多い年間１．７百万トンの有害廃棄物が排出されている[1]。日系企業の進出は DMIC 構想に合わせて今後加速されると見られる。また、新たな工業団体開発等の投資案件が港湾施設の整備と合わせて見込まれており、今後より一層の産業集積が加速されると予想される。

こうした状況を背景に一次調査では、マクロ的な廃棄物のフローを概観するとともに、既存の有害廃棄物処理施設では手付かずとなっている品目を特定しインベントリー調査を行った。その結果、州内主要地区ごとの品目別排出状況について整理した。処理実態については現在進行中であるが、有害廃棄物の環境上適正な管理についての課題についても整理を行っている。

Industrial waste generation situation in India



Source: Central Pollution Control Board



州内における有害廃棄物の排出状況

[1] インド法令では基準を満たしているものが有害廃棄物として規定されるので、非有害廃棄物に規定される産業廃棄物がある。例えば廃タイヤ、廃油は非有害廃棄物に規定されている。なお、07 年度に弊社が行った「インド・バンガロール都市圏産業廃棄物処理施設建設調査」では、トヨタ自動車、デンソー等が進出しているカルナタカ州では有害廃棄物は年間約１３万トンが排出されているのみである。

有害廃棄物の他、法律上は該当しないが潜在的な環境汚染物質を含む E-waste、廃蛍光管（全て埋立されている状況）、廃プラスチック（全て埋立されている状況）の処理状況についても調査を行った。

（2）課題及びニーズ調査

環境上不適正な分別、リサイクル、処理による環境汚染：水銀、重金属を含有する廃蛍光管、電気電子機器廃棄物（e-waste）の処理による環境や健康への影響が懸念される。婦人、子供等が安全具を身につけず作業に従事している状況にある。

法律の未整備：生活レベルの向上とともに発生量が多くなっている電気電子機器廃棄物、廃ペットボトルについては法的な処理義務は生じておらずほぼ全量インフォーマルセクターによる処理に委ねられている。そこでは上記にように環境対策は行われていないのが実態である。

意識啓発の必要性：有害物質を含む廃製品の処理に伴い潜在的な健康被害、環境汚染についての知識がなくそのまま汚染物質が野放しとなっている。また、排出する事業者、消費者の環境汚染に対する意識レベルは高いとは言えない状況にある。

行政セクターの施行・管理能力：有害廃棄物を中心に廃棄物管理の法制度は一定程度整備されているが、管理能力は高いとは言えない状況にある。

３．今後の対応

環境分野の協力案件については、グジャラート州政府及び同州も対象となっているデリー・ムンバイ間産業大動脈開発公社（政府機関）との協議を複数回行った。州政府関係者（環境森林局及び鉱工業局局長）及び開発公社 CEO は、有害廃棄物の管理を環境上より適正に対応していくこと、法律の対象外であるが環境上適正な管理が必要な廃棄物については、法規制の必要性を強く認識している。

このため、法整備や体系的な管理の必要性を日本側との協議において表明している。加えて、日本に対して次のような方策に関して協力を求めており、具体的な要請につなげる対応が望まれるところである。

- **体系的な処理・リサイクルシステムの構築に向けた計画や法規制案づくりの支援**
- **管理能力の向上に資する能力強化の支援**
- **回収及び解体に関するモデルプロジェクトの実施　等**

また、本調査のスコープ外ではあるが、グジャラート州は産業集積が顕著であり、中小零細企業からは大気汚染、水質汚濁について充分な対応が図られていない状況もある。現地側からもニーズが示されており、今後、産業公害分野についてもホットスポット（重点排出源）や具体的な汚染状況の把握、対応方策の検討等も望まれる。

1 Background and objective

Background

IDEAL DEVELOPMENT CONCEPT OF WASTE RECYCLE/MANAGEMENT

Initiation of hazardous waste management project in India The grand concept of 3R (Reduce, Reuse and Recycle) together with an objective to accomplish zero landfill practice by 2021 in Gujarat, has driven a public and private awareness and initiative to collaboratively work on developing the hazardous waste management project in India.

Ideal location for hazardous waste management project Gujarat is an ideal location for an effective functioning of the projects, which depend on reasonable volume of generated wastes, waste characteristics, public acceptance and potential network of the industry for the zero discharge of the waste. Gujarat is characterized by wide spread industrial establishments, robust infrastructure development and stable socio-political environment. The industrial development has remained and is the robust backbone of Gujarat's economical and industrial prospects and a driving force of a future economic growth. In a meantime, the rapid industrial development throughout the state has lead resulted in generating abundant industrial wastes which need proper care in pollution mitigation and recycling in and around urban centers of Ahmedabad, Bharuch, Surat and etc.

Sustainable development with proper waste management/realization of 3R Gujarat State is one of the fastest growing states in India and the number one hazardous waste generating state. Urbanization and population growth as well as economic growth in household sector all contribute increasing the waste generation. For sustaining the healthy growth of Gujarat State, environmentally sound management of the hazardous wastes from industry and other household waste is becoming a main concern among the relevant stakeholders and realization of 3R(Reduce, Reuse and Recycle) is also needed.

No legal framework for promoting 3R of increasing wastes As clearly stated in the government document, there is no legal framework or specific law for such emerging waste as E-waste and other wastes which can be recycled for resource or energy recovery. Unless there is proper legal requirement for collection, 3R based treatment is not feasible in sustainable manner.

Awareness and capacity for proper pollution control needed to be improved Current practices for waste treatment mainly conducted by the informal sector are not environmentally sound. Sometimes proper pollution control measured is not taken cared because of the insufficient awareness. Also, awareness raising and capacity development among waste generators and controlling and implementing officers

Objective of this study project

The primal objective, in this study project, to attempt a systematic correspondence for the improvement of the waste recycle/management practice in Gujarat state, is to pursue a formation of the public and private collaboration for project preparation, and create a governmental cooperative relationship between India and Japan for promoting both countries' environment business industries. In specific, requirements for preferable technologies and applicable knowhow shall be studied in relation to needs of the present local state of the industrial waste management situation, and ideal policy/regal framework settings shall be proposed.

This will ultimately contribute promoting the business collaboration between Japanese and Indian firms in environment industries. In specific, introduction of preferable technologies and knowhow shall be further studied in relation to needs of the present local state of the industrial waste situation in occurrence and management. While industrial advance of Gujarat state has surely increased the volume of industrial wastes, realization of 3R society in Gujarat state could be also pursued with nurturing an environment where industries and people would start to experiment resource recycling to reduce harmful impacts on environment.

2 Scope of work

2.1 Rational: why India and the state of Gujarat

As an ongoing initiative based on top level governmental agreement between India and Japan, DMIC (Delhi Mumbai Industrial Corridor) program has been developed to accelerate two country's economic and industrial relationship, and the approach advocated in the program is for the achievement of high quality infrastructure with joint efforts from public and private sector. On top of that, investment promotion especially addressing Japanese investment in the corridor is the core impetus behind to advance the program proceedings. In this line, Government of India has committed project development fund for mobilizing the formulated concept within the program in collaboration with Japanese government. As for the specific infrastructure development concept and projects in concern, from Japanese side, logistics centers and captive common power supply system are proposed and recent formulation of environment-related projects become of concern for both governments. In this line, the central government of India through the dedicated agency for DMIC, Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) has a MoU with Japanese counterparts to promote green projects such as smart grid, solar power, water/waste water management and recycling system.

As for the state of Gujarat, its administrative area fall under 38% of the entire DMIC region, and the government exerts a strong initiative to prepare a master plan and subsequent projects formulation to envisage the concept of DMIC program. The decision and commitment are shown in an industrial infrastructure development project of Special Investment Region (SIR), and the state also announced to develop environmental infrastructure with which more resource-conscious management practice can be demonstrated with introduction of advanced technologies, then the model can be spread over the other part of states, even to the country. The concept is taken up by the top government officials, which includes honorable chief minister himself as well. Especially, when the concept of industrial waste recycling/management is concerned, the state positions as the largest waste generators, which accrued from high level of industrial cluster's accommodation and the their dedication for advancing their society and industrial activities more environmentally sound and sustainable manner is given. Ultimately, the successful formation of material recycling/management projects needs close and well-managed coordination between public sectors legal back-ups and private sector's project operating knowhow and technology execution of the environmental infrastructure. Consequently a matrix of assessment on the location of project preparation and field of application was undertaken then the promotion of waste recycling/management in Gujarat, India was identified to have a good level of project' success.

2.2 Hazardous waste

The project aims at formulating a system where various hazardous wastes can be recycled, converting current treatment and disposal practices to more environmentally sound manner and accomplishing more value-added treatment e.g. higher efficiency of resource recovery and electricity generation from incinarable wastes. It also aims for proper collection of the hazardous wastes which are currently scattered and unorganized by setting up the network of the collection points in various locations across the state as the collection is a key issue in order for the recycling activities to be feasible. In this regard, a study on a collection network and a value-chain structure of industrial wastes were pursued for grasping the various waste management business activities, which have been undertaken especially by the informal sectors.

The project was also pursed through the cooperation with both public and private sectors of Japanese counterpart entities. First aspect is the private industry which manufactures, supplies, licenses the technology for Environmentally Sound Management (ESM) of hazardous wastes. Through the inventory development and gap analysis, relevant technologies were identified and the preliminary analysis on their applicability was conducted. Second aspect is to seek various technical assistance opportunities from donor agency such as Japan International Cooperation Agency (JICA) and United Nations Environmental Programme (UNEP) for supplement an ultimate goal of materializing 3R society in India at first in Gujarat as a pilot model project. This aspect can be an important portion of the project as it contributes improving current hazardous waste treatment practices by a new measure of collaboration between the private and public sectors' cooperation, and it would make positive synergy effects among the society and industries development.

In the initial phase of project formulation, the basic waste stream in Gujarat was studied and, especially the kind of hazardous wastes generated in the state was analyzed. Moreover technologies applied in the state shall be observed and the capacity of existing waste treatment facilities was closely studied. In addition, inventory making of the "hard to treat waste[2]", under the current waste management practice, that has no option by landfill or simply wait for it becomes stabilized in the state was undertaken. Also a study to identify the kind of waste that has higher potential for high value-added treatment and resource recovery only if there is an appropriate technology available was undertaken. Consequently, those studies can contribute to identify what and how Japanese state of art technology can be introduced in the present waste stream in Gujarat.

Moreover, the hazardous industrial management is currently regulated by the governmental body in India; whereas non-hazardous industrial materials are voluntarily collected and treated mainly by the willing private sector, and its management method has still room for further improvement. Yet such remaining improvement may not be maneuvered solely by the private sector's initiative, hence a proper regulatory intervention from the government body would be of importance. Consequently, the best practice of pro-recycling regulation of Japan shall be introduced in this report, and a legal framework for creating realizing system and industry development in the local context of Gujarat, India, is to be proposed.

2.3 Scope of Works

With abovementioned scope, following activities were planned to be implemented.

- To study overview of industrial structure of the state of Gujarat

[2] For example, fluorescent lamp, lead acid battery, non-ferrous metal segregation and recycling, etc.

- To study the existing waste management nature (players, type, volume, locations, practice, treatment facility and its capacity, policy and laws) in the state of Gujarat.
- To study and inventorize the variety of prioritized hazardous and non-hazardous wastes
- To study the informal chain of recycling and disposal
- To study enhancement measures on the waste collection mechanism at urban and rural levels
- To study integrated approach at regional scale for recycle/recovery and environmentally sound management of hazardous and non-hazardous wastes
- To study any regulation and laws to set up and operationalize waste management zone
- To identify the needs for relevant legal framework structuring
- To identify possible source of Technical assistance for the state-wise recycling master plan, legal framework and capacity building.
- To identify possible sources of funding for private to private base training programs.
- To promote public awareness in environmental sustainability by way of implementing range of resource recovery and recycling projects that enables reduction in the virgin resources consumption.

2.4 Study Overview and Approaches

To comply with the scope of works, the following approach was undertaken throughout the study period.

1) Start with studying general state of Indian socio-economic environment
2) Followed by observing a general condition of project site environment in the state of Gujarat
3) Study the present legal framework and conduct an inventory-gap analysis
4) Try to obtain the public support for the formulation of legal framework, capacity building and specific master plan for recycling activities development from Japan such as JICA, METI, Ministry of Environment and UNEP as well as training supports for private sector from AOTS and UNIDO.
5) Finding possible project financing sources such as JBIC, IFC/ADB.

3 Socio-Economic state of India

3.1 Economic and Financial state of India

3.1.1 Population

The area of India is 3,287,263km2, with a population of over a billion people (2001 census[3]). It is the second largest populated country in the world behind China. The Urban Population is over 286 million (27.8%), the rural population being 742 million (72.2%). The population of major cities is as follows.

Table. 3-1 Population of major cities

City	Population (million)
Delhi	13.80
Greater Mumbai	16.37
Kolkata	13.22
Chennai	6.42
Bangalore	5.69
Hyderabad	5.53
Ahmedabad	4.52
Pune	3.76
Surat	2.81
Kanpur	2.69

Source：NCERT document on Urban Settlement[4]

The population density is summarized in the following table.

Table. 3-2 Population density

	Density (persons/km^2)
India	325
State with largest density	903 (West Bengal)
Capital area	9,340 (Delhi)

Source: Census of India, 2001[5]

The population according to age category is shown below.

Table. 3-3 Age wise population structure

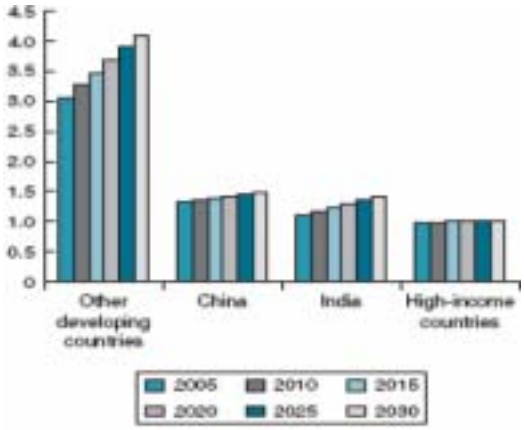
Age class	Male	Female
Less than 6	16.0%	15.9%
7 to 14	19.6%	19.2%
15 to 59	57.0%	56.9%
Over 60	7.1%	7.8%
Others	0.3%	0.3%

Source: Census of India, 2001[6]

[3] 2001 census http://www.censusindia.gov.in/Census_Data_2001/India_at_glance/popu1.aspx
[4] Based on 2001 census http://www.ncert.nic.in/textbooks/XII/India_People_and_Economy/Chapter%206.pdf
[5] http://www.censusindia.gov.in/Census_Data_2001/India_at_glance/density.aspx
[6] http://www.censusindia.gov.in/Census_Data_2001/India_at_glance/broad.aspx

A comparison of future population projection with China is shown below.

Figure 3-1 Future population projections



Source: Global Growth and Distribution: Are China and India Reshaping the World? The World Bank Development Economics Prospects Group (Nov/2007)

India has the largest number of people below the poverty line (income per day less than 1 US$) in the World. The state wise number of people below the poverty line is complied in the following table.

Table. 3-4 The state wise number of people below the poverty line (2004-05 data)

S.No.	States/U.Ts	Rural		Urban		Combined	
		%age of Persons	No. of Persons (Lakhs)	%age of Persons	No. of Persons (Lakhs)	%age of Persons	No. of Persons (Lakhs)
1	Andhra Pradesh	11.2	64.70	28.0	61.40	15.8	126.10
2	Arunachal Pradesh	22.3	1.94	3.3	0.09	17.6	2.03
3	Assam	22.3	54.50	3.3	1.28	19.7	55.77
4	Bihar	42.1	336.72	34.6	32.42	41.4	369.15
5	Chhattisgarh	40.8	71.50	41.2	19.47	40.9	90.96
6	Delhi	6.9	0.63	15.2	22.30	14.7	22.93
7	Goa	5.4	0.36	21.3	1.64	13.8	2.01
8	Gujarat	19.1	63.49	13.0	27.19	16.8	90.69
9	Haryana	13.6	21.49	15.1	10.60	14.0	32.10
10	Himachal Pradesh	10.7	6.14	3.4	0.22	10.0	6.36
11	Jammu & Kashmir	4.6	3.66	7.9	2.19	5.4	5.85
12	Jharkhand	46.3	103.19	20.2	13.20	40.3	116.39
13	Karnataka	20.8	75.05	32.6	63.83	25.0	138.89
14	Kerala	13.2	32.43	20.2	17.17	15.0	49.60
15	Madhya Pradesh	36.9	175.65	42.1	74.03	38.3	249.68
16	Maharashtra	29.6	171.13	32.2	146.25	30.7	317.38
17	Manipur	22.3	3.76	3.3	0.20	17.3	3.95
18	Meghalaya	22.3	4.36	3.3	0.16	18.5	4.52
19	Mizoram	22.3	1.02	3.3	0.16	12.6	1.18
20	Nagaland	22.3	3.87	3.3	0.12	19.0	3.99
21	Orissa	46.8	151.75	44.3	26.74	46.4	178.49
22	Punjab	9.1	15.12	7.1	6.50	8.4	21.63
23	Rajasthan	16.7	87.38	32.9	47.51	22.1	134.89
24	Sikkim	22.3	1.12	3.3	0.02	20.1	1.14
25	Tamil Nadu	22.8	76.50	22.2	69.13	22.5	145.62
26	Tripura	22.3	6.18	3.3	0.20	18.9	6.38
27	Uttar Pradesh	33.4	473.00	30.6	117.03	32.8	590.03
28	Uttarakhand	40.8	27.11	36.5	8.85	39.6	35.96
29	West Bengal	28.6	173.22	14.8	35.14	24.7	208.36
30	A & N Islands	22.9	0.60	22.2	0.32	22.6	0.92
31	Chandigarh	7.1	0.08	7.1	0.67	7.1	0.74
32	Dadra & N. Haveli	39.8	0.68	19.1	0.15	33.2	0.84
33	Daman & Diu	5.4	0.07	21.2	0.14	10.5	0.21
34	Lakshadweep	13.3	0.06	20.2	0.06	16.0	0.11
35	Pondicherry	22.9	0.78	22.2	1.59	22.4	2.37
	All-India	28.3	2209.24	25.7	807.96	27.5	3017.20

Source: Planning commission, Poverty Estimates for 2004-05[7]

[7] http://planningcommission.nic.in/news/prmar07.pdf

3.1.2 Economy

The main industries in India are agriculture, industrial production, mining and IT. The GDP of India is third in Asia behind Japan and China at about 800 billion dollars (2005/IMF). The per capital GDP is US $ 620 (2005/World bank). The GDP growth rate is 8.4%.

Table. 3-5 Main GDP related indicators

Year	2000	2001	2002	2003	2004
Nominal GDP (billion Rupees)	19,302	20,975	22,556	25,434	28,439
Real GDP (billion Rupees)	18,704	19,781	20,526	22,260	23,937
Rate of increase in consumer price index (%)	N/A	4.2	4.1	3.5	4.2

Source: Economic Survey (2005-2006)

The GDP composition (FY 2004) is primary industries at 21.1%, secondary industries at 18.9% and tertiary industries at 60%.

Table. 3-6 GDP composition ratio (nominal)

	(%)	(%)	(%)	(%)	(%)
	1985/86	1990/91	1995/96	2000/01	2004/05
Agriculture	38.6	34.9	30.4	26.2	21.1
Industry	22.5	24.5	27.1	25.9	18.9
Service sector	38.9	40.6	42.5	47.9	60.0

Source: Ministry of Finance, Department of Economic Affairs
http://finmin.nic.in/stats_data/nsdp_sdds/index.html

3.1.3 Finance

The financial state of India is on the red. The fiscal deficit of the central government since 1990 is as follows.

Table. 3-7 The Fiscal deficit of the central government (percentage of GDP)

Year	Revenue Deficit	Primary deficit	Fiscal deficit	Revenue deficit as percent of fiscal deficit
1990-91	3.3	28	6.6	49.4
1991-92	2.5	0.7	4.7	52.7
1992-93	2.5	0.6	4.8	51.7
1993-94	3.8	2.2	6.4	59.2
1994-95	3.1	0.4	4.7	64.6
1995-96	2.5	0.0	4.2	59.2
1996-97	2.4	-0.2	4.1	58.2
1997-98	3.1	0.5	4.8	63.5
1998-99	3.8	0.7	5.1	74.8
1999-2000	3.5	0.7	5.3	64.6
2000-01	4.0	0.9	5.6	71.7
2001-02	4.4	1.5	6.2	71.1
2002-03	4.4	1.1	5.9	74.4
2003-04	3.6	0.0	4.5	79.7
2004-05	2.5	0.0	4.1	62.2
2005-06	2.7	0.5	4.3	63.1
2006-07	2.1	0.2	3.6	

Source: Economic survey (2005-2006), the figure for 2004-2005 from the Ministry of Finance

3.1.4 Trade and investment

3.1.4.1 Trade

The total external trade amount, since 2001 is shown below. A marked increase in both import and export can be seen.

Table. 3-8 Total trade (hundred million dollars)

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Export	438.3	527.2	638.4	835.4	1027.3	1,246.3
Import	514.1	614.1	781.5	1115.2	1424.2	1,813.7

Source: www.mofa.go.jp/mofaj/area/india/data.html

While the main items imported can be seen in the Table 3-9, the main countries from which India is importing goods are Germany, Belgium, UK, China, USA, Saudi Arabia and the UAE. Import from Japan covers only about 2.46% of the total.

The main countries India exports its goods to are the USA, UK, Germany, Belgium, Italy, Holland, UAE, China, Singapore and Hong Kong. Export to Japan covers about 2.01% of the total. The main items exported are Jewellaries, chemical products and pharmaceuticals, ready made clothes, cotton, petroleum products etc. (Table. 3-10)

Table. 3-9 Main import goods (2005-2006), thousand tons

		2005-06			2005 (April-October)			2006 (April-October)		
		Qty.	Rs. cr	$ million	Qty.	Rs. cr	$ million	Qty.	Rs. cr	$ million
1	2	21	22	23	24	25	26	27	28	29
I.	**Food and live animals chiefly for food (excl. cashew raw) of which:**	—	—	—	—	—	—	—	—	—
I.1	Cereals and cereal preparations	70.3	159	36	25.6	71	16	33.9	97	21
II	**Raw materials and intermediate manufactures**									
II.1	Cashew (unprocessed)	543.9	2089	472	347.8	1374	314	423.0	1297	283
II.2	Crude rubber (including synthetic and reclaimed	219.1	1833	414	143.1	1164	266	1715.1	1549	338
II.3	Fibres of which :									
II.3.1	Synthetic and regenerated fibres (man-made fibres)	37.9	345	78	24.6	220	50	29.5	283	62
II.3.2	Raw wool	90.2	903	204	56.4	563	128	62.6	644	140
II.3.3	Raw cotton	98.8	704	159	60.3	374	85	48.5	408	89
II.3.4	Raw jute	61.3	93	21	8.7	10	2	43.9	71	15
II.4	Petroleum, oil and lubricants		194640	43963		106875	24392		161050	35121
II.5	Animal and vegetable oils and fat of which :									
II.5.1	Edible oils	4288.1	8961	2024	2897.9	6022	1374	2784.3	6231	1359
II.6	Fertilizers and chemical products of which :									
II.6.1	Fertilizers and fertilizer Mfg.	11776.4	8815	1991	6795.0	4946	1129	9414.5	8417	1836
II.6.2	Chemical elements and compounds		35582	8037		20836	4755		24507	5344
II.6.3	Dyeing, tanning and colouring material		2226	503		1300	297		1650	360
II.6.4	Medicinal and pharmaceutical products		4551	1028		2471	564		3037	662
II.6.5	Plastic material, regenerated cellulose and artificial resins		10040	2268		6024	1375		6981	1522
II.7	Pulp and waste paper	2226.7	2537	573	1299.7	1515	346	1310.4	1662	362
II.8	Paper, paper board and manufactures thereof	1092.6	4180	944	619.8	2433	555	785.9	3437	750
II.9	Non-metallic mineral manufactures of which :									
II.9.1	Pearls, precious and semi-precious stones, unworked or wo		40441	9134		27152	6197		19510	4255
II.10	Iron and steel	5778.5	20243	4572	3645.5	12434	2838	3885.6	15741	3433
II.11	Non-ferrous metals incl. Gold & Silver		58273	13162		36896	8421		44834	9777
III.	**Capital goods ***		**104142**	**23522**		**41150**	**9392**		**61576**	13428
III.1	Manufactures of metals		5362	1211		3030	692		3856	841
III.2	Non-electrical machinery ** apparatus and appliances including machine tools		49081	11086		26070	5950		37916	8269
III.3	Electrical machinery apparatus and appliances **		6660	1504		3554	811		5114	1115
III.4	Transport equipment		39131	8838		6480	1479		10110	2205
V.	**TOTAL**		**660409**	**149166**		**360912**	**82371**		**477452**	**104120**

N.A. Not available.

* From the year 1987-88 onwards, Capital Goods include Project Goods.
** From the year 1991-92 onwards, Items III.2 & III.3 exclude electronic goods.

Source : DGCI&S, Kolkata.

Source: Economic Survey (http://indiabudget.nic.in/es2006-07/chapt2007/tab72.pdf)

Table. 3-10 Main export products (2005-2006), Thousand tons

		2005-06			2005 (April-October)			2006 (April-October)		
		Qty.	Rs. cr	$ million	Qty.	Rs. cr	$ million	Qty.	Rs. cr	$ million
1	2	21	22	23	24	25	26	27	28	29
I.	**Agricultural and allied products: of which**		**46703**	**10549**		**24630**	**5621**		**32316**	**7047**
I. 1	Coffee	162.9	1731	391	101.5	893	204	138.1	1195	261
I. 2	Tea and mate	177.7	1589	359	94.3	1024	234	109.5	1234	269
I. 3	Oil cakes	5976	4875	1101	1947.4	1584	362	2499	2022	441
I. 4	Tobacco	142.7	1032	233	85.7	752	172	87.3	901	196
I. 5	Cashew kernels	131	2594	586	58.8	1571	359	72.3	1465	319
I. 6	Spices	400.2	2116	478	237.6	1194	273	256.5	1633	356
I. 7	Sugar and molasses	394.1	598	135	68	84	19	1303.7	2408	525
I. 8	Raw cotton	614.8	2904	656	152	663	151	328.4	1681	367
I. 9	Rice	4088.2	6221	1405	2331.1	3504	800	2686.4	3799	828
I. 10	Fish and fish preparations		7036	1589		3865	882		4300	938
I. 11	Meat and meat preparations		2750	621		1479	338		1764	385
I. 12	Fruits, vegetables and pulses (excl.cashew kernels, processed fruits & juices)		3649	824		2005	458		2420	528
I. 13	Miscellaneous processed foods (incl. processed fruits and juices)		1589	359		868	198		1034	225
II.	**Ores and minerals (excl. coal) of which**		**23733**	**5361**		**12311**	**2810**		**13024**	**2840**
II.1	Mica		77	17		44	10		44	10
II.2	Iron ore (million tonne)		16829	3801		8451	1929		8146	1776
III.	**Manufactured goods of which**		**328507**	74199		**182600**	**41675**		**224693**	**49000**
III. 1	Textile fabrics & manufactures (excl. carpets hand-made) of which									
III.1.1	Cotton yarn,fabrics, made-ups etc.		17456	3943		9630	2198		10852	2367
III.1.2	Readymade garments of all textile materials		37952	8572		20451	4668		22104	4820
III. 2	Coir yarn and manufactures		590	133		344	79		371	81
III. 3	Jute manufactures incl.twist & yarn		1318	298		762	174		776	169
III. 4	Leather & leather manufactures incl.leather footwear,leather travel goods & leather garments		11915	2691		6834	1560		7452	1625
III. 5	Handicrafts (incl. carpets hand-made)		5683	1284		3264	745		3168	691
III. 6	Gems and jewellery**		68752	15529		41834	9548		41877	9132
III. 7	Chemicals and allied products @		52839	11935		28045	6401		33703	7350
III. 8	Machinery, transport & metal manufactures including iron and steel*		94389	21315		51196	11685		73404	16008
IV.	**Mineral fuels and lubricants (incl.coal) #**		**52538**	**11867**		**27407**	**6255**		**53160**	**11593**
	Total Exports		456418	103091		249968	57050		325553	70995

@ Chemicals and allied products figures relate to "Basic Chemicals" and "Plastic Linoleum products".
* Also includes electronic goods and computer software.
** Gems and Jewellery excluded from Handicrafts and reported as individual item since 1997-98.
\# During 1990-91, 1995-96, 2000-01, 2001-02, 2002-03 and 2003-04, Crude oil exports amount to Rs. Nil.

Source: Economic Survey (http://indiabudget.nic.in/es2006-07/chapt2007/tab73.pdf)

The trend of trade between Japan and India is shown below. It can be seem that both the import and export amount are on the rise.

Table. 3-11 Trade of Japan with India (10 billion Yen)

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Export to India	23.3	23.3	27.6	32.9	38.8	51.8
Import from Japan	26.9	26.1	25.2	28.2	35.2	47.2

Source: Ministry of Foreign Affairs of Japan
http://www.mofa.go.jp/mofaj/area/india/data.html

3.1.4.2 Investment

The FDI to India, according to the country doing the investment is shown in the following table. As shown below, Mauritius, USA and the UK are the main investors in India.

Table. 3-12 FDI (direct inward investment), million Rupees

	2003	2004	2005	2006	Increase % in 2006 from 2005
Mauritius	28,859	46,162	94,078	222,208	136.2%
USA	19,040	29,792	20,700	33,204	60.4%
Japan	4,344	5,337	7,450	5,229	(-)29.8%
Holland	11,619	22,779	5,277	22,457	325.5%
UK	8,629	6,585	9,578	78,247	716.9%
Germany	3,625	7,275	3,683	13,972	279.4%
Singapore	1,680	2,855	14,169	28,532	101.4%
France	1,643	5,289	1,288	3,877	200.9%
South Korea	1,129	1,227	2,943	2,935	(-)0.3%
Switzerland	4,290	3,137	3,689	3,151	(-)14.6%
Italy	617	1,178	1,434	2,576	79.7%
Others	30,697	41,049	28,702	-	-
Total	116,172	172,665	192,991	503,573	160.9%

Source: Complied on information obtained from JETRO

The direct inward investment in India, as shown in the following table, is increasing in the sectors like telecommunications, power, petroleum refining etc.

Table. 3-13 Sector wise distribution of direct inward investment in India, million rupees

Business	2002	2003	2004
Electronics (appliances and software	31,909	13,550	39,667
Construction, Real estate, Agriculture, Jewelries etc	12,148	14,569	13,400
Transportation devices	21,242	15,134	8,064
Telecommunications	9,091	7,273	6,088
Power, Petroleum refining	31,077	7,419	7,160
Service (Finance etc)	15,431	13,904	11,456
Chemical (excluding fertilizers)	5,800	2,849	8,677
Processed food	9,470	3,076	3,690
Drugs, pharmaceuticals	2,511	2,793	15,711
Metallurgy	2,096	1,455	8,583
Consulting service	1,003	2,480	11,844
Mechanical appliances	1,334	1,910	717
Trade	1,824	831	682
Textiles	2,204	838	1,785
Total	181,956	116,173	172,6651

Source: Complied on information obtained from JETRO etc
(http://www.jetro.go.jp/biz/world/asia/in/stat_06/)

The FDI from Japan to India in 2006 has increased to JPY 59.8 billion from JPY 29.8 billion in 2005.

3.1.5 Energy production and consumption

The primary energy supply in India is based on coal (33.2%), petroleum (22.4%) and biofuel (38.2%). The production and consumption of petroleum is increasing every year and India now holds the 23rd position in the world (0.9% of world share) in petroleum production (784,000 barrel per day). India is the 6th largest consumer of petroleum (3.0% of world share, 2,485,000 barrels per day). The production of natural gas in India is totally consumed in India. The consumption rate is growing in recent years and from 2004, India has started importing natural gas from Qatar. India is the third largest consumer of coal and imports coal mainly from Indonesia, Australia and China.

The dependence of India in imports on energy sector is, petroleum (80.9%), coal (8.2%), natural gas (0%) with the total dependence amounting to 21% (2003 data). The dependence on petroleum is high in import, but most of the coal and natural gas is available in India itself. Regarding electricity, generation of electricity from coal is about 70% which is a very high proportion compared to the world average of 40% or that of Japan (28%). It is expected that coal will be the main source of electricity in the future also. The production amount of electrical energy in 2005-2006 was 697.3 billion kWh and is increasing year by year.

Table. 3-14 The trend of electricity generation (billion kWh)

(Billion KWH)

Year	Utilities				Non-Utilities	Total (5)+(6)
	Hydro+Wind	Thermal+NCES	Nuclear	Total		
1	2	3	4	5	6	7
1950-51+	2.5	2.6	—	5.1	1.5	6.6
1960-61	7.8	9.1	—	16.9	3.2	20.1
1970-71	25.2	28.2	2.4	55.8	5.4	61.2
1975-76	33.3	43.3	2.6	79.2	6.7	85.9
1980-81	56.5	61.3	3.0	120.8	8.4	129.2
1981-82	49.6	69.5	3.0	122.1	9.0	131.1
1982-83	48.4	79.9	2.0	130.3	10.0	140.3
1983-84	50.0	86.7	3.5	140.2	10.8	151.0
1984-85	53.9	98.8	4.1	156.8	12.3	169.1
1985-86	51.0	114.4	5.0	170.4	13.0	183.4
1986-87	53.8	128.9	5.0	187.7	13.6	201.3
1987-88	47.5	149.6	5.0	202.1	16.9	219.0
1988-89	57.9	157.7	5.8	221.4	19.9	241.3
1989-90	62.1	178.7	4.6	245.4	23.0	268.4
1990-91	71.7	186.5	6.1	264.3	25.1	289.4
1991-92	72.8	208.7	5.5	287.0	28.6	315.6
1992-93	69.9	224.8	6.7	301.4	31.3	332.7
1993-94	70.4	248.2	5.4	324.0	32.3	356.3
1994-95	82.7	262.1	5.6	350.4	35.1	385.5
1995-96	72.6	299.3	8.0	379.9	38.2	418.1
1996-97	68.9	317.9	9.1	395.9	40.8	436.7
1997-98	74.6	337.0	10.1	421.7	44.1	465.8
1998-99	82.9	353.7	11.9	448.5	48.4	496.9
1999-00	80.6	386.8	13.3	480.7	51.5	532.2
2000-01	74.5	408.1	16.9	499.5	55.0	554.5
2001-02	73.5	424.4	19.5	517.4	61.7	579.1
2002-03	64.0	449.3	19.4	532.7	63.8	596.5
2003-04	75.2	472.1	17.8	565.1	68.2	633.3
2004-05	84.6	492.8	17.0	594.4	71.4	665.8
2005-06*	99.9	506.0	17.3	623.2	74.1	697.3

* Provisional + On a calendar year basis. NCES: indicates Non-conventional Energy Sources other than wind.

Note : Figures may not add up to the total owing to rounding off.

Source : Ministry of Power.

Source: Economic Survey (http://indiabudget.nic.in/es2006-07/chapt2007/tab124.pdf)

Electricity generation from thermal power is the largest source with coal covering about 70%. An increase in the usage of domestic electrical appliances can be seen in recent years with the biggest rise in the usage of air conditioners. As a result of this, the demand of electricity is increasing and

the electricity usage per person in 2004 was 606 KW, a figure about 2.5 times higher than the figure of 238 KW in 1990.

The installed capacity of electricity generation equipments in India was about 697.3 billion KWh in 2006 (150,323 MW). India has plans to increase the production of nuclear energy in the future with plans to increase the electricity generation capacity to 40,000 MW by 2020. The consumption of electricity is growing in all the commercial, industrial and agricultural sectors.

Table. 3-15 Trend of electricity consumption

Year	Domestic	Commercial	Industry	Traction	Agriculture	Others
1	2	3	4	5	6	7
1950-51+	12.6	7.5	62.6	7.4	3.9	4.0
1960-61	10.7	6.1	69.4	3.3	6.0	4.5
1970-71	8.8	5.9	67.6	3.2	10.2	4.3
1975-76	9.7	5.8	62.4	3.1	14.5	4.5
1978-79	9.8	5.6	61.8	2.8	15.6	4.4
1979-80	10.8	6.0	58.9	2.9	17.2	4.2
1980-81	11.2	5.7	58.4	2.7	17.6	4.4
1981-82	11.6	5.8	58.8	2.8	16.8	4.2
1982-83	12.7	6.1	55.4	2.8	18.6	4.4
1983-84	12.9	6.4	55.8	2.6	17.8	4.5
1984-85	13.6	6.1	55.2	2.5	18.4	4.2
1985-86	14.0	5.9	54.5	2.5	19.1	4.0
1986-87	14.2	5.7	51.7	2.4	21.7	4.3
1987-88	15.2	6.1	47.5	2.5	24.2	4.5
1988-89	15.5	6.2	47.1	2.3	24.3	4.6
1989-90	16.9	5.4	46.0	2.3	25.1	4.3
1990-91	16.0	5.9	44.2	2.2	26.4	4.5
1991-92	17.3	5.8	42.0	2.2	28.2	4.5
1992-93	18.0	5.7	40.9	2.3	28.7	4.4
1993-94	18.2	5.9	39.6	2.3	29.7	4.3
1994-95	18.5	6.1	38.6	2.3	30.5	4.0
1995-96	18.7	6.1	37.8	2.3	30.9	4.2
1996-97	19.7	6.2	37.2	2.4	30.0	4.5
1997-98	20.3	6.5	35.4	2.3	30.8	4.7
1998-99	21.0	6.4	33.9	2.4	31.4	4.9
1999-00	22.2	6.3	34.8	2.6	29.2	4.9
2000-01	23.9	7.1	34.0	2.6	26.8	5.6
2001-02	24.7	7.5	33.3	2.5	25.3	6.7
2002-03	24.6	7.5	33.9	2.6	24.9	6.5
2003-04	24.9	7.8	34.5	2.6	24.1	6.1
2004-05	24.8	8.1	35.6	2.5	22.9	6.1
2005-06*	**24.9**	**8.4**	**35.9**	**2.5**	**23**	**5.3**

* Provisional. + On a calendar year basis.
Note: Figures may not add up to 100 per cent owing to rounding off.
Source : Ministry of Power.

Source: Economic Survey (http://indiabudget.nic.in/es2006-07/chapt2007/tab125.pdf)

The total amount of petroleum refinement is increasing and is about 32 million t barrels in recent years. However, the demand for petroleum products is increasing due to increase in demand in the automobile, construction materials, fertilizer and chemical sectors and the need for finding alternatives to petroleum products is being pointed out.

Table. 3-16 Demand and supply of crude oil and petroleum products (10,000 t)

	Item	1998	1999	2000	2001	2002	2005
Crude oil	Refined amount	6,520	6,850	8,600	10,340	10,730	13,010
	Domestic production	3,390	3,270	3,190	3,240	3,200	3,220
Petroleum products	Domestic consumption	8,430	9,060	9,710	10,010	10,010	11,190
	Domestic production	6,130	6,450	7,940	9,560	10,000	11,900

Source: Economic Survey (http://indiabudget.nic.in/es2006-07/chapt2007/tab130.pdf)

The consumption and production of various materials in India is as shown below.

Table. 3-17 Production and consumption of some principle materials

Material	Production	Consumption	Source
Iron (raw steel)	19 million t (1994) 32 million t (2003)	22 million t (1995) 26 million t (2000) 30 million t (2003)	Steel Statistical Yearbook 2004
Cement	87 million t (1998) 119 million t (2002)	—	Japan Cement Association
Paper/paperboard	5.3 million t (2002) 5.5 million t (2003)	5.8 million t (2002) 5.9 million t (2003)	Paper recycling promotion center
Aluminum	0.8 million t (2004)	0.8 million t (2004)	Japan Aluminum Association
Plastic	—	4.kg/person (2003)	Polymer digest

The production of steel in India is 32 million tons and the consumption is 30 million tons (2003). The consumption in the last 10 years has increased by 60%. The Indian government has a target of economic growth of 7-8 % and the consumption of steel is expected to increase to about 60 million tons by 2012 (Japan Iron and Steel Federation).

The production of cement in India is the second largest in the world , next to China and has increased from 1998 to 2002 by 1.3 times.

4 Natural Environment of State of Gujarat

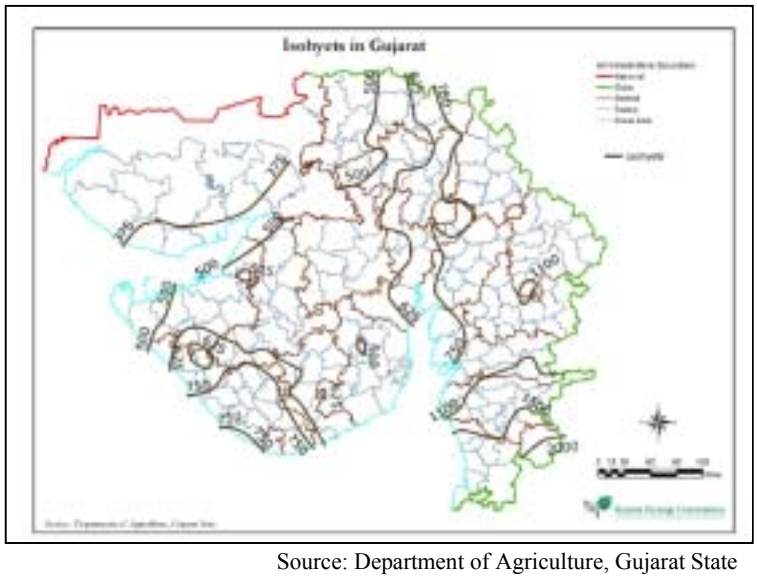
In the following chapters, general setting of the project shall be outlined especially in the context of the proposed waste recycling/management project development projects. In this first chapter geographical, geological and topological description of the state of Gujarat shall be given.

The state of Gujarat is located on the west coast of India. It is bounded by the Arabian Sea in the west, by the States of Rajasthan in the North and North-East, by Madhya Pradesh in the East and by Maharashtra in the South and South East. The state of Gujarat has an international border with the Pakistan at the north-western area. The state has a long coast-line of about 1,600 km, and is the longest among all states in India. As for administrative setting, Gujarat at present comprises of 25 districts, 226 talukas (sub-district), having 18,618 villages and 242 towns. Gujarat has geographical area of 196,024 sq.kms, which accounts for 6.19 percent of the total area of India.

Figure. 4-1 State of Gujarat

The State is endowed with a wide variation of geo-climatic environments. A wide range of physiographic features are observed within the state from sea level to 1000 m elevation. The state lies in the subtropical zone. However, its climate is dominantly influenced by the monsoon (June to September), and physiographic set up is diversified in extremes of arid to humid conditions. The mean annual rainfall varies between 300 mm to 2000 mm with rainy days of 10 to 70 a year. The rainfall dependability has a very broad range of 40 to 70 percent.

Figure. 4-2 Isohyets in Gujarat



Source: Department of Agriculture, Gujarat State

The surface water as well as groundwater resources are dominantly concentrated in the southern and central part of the state (40% of area of the State), where wetlands are also sighted providing rich water availability and environment. In the vast remaining area the groundwater occurs only under phreatic conditions with limited yield. More than 70% water needs of the state is therefore feed by the groundwater. The resource is overstressed and the state faces increasingly serious problems of water supplies. Furthermore, the state holds two deserts, one north of Kachchh and the other between Kachchh and the mainland are saline wastes, where salinisation and ecological degradation draw attention.

Nevertheless, the state is endowed with rich potential of various natural resources of land, water, minerals, soil, vegetation, wild life, energy, marine products. By exploiting such resources, huge industrial complexes like the oil refineries, fertilizer plant, alkali plant, cyanide plant operates in the state has been operating. From the complexes, common pollutants/wastes generated, and they are dominantly oxides of nitrogen, sulphur, ethylene, ammonia, fluorides and other organic and inorganic wastes.

5 Socio-Policy Environment of State of Gujarat

In this chapter, state policies and strategies regulating industrial and economic development in Gujarat shall be observed. First of all, the population census of Gujarat shall be described.

According to population census 2001, the population of Gujarat was 50.7 million, which is 5% of the total population of India. The density of Gujarat is 258 persons per km² in 2001. The literacy rate in the state was 59% in 2001. About 63% of the population resides in rural area whereas 37% lives in urban areas. 42% of the total population engaged in some kind of working activities. According to the provisional results of population census 2001, the total number of households was 9.7 million.

Table. 5-1 Top 10 sub district and total of demographic situation in Gujarat

No.	Sub District	District	Households	Population	Literate population	Worker population
1	Ahmadabad City	Ahmadabad	837,223	4,220,048	3,100,167	1,345,972
2	Surat City	Surat	491,190	2,433,835	1,736,939	929,275
3	Vadodara	Vadodara	363,886	1,705,989	1,278,054	566,228
4	Rajkot	Rajkot	220,028	1,137,984	800,018	389,308
5	Jamnagar	Jamnagar	141,588	761,375	480,497	251,878
6	Bhavnagar	Bhavnagar	121,981	662,680	437,638	217,496
7	Chorasi	Surat	127,093	585,733	407,445	241,432
8	Gandhinagar	Gandhinagar	116,793	571,307	400,786	216,847
9	Anand	Anand	100,298	513,900	362,943	188,194
10	Nadiad	Kheda	96,039	488,628	335,009	188,189
Total –Gujarat State			9,693,362	50,671,017	29,827,750	21,255,521

Source: Population Census 2001

5.1 Industrial Policy and Economic Development Strategy

The state industrial policy promulgated in 2009 is a main framework to guide industrial and economic development in Gujarat. The primary vision expressed in the state's industrial policy is to make Gujarat a global investment destination, besides the extent and nature of the development is aimed for not only excellent levels but also "sustainable, balanced and inclusive development" in long run performance. The policy has also prioritized creation of employment opportunities which would be directly and indirectly brought about from addition investment projects in the state. Moreover, the state government stresses on facilitation of trained manpower to be produced through various fields of economic activities, and to this end, aid measures with various incentives and interventions to support industries becomes available.

Acknowledged being a major trade and commercial hub, Gujarat has accelerated its strength in flourishing trade and business activities. The virtue of free trade and entrepreneurism has been well envisaged in government policies and administrative manners. With an open policy aspiring highly investor-friendly state, Gujarat attracts investments and contributes to 11% of India's GNP and 10% of national consumption. This has made Gujarat one of the most prosperous and vibrant states in India (GSP's annual growth rate is the highest among all states as shown in Table 5-2). The growth thrust policies is expected to continue and the right incentive packages and administrative supports is surely a backbone to make Gujarat one of the prime investment destinations for both foreign and local investors in the continuing future.

Table. 5-2 Gross State Products from FY 2003 to FY 2005

State	2003-2004	2004-2005	2005-2006	2003-2004	2004-2005	2005-2006
1 Maharashtra	337,495	378,839	432,413	12.77 %	12.25 %	14.14 %
2 Uttar Pradesh	227,086	246,618	279,762	9.65 %	8.60 %	13.44 %
3 West Bengal	189,099	208,578	236,044	12.53 %	10.30 %	13.17 %
4 Andhra Pr.	190,880	210,449	236,034	13.52 %	10.25 %	12.16 %
5 Tamil Nadu	175,897	200,781	223,528	11.07 %	14.15 %	11.33 %
6 Gujarat	168,080	186,181	216,651	18.76 %	10.77 %	16.37 %
7 Karnataka	128,556	148,541	170,741	9.42 %	15.55 %	14.95 %
Total (India)	2,538,171	2,877,706	3,275,670	-	-	-

Source: For Sl. No. 1-32 -- Directorate of Economics & Statistics of respective State Governments, and for All-India -- Central Statistical Organisation

Gujarat's proactive industrial policy also pertains to critical supports in provision of industrial infrastructure and transport network. The 'growth oriented' strategies has indeed applied in developing industrial units in state's strategic locations and logistics network to connect the industrial units with key industrial infrastructure like port, airport, power station and other utilities which include waste management facilities through road, expressway and railway network. Keeping this context, state government has designed out an ambitious plan to accelerate infrastructure development in the state. In a broader perspective, Gujarat's industrial blue print seeks to achieve speedy and balanced developments of industries and industrial hubs by creating favorable conditions for installation and expansion of industrial units and industry-supporting infrastructure. In order to achieve these objectives a scheme of utilizing private capital and expertise is considered as a form of Public Private Partnership (PPP), hence various incentives, tax holidays, single window clearances to developers have been introduced by the state government. Actually these proactive measures have been took by the state of Gujarat at the earliest among other Indian states to create an enabling framework for private sector participation in infrastructure development.

The most successful infrastructure development is particularly seen in the port development and operation project in that Gujarat ports handle 25% of India's cargo, and, especially, "minor" ports in Gujarat, which are labeled as private sector's operating port, handle around 80% of all cargo handled by all minor ports in India. Being stimulated by its high performance, in the state strategy, update of the Blueprint for Infrastructure in Gujarat 2020 (BIG 2020) is presented with a coherent and comprehensive action paper in which all infrastructure sectors, including road, ports, urban development, railways, ICD, industrial parks, water sectors and waste treatment facilities development, shall be perused in PPP initiatives.
Furthermore, under the scope of DMIC (Delhi Mumbai Industrial Corridor) development plan, which has been jointly initiated by India and Japan government, Gujarat government intend to leverage DMIC initiative to achieve region's speedy infrastructure development. As for the state of Gujarat, the proposed Dedicated Freight Corridor (DFC) between Delhi and Mumbai is one of the envisaged developments and its importance is indicated in that its length of the part passing through Gujarat accounts for 38% of the total project length.

The frame of DMIC is inflicted in the state industrial master plan and the execution of the DFC project as well as industrial clusters development projects (called Special Investment Region (SIR); the announced industrial accumulation ground together with the related industrial infrastructure group that supports industries). Especially, when the high-speed freight railway where Delhi and Mumbai are connected with a special lane was developed, it is scheduled that the technology and the capital cooperation from Japan will be provided, and Gujarat state is advanced to construct to connect DFC with the state's main sea ports like Mundra, Kandla and Pipavav. Ultimately, the formation and the execution of the infrastructure project to contribute to the global competitiveness strengthening of the private enterprises stationed in Gujarat shall be benefited through initiative of DMIC project formation scheme together with the advancement support from Japanese government in the future.

Table. 5-3 Special Investment Regions of Gujarat

GIDB has been appointed by the State Government to act as the nodal agency and the Apex Authority for the DFC & DMIC project. Four industrial nodes are to be developed in the first phase of the DMIC (2008-2012).

1. The Ahmedabad-Dholera Special Investment Region (SIR) has been taken up on priority basis. This investment region is being developed in an area of 360 sq. kms. Feasibility studies have been completed and the master planning work is going on. .
2. A master plan has been submitted to DIPP-GoI, Delhi, for development of infrastructure in the state during first phase work on DMIC. This includes construction or up gradation of about 22 different roads of six and four lane nature covering a length of about 2000 kms. It also includes strengthening of rail infrastructure in form of doubling rail lines, broadening or providing fresh lines of about 1900 kms. It also envisages Metro Rail and International Airport and several logistics parks.
3. An organic structure in form an SPV at the state level for execution of DMIC projects, preferably with pvt. Sector major equity stake, has been approved to smoothen the execution process.
4. For the Dholera SIR, following major infrastructure projects, have been identified as early bird projects;

    - Metro Rail system between Gandhinagar-Ahmedabad and Dholera.
    - New International airport in the vicinity of the SIR.
    - Six lane road connecting Ahmedabad-Dholera-Bhavnagar and passing through the SIR as its central spine.

Mega Industrial Parks within the SIR.
The SIR project will have enormous potential for development in terms of industrial growth as also increased employment opportunities.

Dholera Special Investment Region (SIR), Petroleum Chemical and Petrochemical Investment Region

(PCPIR), Gujarat International Financial Tech City (GIFT) etc.

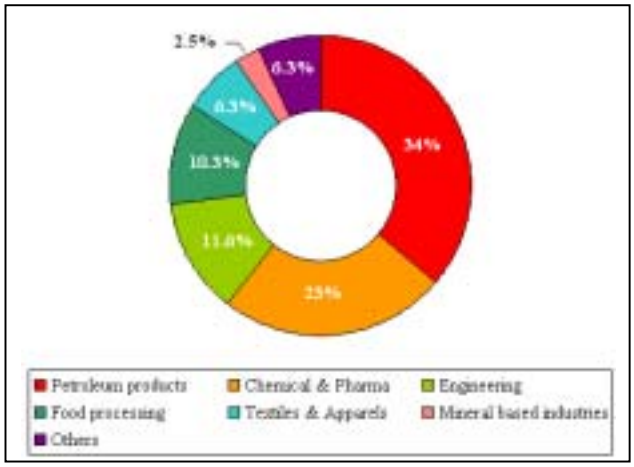
- Special Investment Regions (SIRs)
- Palanpur – Sidhpur – Mahesana Industrial Area
- Ahmedabad – Dholera Investment Region
- Vadodara – Ankleshwar Industrial Area
- Bharuch – Dahej Investment Region
- Surat – Navsari Industraial Area
- Valsad – Umbergaon Industrial Area

Source: GIDB

5.2 Major industrial sectors

Though Gujarat accounts for only 6% of India's geographical area and 5 % of the population, Gujarat has remained the strong-arm of India's industrial and trade performance in that 21% of national exports and 6.4% of GDP is contributed by Gujarat.

Figure. 5-1 Composition and share of major industry in Gujarat state



Sector	Share in Gujarat (%)	Share in India (%)
Refined Petroleum	30.8	38
Chemicals including Pharma	26.7	30
Engineering	9.5	7
Food and Beverages	9.2	9
Metallurgical	7.4	11
Textiles	7.2	15
Non-metallic mineral	2.4	12
Plastics	1.9	10
Paper	1.2	11

Source: Industries Commissionerate, Industries in Gujarat 2007

In particular industry-wise performance, Gujarat has achieved high growth in sectors like, chemicals and petrochemicals, engineering, agro and food processing. The several key sectors of industries characteristics in Gujarat shall be described in the following;

Energy Gujarat has increased its installed capacity of 10,290 MW (June 2009) which compared with the capacity of 9,288 MW in 2005. Per capita consumption of electricity of Gujarat is also double of that of the average for India**.** Moreover the state government has proactively promoted solar energy projects in the state, back-up by the related supporting policy and incentives.

Chemicals and petro-chemicals The chemical industry in Gujarat produces a wide range of products, which include Pharmaceuticals, Dyes, Man-made Fibers, Plastics, Pesticides, Fertilizers, Cosmetics and Toiletries, Paint , Auxiliary Chemicals and variety of Organic and Inorganic compounds for applications to industries ranging from automobiles, textile industry, engineering industry, construct ion chemicals and food additives to veterinary and health care.

Since August 1991, chemical and allied sector accounts for an investment of Rs.1531 billion which is 50.3% of total investment of the state. Moreover the state accounts for 28% of the national production in Chemicals. The major reasons which could be attributed to such a spectacular growth of this sector in the state are a strong base of petrochemical industry, increasing availability of basic feed stock, relatively low overhead cost, availability of necessary infrastructure, trained and technical manpower and high degree of entrepreneurship. Gujarat Industrial Development Corporation (GIDC) has set up mega estates, particularly for chemicals at Ankleshwar, Panoli, Vapi, Vatwa, Jhagadia, Vilayat and Dahej to facilitate further development and growth of the sector.

Oil and gas Gujarat governs a command over the on shore production of the crude oil in India by contributing almost 54% of the total production. Refineries in Gujarat also account for 46% of refining capacity of the country. Moreover Gujarat has unique feature of having State Wise Gas Grid and Multi Gas Supplier. The gross production of natural gas in Gujarat accounted for 7% of the total in India, which was 2.2 TCM. Noteworthingly it was Gujarat state own corporation of GSPC (Gujarat State Petroleum Corporation) that has given India its largest Natural Gas discovery of 20 TCF at The Krishna-Godavari basin at Andhra Pradesh, South India. In Gujarat state, it has already started implementing a 2,200 km state-wide gas grid – to connect the demand and supply centres. Out of this, 750 km network is already operational and another 650 km pipeline is under implementation.

Hazira and Palej are the only two LNG terminals in India[8], mentioning the potential of Gujarat to be a state which can lead India in the development and growth in oil and gas sector. Consequently it can be said that Gujarat has taken a pioneering role in utilizing Natural Gas for power generation, fertilizer product ion, manufacturing and transportation.

Textile Textile also plays a vital role in economy of Gujarat and it contributes around 7.2% of state GDP. Gujarat is famous for traditional textile industrial cluster. The lifting of quotas and incentive schemes such as the Technology Up-gradation Fund has improved the prospects of textile clusters of Gujarat. It posses strong presence in the entire value chain from farm to fiber (mainly synthetic) to fabric to fashion and foreign trade. The government has prioritized developing spinning and weaving sector in the state with favorable incentives and industrial development strategy.

Gems and Jewellery Gujarat is one of the world's largest producers of gems and jewellery. Gujarat contributes about 72% of the total exports of the products in India. The state with its diamond and jewellery units at Ahmedabad and Palanpur in north Gujarat, Bhavnagar in

[8] New LNG terminal is planned in Mundra port

Saurashtra, and Surat, Navsari and Valsad in south Gujarat is one of the main contributors to the gems and jewellery industry in India. Gujarat accounts for about 80% of the diamonds processed and 90% of the diamond export from India. Surat has 65% share in India's diamond trade.

The new industrial policy seeks to develop a Jewellery Park, which incorporate R&D, Gems Testing Centres and Hallmark Certificate Centres, in the state on PPP basis with option of viability gap funding.

Ship-Breaking and Ship-Building Environmental management planning of the world's largest ship-breaking yard at Alang was undertaken under the jurisdiction of the Gujarat Maritime Board (GMB). A study to develop a dry dock yard identified areas for fresh intervention for evolving an environmentally sound and practical strategy for the development of the new set of ship-breaking industries in the region is carried out in 2010. The study came out with a restoration plan for better the management of the yard. On the other hand, ship-building potentials are to be explored in the state of Gujarat with a strong initiative from the Chief Minister's office as well as the GMB.

5.3 Facilitating measures

PPP scheme for infrastructure projects and environmental protection Any administrative measures to conducive to new developments is formed in the industrial policy 2009 in that it is declared that the government of Gujarat has played a very proactive role in encouraging private sector participation in infrastructure projects through PPP scheme.

Gujarat places a special emphasis on cluster development approach in the new industrial policy by announcing scheme for assistance to industrial clusters development. The scheme would not only lay importance on soft interventions such as capacity building of cluster enterprises through marketing initiatives, technology upgradation initiative, quality improvement and training/skill upgradation initiatives; but also focus on hard interventions such as development of cluster-specific common infrastructure and facilities, incubation center, Common Facility Center (CFC), Industrial Training Institute (ITI) extension center and other needed business-support facilities.

The state government also encourages the industrial units in moving towards adoption of newer and better technologies and facilitates in creating an atmosphere of greater efficiency and speed of operations in that financial support will be provided to each cluster for every innovative technology they adopt and introduce into the manufacturing process, and Gujarat will facilitate the setting up of R&D institutions by defraying part of the project cost.

In this respect, it is clear that the state government in the new industrial policy intends to emphasize infrastructure development yet it is aimed to support industrial cluster development or giving a connection to accelerate each cluster linkage to nurture industrial synergy. In doing so, the state government plans to provide a wide range of incentives for all the sectors to encourage greater compliance with the environmental norms and standards. The state government has taken initiatives to develop infrastructure for environment protection including setting up of common effluent treatment plants, development of hazardous waste disposal sites and disposal of treated effluents into sea. The environment protection measures would continue to get priority. Now the environment protection operations shall be carried out by the third party having responsibility for monitoring and compliance and not by the polluters/stake holders.

The state government aims to encourage environment management by rational use of resources, environment audit and taking measures to reduce pollution load, waste recovery, recycling and waste recharge besides focusing on adoption of clean process technology. The state government

also aims to promote waste management as a stand alone viable activity through professional independent technology-driven entities. Moreover the state government intends to gain carbon credits and reduce carbon foot prints in the industrial sectors. It will, therefore, provide greater opportunity to the people willing to take the benefit of green business like carbon credit earning. Focus would be on green credits through compensatory or advance afforestation. The state government also aims at zero discharge from specific industrial sectors over a period of 10 years.

6 Regional Development Plan of State of Gujarat

Regional development plan which is predominantly supported by unique land acquisition policy and legal environment shall be observed first in hereafter, then a regional development plan initiated by the national development plan of Delhi Mumbai Industrial Corridor (DMIC) which is directly related to the project or project site shall follow next

6.1 Land Acquisition Policy

General framework on land ownership and land acquisition issues in Gujarat have not faced serious issues for both industrial project developers as well as land owners like farmers when these are compared to states like Orissa and West Bengal. A possible reason can be withdrawn based on the long tradition of giving land at only market prices to industrial project developers, with a reasonable compensation to land-losers, besides interferences from the government are minimized. In fact, most of the land acquisitions in the state are undertaken directly by industrial project developers without direct intervention from the government.

Furthermore, as Gujarat Industrial Development Corporation (GIDC), an arm of the state government in the area of promotion and development of investment projects in Gujarat, has developed a huge land bank over the years and most of the land in Gujarat given to industries is offered by GIDC. There is no issue of displacement of residence in such cases. Moreover the state government may take a special dispensation for the land tenure conversion for Mega Project as above (Table. 5-3).

In the new industrial policy, zoning on the basis of environmental aspects, existing and proposed infrastructure including environmental infrastructure and land availability would be carried out. This would help the investor in selecting appropriate location from the environment point of view and enable Gujarat Pollution Control Board (GPCB) to process the No Object Certificate (NOC) application faster.

6.2 Regional planning

The state government has passed the Special Investment Region (SIR) ordinance particularly to create large size investment regions and industrial areas, under the proposition of DMIC initiative, in the state of Gujarat; and to specially aiming at their development as global hubs of economic activity supported by world class infrastructure, premium civic amenities, centers of excellence and pro-active policy framework; and to set up an organizational structure with that purpose. The SIR ordinance provides for the development of such economic hub(s) with global standards. As described earlier, the state has already identified six potential locations to be developed as SIRs, which include (1) Dholera-Ahmedabad Investment Region (2) Vadodara-Ankleshwar Industrial Area (3) Palanpur-Mehsana Industrial Area (4) Bharuch –Dahej Investment Region as (Petroleum, Chemicals and Petrochemical Investment Regions) PCPIR, (5) Surat-Hazira Industrial Area and (6) Valsad-Umergam Industrial Area.

This strategy of the state government is complimented with the strategy of the Government of India. Government of India has proposed a project of Dedicated Freight Corridor (DFC) between Delhi and Mumbai. The area of 150 kms on both sides of the DFC will be developed as the industrial corridor.

Figure. 6-1 Location Map of Special Investment Regions in Gujarat

As mentioned earlier, integrating into the part of this Delhi-Mumbai Industrial Corridor (DMIC), six mega industrial nodes (four industrial areas and two investment regions) have been proposed by the state of Gujarat. When we compare the prospective economic impacts from the regional development concept, almost one third of the proposed investments of about 90 billion US dollars in DMIC is expected to take place in Gujarat alone. As part of the DMIC project, identified industrial nodes have been thought to be developed as global manufacturing and commercial hubs. All kinds of infrastructure both within and outside the nodes also have to be developed with global standards; Government of Gujarat has not only given its full commitment for the DMIC project but has been actively working with the Government of India on the same. Even Government of India has suggested to the state to put in place a legal framework and a dedicated organizational structure for coordination of developing world class industrial nodes.

7 Industrial Wastes Management Situation

7.1 Industrial Hazardous Waste

7.1.1 Legal framework governing Industrial Hazardous waste

7.1.1.1 Classification of waste

In India, legally defined waste materials are largely differentiated into municipal solid waste, hazardous industrial waste and bio-medical waste. A list of waste sources, the type of waste and the applicable laws and regulations has been listed in the following table.

Table. 7-1 Classification of waste in India

Source	Classification	Related law
Hospital	Bio medical waste	Bio-medical wastes (Handling and management) rules, 1989
Industry	Hazardous waste	Hazardous wastes (management and handling) rules, 1989
Office	Municipal solid waste	MSW (management and handling) Rules, 2000
Residence	Municipal solid waste	
Market	Commercial waste (similar to MSW)	MSW (management and handling) Rules, 2000
Farms	Horticulture/farm waste/MSW	MSW (management and handling) Rules, 2000
Small factories	Industrial/hazardous waste/MSW	MSW (management and handling) Rules, 2000 Hazardous wastes (management and handling) rules, 1989
Parks	Horticulture waste	MSW (management and handling) Rules, 2000

Source: Feasibility Study on Construction of an Integrated Waste Treatment Facility in Delhi, India

7.1.1.2 Laws and regulations related to Municipal Solid Waste

The laws applicable to municipal solid waste (hereinafter, "MSW") in India is the Municipal Solid Waste (management and handling) rules, 2000 (hereinafter referred to as "MSW rules"). It is the responsibility of the municipalities to carry out the specifics mentioned in the MSW rules. This rule specifies the responsibility of collection and treatment/disposal of the MSW to the municipalities. According to this rule, MSW should be segregated into organic matters, recyclable matters and other inserts. The municipalities are required to collect MSW by placing special containers in streets and treat it properly by measures such as landfilling. In order to decrease the load on landfills, it is mandatory to segregate the organic content as much as possible before taking the entire wastes to the landfill site. This rule also specifies the condition that needs to be fulfilled for choosing sites for MSW landfills and also specifies the process of landfilling and structures of the landfills.

Requirements regarding landfills are as follows.

- Proper consideration to the groundwater pollution is to be made before selection of the landfill site. Landfill sites lasting at least 20-30 years should have a buffer zone to be established between landfills and areas of other land use. Existing landfills, which will be used for more than 5 years, are required to comply with these rules. Proper monitoring of the waste going into landfills is to be done and a weighbridge should be established.
- A cover layer of minimum 10 cm is to be maintained over the landfilled waste. Proper drainage system is to be maintained to divert run off water. After the completion of

landfilling, a final barrier of soil layer (60 cm with permeability less than 10^{-7}cm/sec), drainage layer (15 cm) and a vegetative layer (45 cm) should be also maintained.

- A non-permeable lining layer is to be constructed on the base and walls of the landfills. Provision for leachate treatment should be made. (MSW Rules sets out standards for leachate)
- Water quality and ambient air quality monitoring around the landfill should be done on a regular basis
- Landfill gas is to be vented and properly used
- Post closure monitoring of the landfill is to be continued for at least 15 years.

7.1.1.3 Laws and regulations related to hazardous waste

1) Definition of Hazardous waste

The hazardous wastes (management and handling) rules, 1989 (amended later) is the rule that is applicable to hazardous wastes in India. Unlike Japan, there is no legal definition or category called "industrial waste" and waste material from factories would be differentiated as MSW if it is not classified as "hazardous ".

Hazardous waste, in the abovementioned rule, is defines as follows:

"Waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances". The hazardous wastes (management and handling) rules classify waste as hazardous by processes generating wastes (as listed in Schedule 1 of the rule) or by concentration of hazardous contents in such wastes (as listed in Schedule 2 of the rule).

2) The responsibility of related stakeholders concerning hazardous waste

The related stakeholders regarding the treatment of hazardous waste are the central government, the state government, the generator and treater of the waste. Responsibility regarding the identification of hazardous waste and giving permits to import/exports of this waste is the responsibility of the Ministry of Environment and Forestry (MoEF). The Central Pollution Control Board (CPCB) is responsible for classifying the hazardous waste and proposing standards regarding the treatment and disposal. It is the responsibility of the state government to identify the sites for the Treatment Storage Disposal Facility (TSDF) for hazardous waste. Further, it is the responsibility of the various State Pollution Control Boards (SPCB) to prepare an inventory of hazardous waste within the states and provide licenses regarding the handling of these waste materials.

The responsibility of the treatment of hazardous waste lies in the occupier of the facility handling the hazardous waste. The generator should get the permission from the SPCB of handling hazardous waste before the start of its operation. They should also prepare manifest and pass it along to the waste management companies (the treaters) along with related information during the transportation stage for treatment. They are also required to report information regarding the handling of hazardous waste to SPCB at least once a year (by December 31st each year).

Anyone involved in transportation of hazardous waste is required to properly label, pack and cover the waste according to the "Guidelines for the transportation of Hazardous Waste" produced by the CPCB.

3) The treatment and disposal of hazardous waste

The hazardous wastes (management and handling) rules do not specify the standard for the treatment of waste, but the MoEF and the CPCB have prepared various guidelines. Technical requirements regarding landfills for hazardous waste has been laid out in "Criteria for Hazardous Waste Landfills" and "Guidelines for Setting up of Operating Facility- Hazardous Waste Management". These guidelines require landfills for hazardous waste to have double linings and be equipped with a proper water treatment facility.

The "Guidelines For Proper Functioning and Upkeep of Disposal Sites" published in 2006 specifies the accepting criteria for taking waste into landfills (Concentration Limits/Criteria for Acceptance of Hazardous Wastes for Direct Disposal to Secured Landfill) and is summarized below.

Table. 7-2 Acceptance criteria for direct landfiling of hazardous waste

Leachate Quality *	Concentration
PH	4 – 12
Total Phenols	< 100 mg/l
Arsenic	< 1 mg/l
Lead	< 2 mg/l
Cadmium	< 0.2 mg/l
Chromium-VI	< 0.5 mg/l
Copper	< 10 mg/l
Nickel	< 3 mg/l
Mercury	< 0.1 mg/l
Zinc	< 10 mg/l
Fluoride	< 50 mg/l
Ammonia	< 1,000 mg/l
Cyanide	< 2 mg/l
Nitrate	< 30 mg/l
Adsorbable organic bound Chlorine	< 3 mg/l
Water soluble compounds except salts	< 10%
Calorific value	< 2500 K.Cal/kg
Strength	
Transversal strength (Vane Testing)	> 25 KN/m^2
Unconfined Compression Test	>50 KN/m^2
Axial Deformation	< 20 %
Degree of Mineralization or Content of Organic Materials (Original Sample)	
Annealing loss of the dry residue at 550°C	< 20% by weight (for non-biodegradable waste) < 5% by weight (for biodegradable waste)
Extractible Lipophilic contents (Oil & Grease)	< 4% by weight

* Leachate quality is based on Water Leach Test

Source: Guidelines for proper functioning and upkeep of disposal site

Further, "Guidelines For Common Hazardous Waste Incineration" published in June 2006 specifies the following waste materials as suitable for incineration.

- Waste solvents
- Waste oil, emulsions and mixture of oil
- Hospital waste
- Waste pesticides
- Waste medicines
- Waste from refineries
- Phenolic waste
- Grease/Wax
- Organic material containing halogens, sulfur, nitrogen compounds and phosphates
- Waste cells containing PCB
- Solid matter containing oil
- Waste with calorific value over 2500 Kcal

7.1.2 Laws and regulations related to water treatment

Environment Protection Act, 1986, is the basic Environmental law of India .The Environment Protection Act sets out the responsibilities of the central government to prevent, counteract, control and abate environmental pollution. Power is given to the central government to make relevant rules and regulations to obtain the objectives of the act.

The Environment Pollution Rules, 1986 (latest amendment in 2003), enacted under the provisions of The Environment Protection Act, sets out specific standards for the emission/discharge of environmental pollutants. The rule also prohibits the installation of certain specific industries in specific areas. The rule also makes it mandatory for factories or other similar facilities to collect samples and present environmental reports to the authorities.

The Water (prevention and control of pollution) Act, 1974, aims at the prevention and regulation of water pollution, and the maintenance and improvement of water quality. The act has stipulated the formation of Central Pollution Control Board responsible for exercising the powers conferred by the act. The Water (Prevention and Control of Pollution) Rules that came into force in 1974 has set out the terms and conditions for the functioning of the central pollution control board.

The standard of effluents from factories etc. has been specified in the "The Water (Prevention and Control of Pollution) Rules" and has been summarized in the following tables.

Table. 7-3 Effluent standards as set out in the Environment Protection Rules, 1986

		mg/L unless specified			
			Treated Effluent		
		Primary Treatment[1,2]	Into Inland Surface Waters (a)	On Land for Irrigation (b)	Into Marine Coastal Areas C
PH		5.5 – 9.0	5.5 – 9.0	5.5 – 9.0	5.5 – 9.0
BOD(5 days at 20C)		-	30	100	100
COD		-	250	-	250
Temperature (degree Celsius)		45	Shall not exceed 40C in any section of the stream within 15 meters downstream from the effluent outlet		45C at the point of discharge
Oil and grease		20	10	10	20
Suspended Solids		-	100	200	For process waste waters-100(b). For cooling water effluents 10 per cent above total suspended matter of in effluent cooling water
Dissolved Solids (Inorganic)		-	2100	2100-	
Total residual Chlorine		-	1.0	-	1.0
Phenolic compounds (as C6H5OH)		5.0	10	-	5.0
Ammonical Nitrogen (as N)		50	50	-	50
Total Kjeldahl Nitrogen (as N)		-	100	-	100
Cyanide (as CN)		2.0	0.2	0.2	0.2
Chromium (as CR 6^{+})		2.0			
Chromium (Total, as CR)		2.0	2.0	-	2.0
Copper (as Cu)		3.0	3.0	-	3.0
Lead (as Pb)		1.0	0.1	-	1.0
Nickel (as Ni)		3.0	3.0	-	5.0
Zinc (as Zn)		15	5.0	-	15
Arsenic (as As)		0.2	0.2	0.2	0.2
Mercury(as Hg)		0.01	0.01	-	0.01
Cacuminal (as Cd)		-	1.0	-	2.0
Cadmium(as Cd)		1.0	1.0	-	2.0
Selenium (Se)		0.05	0.05	-	0.05
Fluoride(as F)		15	2.0		15
Boron(as B)		2.0	2.0	2.0	-
Chloride (as Cl)			1000	600	-
Per Cent sodium		-	-	60%	-
Sulphate (as SO_4)		-	1000	1000	-
Sulfide (as S)		-	2.8	-	5.0
Pesticides		-	Absent	Absent	Absent
Radioactive Materials	Alpha emitters, Hc/mL	10^{-7}			
	Beta emitters, Hc/mL	10^{-8}			

1. These standards apply to the small scale industries, i.e. total discharge upto 25Kl/day
2. For each CETP and its constituent units, the state board will prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed in the table.

Source : Environment Protection Rules, 1986

Table. 7-4 General Standards for Discharge of Environmental Pollutants (effluents)

		Treated Effluent			
		Into Inland Surface Waters (a)	Public Sewers (b)	On Land for Irrigation (c)	Into Marine Coastal Areas (d)
Colour and Odour		Max effort to remove color and odour		Max effort to remove color and odour	Max effort to remove color and odour
Suspended Solids		100	600	200	For process water –100 For cooling water effluent 10 per cent above total suspended matter of influent
Particle size of suspended solids		Shall pass 850 micron sieve	-	-	Floatable solids max. 3mm Settleable solids, max 850 microns
PH		5.5 – 9.0	5.5 – 9.0	5.5 – 9.0	5.5 – 9.0
Temperature (degree Celsius)		Shall not exceed 5C above the receiving water temperature	-	-	Shall not exceed 5C above the receiving water temperature
Oil and grease		10	20	10	20
Total residual Chlorine		1.0	-	-	1.0
Ammonical Nitrogen (as N)		50	50	-	50
Total Kjeldahl Nitrogen (as N)		100		-	100
Free Ammonia [NH3], mg/L		5.0			5.0
BOD(5 days at 20C)		30	350	100	100
COD		250		-	250
Arsenic (as As)		0.2	0.2	0.2	0.2
Mercury(as Hg)		0.01	0.01	-	0.01
Lead (as Pb)		0.1	1.0	-	2.0
Cadmium(as Cd)		2.0	1.0		2.0
Hexavalent Chromium (as CR 6^{+})		0.1	2.0	-	1.0
Chromium (Total, as CR)		2.0	2.0		2.0
Copper (as Cu)		3.0	3.0	-	3.0
Zinc (as Zn)		5.0	15	-	15
Selenium (Se)		0.05	0.05	-	0.05
Nickel (as Ni)		3.0	3.0	-	5.0
Cyanide (as CN)		0.2	2.0	0.2	0.2
Fluoride(as F)		2.0	15		15
Dissolved Phosphates(as P)		5.0			
Sulphide (as S)		2.0		-	5.0
Phenolic compounds(as C6H5OH)		1.0	5.0	-	5.0
Radioactive Materials	Alpha emitters, Micro curie/mL	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	Beta emitters, Micro curie /mL	10^{-6}	10^{-6}	10^{-7}	10^{-6}
Bio-assay test		90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
Manganese (as Mn)		2	2		2
Iron (as Fe)		3	3		3
Vanadium(as V)		0.2	0.2		0.2
Nitrate Nitrogen		10			20

Source: Environment Protection Rules, 1986

Table. 7-5 Treated effluent

	Treated Effluent			
	Into Inland Surface Waters (a)	Public Sewers (b)	On Land for Irrigation (c)	Into Marine Coastal Areas (d)
Pesticides (µg/L)				
(i) Benzene hexachloride	10		10	10
(ii)Carbaryl	10		10	10
(iii)DDT	10		10	10
(iv)Endosulfan	10		10	10
(v)Diamethoate	450		450	450
(vi) Penitrothion	10		10	10
(vii)Malathion	10		10	10
(viii)Phorate	10		10	10
(ix)Methyl Palathion	10		10	10
(x) Phenthoate	10		10	10
(xi) Pyrethrums	10		10	10
(xii)Copper Oxychloride	9600		9600	9600
(xiii)Copper Sulphate	50		50	50
(xiv)Ziram	1000		1000	1000
(xv) Sulphur	30		30	30
(xvi)Paraouat	2300		2300	2300
(xvii) Proponil	7300		7300	7300
(xviii) Nitrogen	780		780	780

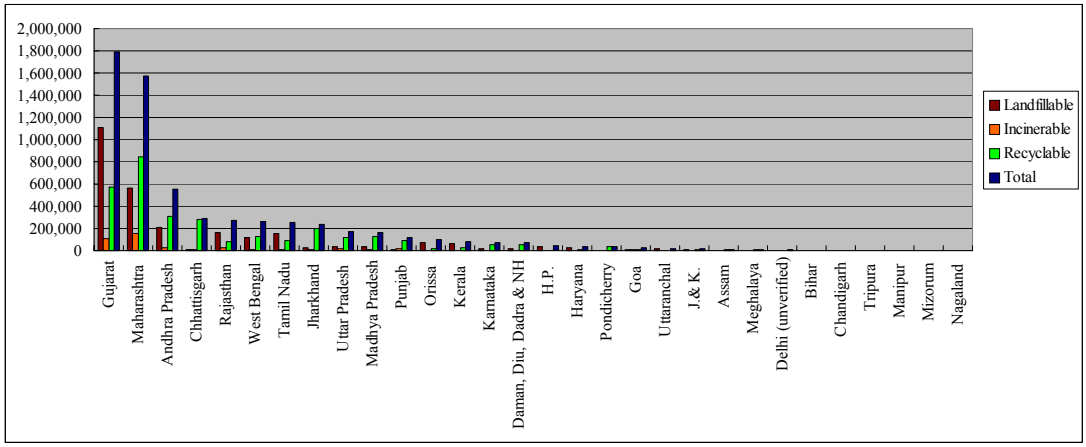
Source: Environment Protection Rules, 1986

7.1.3 Situation of the generation and challenges of Industrial Hazardous waste

From this section, a relative comparison of the amounts of the industrial hazardous wastes generated in Indian and in the state of Gujarat shall be observed. Also the comparison between India and Japan shall be given. According to the statistics of Central Pollution Control Board (National Inventory of Hazardous Wastes Generating Industries & Hazardous Waste Management in India, Feb. 2009), industrial hazardous waste generated in all over India in 2007 was about 6.23 million tons. When it was compared with that in Japan, Japan generated 400 million tons according to the statistical data from the Ministry of the Environment of Japanese in December, 2008. Hence it indicates that India generated 1/67 of industrial hazardous wastes in comparison with the gross generation of Japan. In addition, when we focus on the location of the major waste generation states in India, it can be seen that Gujarat is the largest generator of industrial waste, and it accounts for about 28% of the gross generation of industrial waste in India.

Moreover, the difference can be detected between the methods of waste management in India and Japan in that while the processing of landfilling is 44% of the gross industrial hazardous waste in India, Japan practice landfilling method with only 6% of the gross total. Moreover, when it comes to the context of Gujarat, the ratio goes up to 61% with landfilling. By looking at just one example of difference on waste management method, there seems to be much room for improvement and cooperation between Indian and Japan for realizing more environmentally friendly social and industrial development.

Figure. 7-1 Industrial waste generation situation in India



Source: Central Pollution Control Board

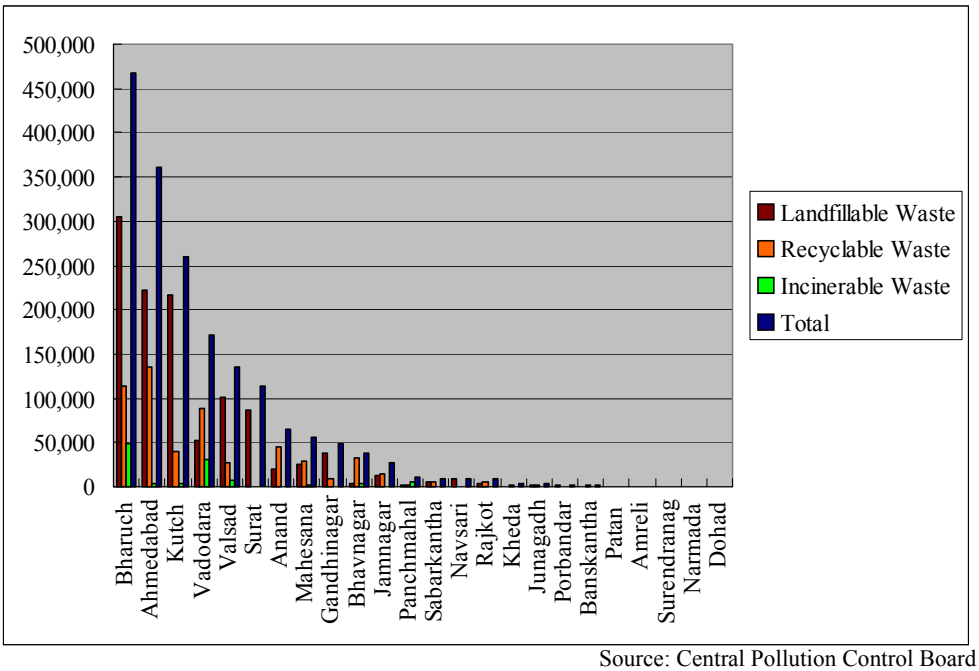
Table. 7-6 Hazardous waste generation in India

S. No.	Name Of State/UTs	Quantity of Hazardous waste generation (MTA)			
		Landfillable	Incinerable	Recyclable	Total
1	Gujarat	1,107,128	108,622	577,037	1,792,787
2	Maharashtra	568,135	152,791	847,442	1,568,368
3	Andhra Pradesh	211,442	31,660	313,217	556,319
4	Chhattisgarh	5,277	6,897	283,213	295,387
5	Rajasthan	165,107	23,025	84,739	272,871
6	West Bengal	120,598	12,583	126,597	259,777
7	Tamil Nadu	157,909	11,145	89,593	258,647
8	Jharkhand	23,135	9,813	204,236	237,184
9	Uttar Pradesh	36,370	15,697	117,227	169,294
10	Madhya Pradesh	34,945	5,036	127,909	167,890
11	Punjab	13,601	14,831	89,481	117,913
12	Orissa	74,351	4,052	18,427	96,830
13	Kerala	59,591	223	23,085	82,899
14	Karnataka	18,366	3,713	54,490	76,569
15	Daman, Diu, Dadra & NH	17,219	421	56,350	73,990
16	H.P.	35,519	2,248	4,380	42,147
17	Haryana	30,452	1,429	4,919	36,800
18	Pondicherry	132	25	36,235	36,392
19	Goa	10,763	8,271	7,614	26,648
20	Uttaranchal	17,991	580	11	18,582
21	J.& K.	9,946	141	6,867	16,954
22	Assam	3,252	0	7,480	10,732
23	Meghalaya	19	697	6,443	7,159
24	Delhi (unverified)	3,338	1,740	203	5,281
25	Bihar	3,357	9	73	3,439
26	Chandigarh	232	0	723	955
27	Tripura	0	30	237	267
28	Manipur	0	115	137	252
29	Mizorum	90	0	12	102
30	Nagaland	61	0	11	72
	Total	2,728,326	415,794	3,088,387	6,232,507

Source: Central Pollution Control Board

In Gujarat state, it is as describing in a previous chapter that it positions as a home ground of various industries and industrial clusters of the petrochemical, engineering, the textile, pharmaceutical, energy, and the mineral processing industries are advanced. As for the situation of industrial waste generation, in the district-wise, as a general tendency of “waste generating hot spot”, distribution is widely acknowledged throughout the state, yet major generators of waste have been remarkably concentrated in the radius of influence are of DMIC. The amount of the industrial waste in the entire Gujarat state was about 1.74 million tons in 2007. The generation of the industrial hazardous waste in Bharuch district was the highest, which is followed by Ahmedabad district. The third place was Kutch district in west where engineering and heavy industrial bases of Kandla and Mundra locate. The above-mentioned districts are characterized highly industrialized district where the level of waste generation parallelly gets higher, compared with the rest of the districts.

Figure. 7-2 Hazardous waste generation in Gujarat State



Source: Central Pollution Control Board

Table. 7-7 Hazardous waste generation in Gujarat State

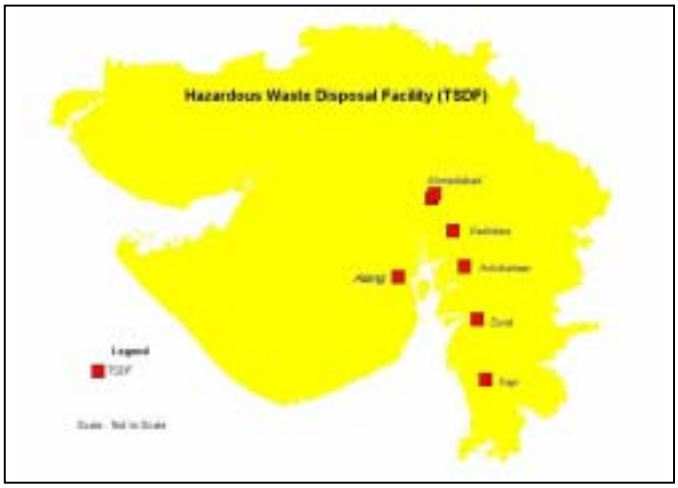
District	Landfillable Waste	Recyclable Waste	Incinerable Waste	Total
Bharuch	304,345	114,485	48,270	467,100
Ahmedabad	221,832	134,960	3,692	360,484
Kutch	217,149	40,154	2,903	260,206
Vadodara	51,564	88,901	30,769	171,234
Valsad	101,497	27,262	6,858	135,617
Surat	87,456	23141 2	701	113,298
Anand	19,443	44,716	116	64,275
Mahesana	25,678	29,074	1,975	56,727
Gandhinagar	38,075	9,723	843	48,641
Bhavnagar	3,496	31,917	2,738	38,151
Jamnagar	12,956	13,717	199	26,872
Panchmahal	2,504	2,004	5,638	10,146
Sabarkantha	4,570	4,968	123	9,661
Navsari	8,434	632	265	9,331
Rajkot	3,003	5,052	183	8,238
Kheda	512	2,570	829	3,911
Junagadh	1,949	1,492	0	3,441
Porbandar	1,643	52	0	1,695
Banaskantha	222	1,369	8	1,599
Patan	56	662	52	770
Amreli	149	135	460	744
Surendranagar	581	31	0	612
Narmada	13	20	0	33
Dohad	1	0	0	1
Total	1,107,128	577,037	108,622	1,792,787

Source: Central Pollution Control Board

7.1.4 Situation of the Hazardous waste treatment facilities

When the processing/management situation of hazardous waste is observed in the context of Gujarat, landfilling and some incineration facilities are available at the facility of Treatment Storage and Disposal Facility (TSDF). As displayed in the following figure, seven TSDFs are available in Gujarat state in the shape along with DMIC. Currently all TSDF in Gujarat provides the landfill facilities function, and 4 facilities provide the incineration facilities function. However, only about 40% of the gross weight waste to be treated in the landfill is managed with the installed capacity of these 7 TSDFs. As a total TSDFs possess 450,000 tones of receiving capacity per annum while 1.11 million tons of processing demand for landfill treatment per annum is present in Gujarat. On the other hand, TSDFs and captive waste treatment facilities which possess the incineration processing function have processing capacity of 160,000 tons per annum as a total, in the meanwhile 110,000 tons of incinarable waste is generated per annum in Gujarat, hence the processing capacity has a surplus compared with the amount of the incinarable waste generated. However, confined to the capacity of TSDFs alone, only about 30% of the gross amount is managed, consequently the processing capacity and performance with capacity development of TSDF becomes a future problem if the current trend of waste generation continue.

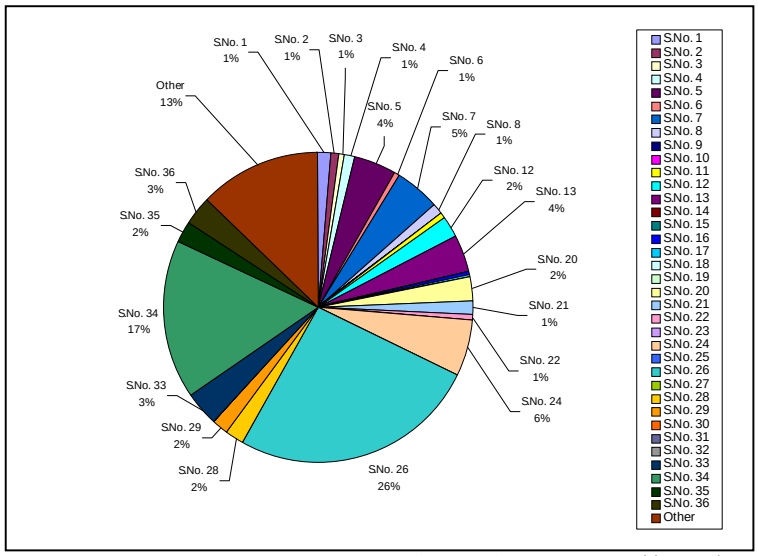
Figure. 7-3 Location of TSDF in Gujarat



Source: Central Pollution Control Board

The characteristics of industrial hazardous waste generated in Gujarat is largely remarked that waste items generated in the process of the production and industrial use of synthetic dyes, dye-intermediates and pigments (Schedule No. 26: see appendix) accounts for 26% of the entire volume of the waste. The second largest waste item is generated in the industrial process of purification and treatment of exhaust air, water & waste water at common industrial effluent treatment plants (CETP's), which take up 17% of total generated volume as shown below.

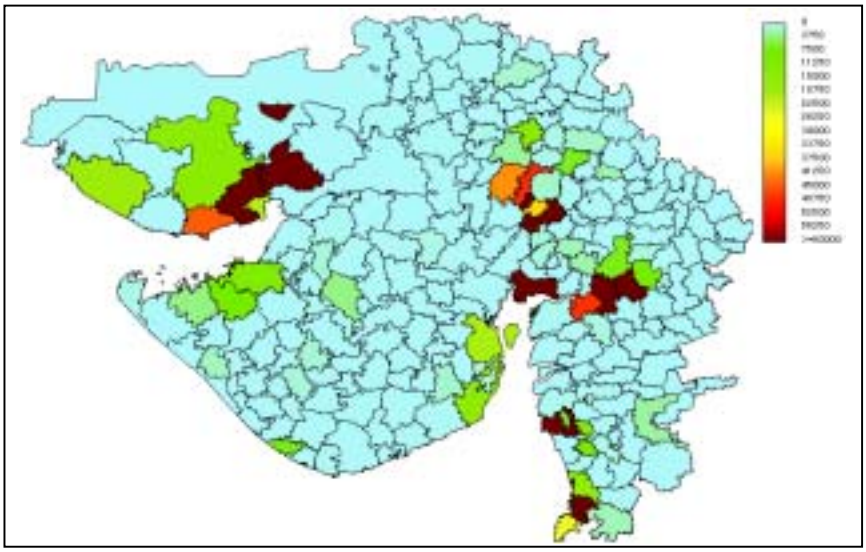
Figure. 7-4 Share of industrial hazardous wastes in Gujarat



Source: GEPIL, prepared by study team

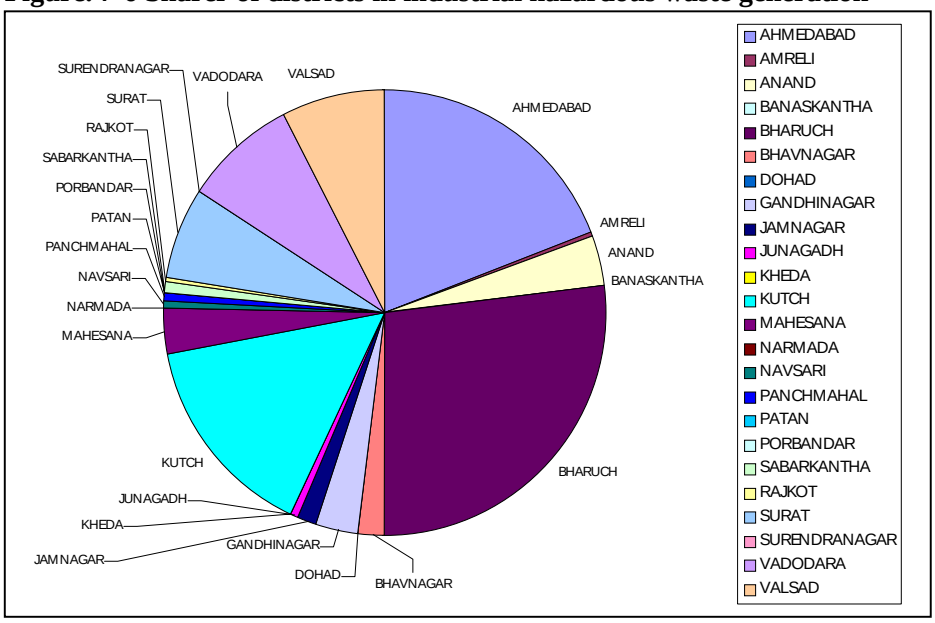
If we see the geographic distribution of industrial hazardous waste, the major hot spots of the waste generation can be found around Bharuch district and Ahmedabad district, and two districts have come to account for 46% of the total amount of industrial hazardous waste in Gujarat. The industrial hazardous waste generated in Bharuch was 466,811 tons, out of which 28% is a waste schedule category of No.34 (waste items generated in the process of purification and treatment of exhaust air, water & waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's)), and 17% is the waste items of No.17 that is generated in the process of production of mineral acids. Ahmadabad district comes next, and the district generates industry hazardous waste of 336,531 tons per annum, and the main waste was No.26 which accounts for 55% of the entire waste volume of the district.

Figure. 7-5 Geographical distribution of industrial hazardous waste in Gujarat



Source: GEPIL, prepared by study team

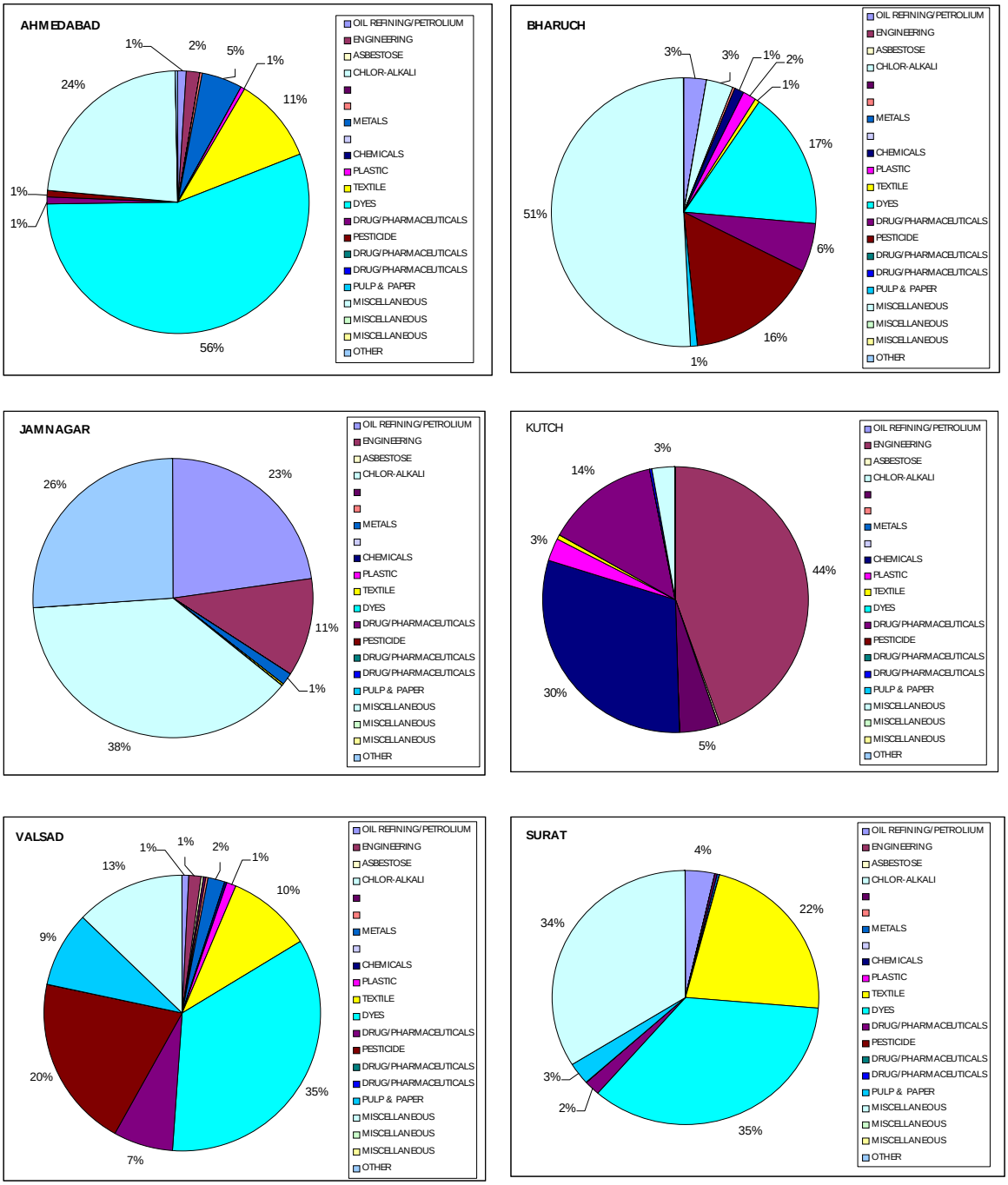
Figure. 7-6 Sharer of districts in industrial hazardous waste generation



Source: GEPIL, prepared by study team

In relation to the industrial sector-wise analysis, waste generation volume of the major waste generating districts is illustrated as follows; Ahmedabad holds a unique hazardous waste generation in which dyes industrial sector outstand the generating volume. The district of Bharuch has a wide variety of waste generation comprising of about 51% of miscellaneous sector. Consequently it can be said that the nature of industrial sector is an important element to provide distinctive characters of its waste generation environment. On the basis of waste generation environment, as we can see below, the characters of the districts varies considerably each other.

Figure. 7-7 Sector-wise waste generation volume in Major Waste Generating Districts

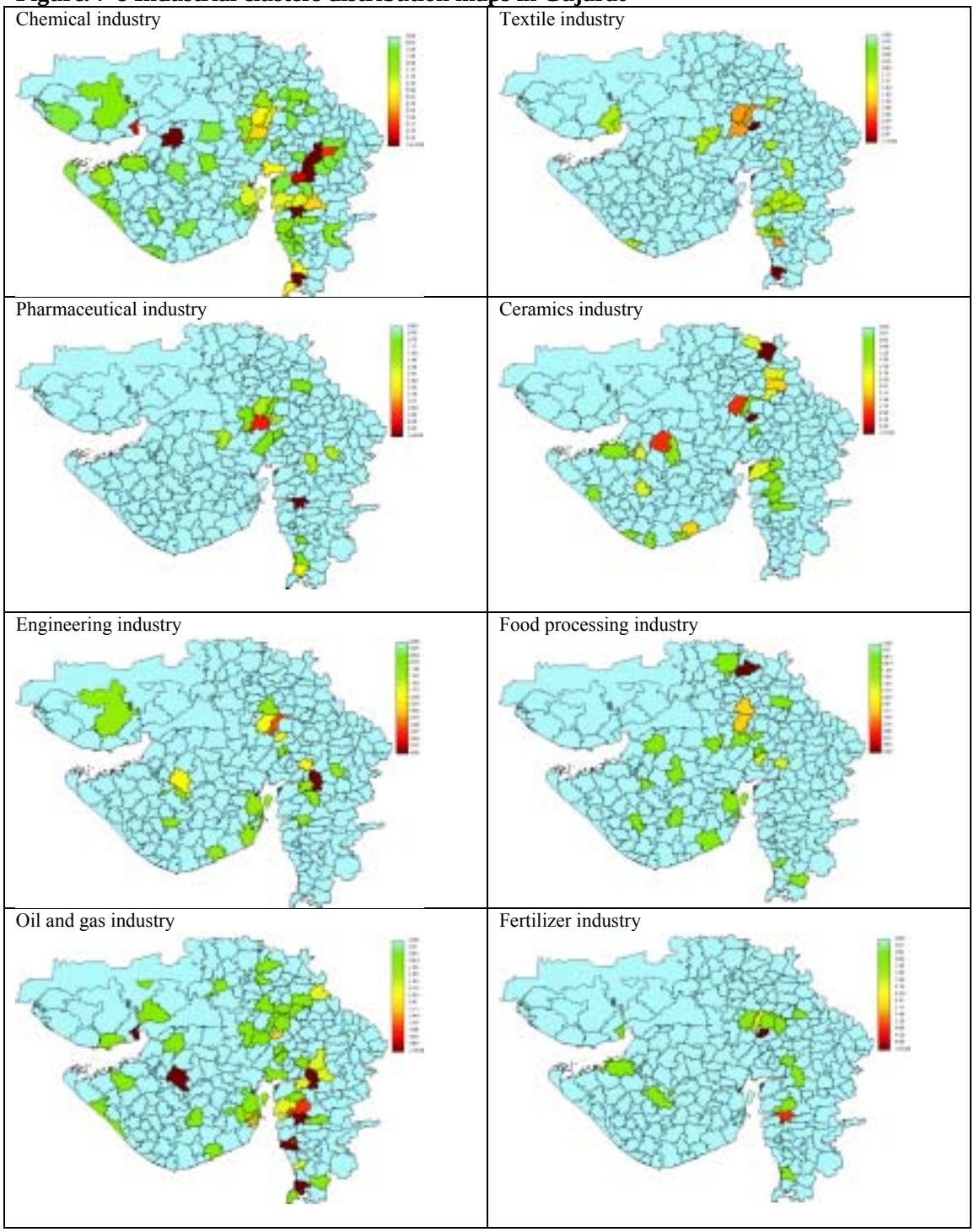


Source: GEPIL, prepared by study team

When we compared the hot spot of industrial waste generation with the situation of industrial clusters distribution in Gujarat, it can be identifiable that, although the wide range of different industrial activities reflect on the generation map of hazardous wastes features, the nature of industrial activity will govern the characterization of the various waste generation features of regions in the state. A comparative illustration of the major features of the industrial cluster distribution is given in the following tables to see the alignment of industrial concentration, which

could help understanding of the classification and characterization of the waste generation situation in Gujarat. Consequently chemical and textile industries seem to cast the most influential force on the generation map of the hazardous waste in Gujarat.

Figure. 7-8 Industrial clusters distribution maps in Gujarat



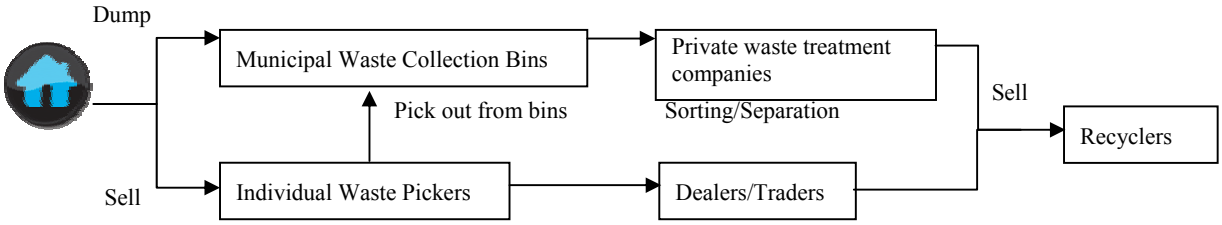
Source: Industries in Gujarat Statistical Information, prepared by study team

7.2 Industrial Non-Hazardous Wastes

7.2.1 Collection system

There are mainly two sectors in non-hazardous waste collection system in the Gujarat state. The first is the Municipal collectors (formal), who collect any waste generated from households. The second is the informal sector, which usually collect recyclable goods that can be turned into income source. Currently, the state does not impose rules of separation on wastes to each household. Separation will be happen after all wastes are collected at the municipal waste collection centers by out-sourcing to private companies. The total of Surat municipal's collection volume of such wastes is about 1,000tons/day.

However, although separation of wastes (non-recyclable and recyclable) is not specified under rules, 90-95% of households separate because they know recyclable goods can be sold to pickers, who engage in informal recyclable waste collection. Money received through selling recyclable wastes creates "unsaid" rule of waste separation and recycle, and incentive for people to follow it.



In addition, the notion of "recycle" with monetary transaction may be a new idea for people, the concept of "reusing" goods until running out of a way to use is shared by the people in India since a long time ago. For example, when a painting ink is used, the container will be first washed and used as a basket to carry water or goods. After it gets dirty, it may be used as a toy for children. When finally the paint container was broken, it will be treated as "waste". The long-hold idea of "maximizing the use of a good" is now shared in the recycle industry of India. Recyclable waste collectors sell every last piece of wastes to various buyers by sorting and separating.

7.2.2 Informal Waste Collectors

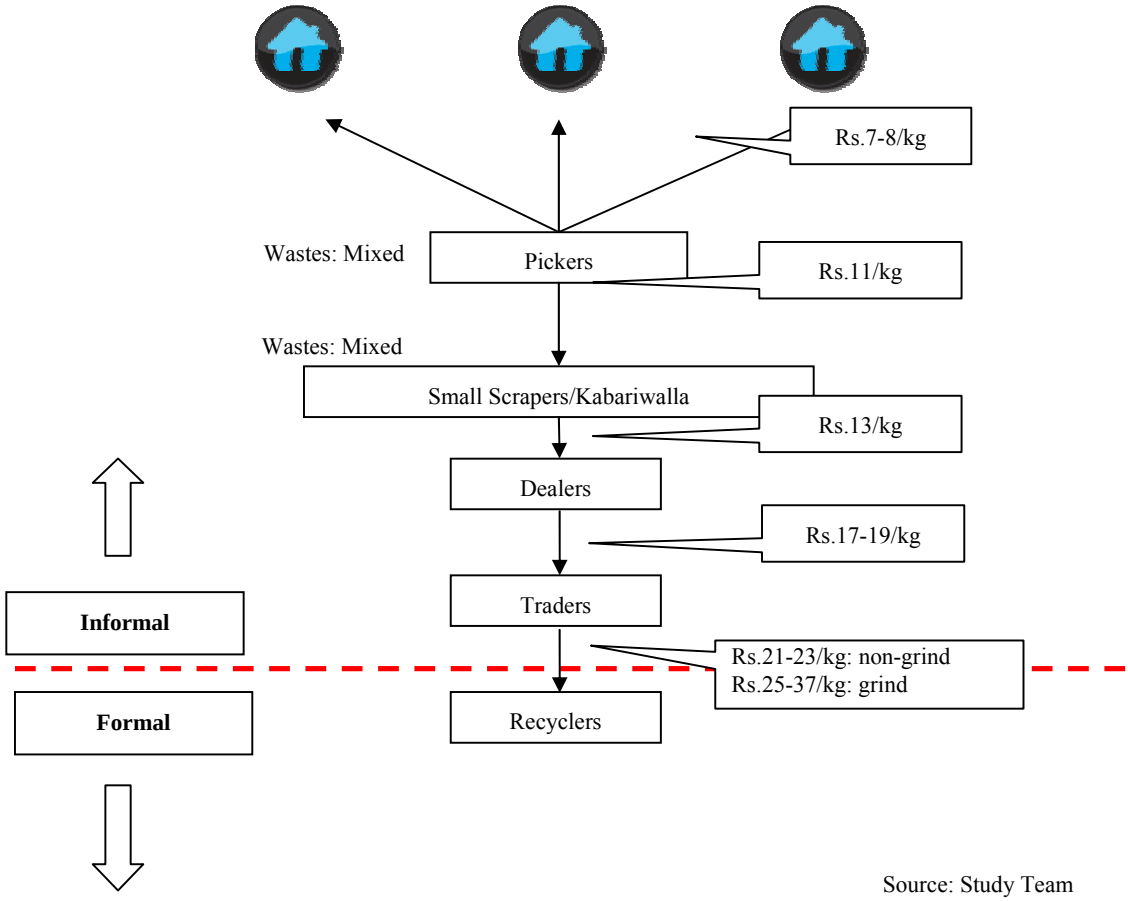
Informal waste collectors have an organized chain of collecting and selling recyclable wastes. At each level of the collection chain, a value is added, and profit is generated.

Though the collection system is organized, this sector is considered as "informal" since they are not regulated by any rules, nor have a duty to pay tax. However, municipal waste organization is well aware of their presences. Therefore, it can be stated that the informal sector is "recognized" and "organized", but not "legalized".

Most of the collectors just occupy a land, and put a hut to store wastes collected, or just pile up on ground. They are usually not equipped with any treatment facilities, nor applied rules on how wastes should be managed. Some collectors may have received a certificate from the municipal government, however, certificate is issued on "operating a business" without specifying what business the entity is engaged in. Therefore, waste treatment rules that are enforced by the State Pollution Control Board do not apply to "informal" sector.

Although names of each level may be different, the structure of the collection system is more or less the same for other wastes too.

Figure. 7-9 Collection Chain for Plastic Waste



Source: Study Team

If a collector can recognize the waste type and sort wastes, the value will be higher. In addition, if the waste is pure (which means made from virgin material, and not mixed with chemicals during the recycle process) has a higher value. The pureness of waste is usually measured through the softness or flexibility of a waste (more flexible, the more pure). These skills and knowledge are acquired through experiences.

In the informal sector of recyclable wastes collection, the key players are "dealers" and "traders". Their differences are as follow:

Dealers:

1) They are collectors who collect wastes more than 15 tons/year.
2) They may sort wastes, or be equipped with facilities that can grind wastes into pieces.
3) When dealers are able to sort and grind wastes, they may directly sold wastes to granulators or recyclers for higher prices. In this sense, dealer may collect only a small quantity, but assume a role of a "trader".

4) Usually, dealer is not aware of the whole picture of the recycling system. For example, a textile waste dealer collects wastes from individual pickers and sells to large traders. He knows how much the waste should be bought and sold, and knows which quality is acceptable. However, he does not know what the textile waste he sold will be turned into after recycled.

Traders:

1) They are collectors who collect wastes more than 200 tons/year.
2) They do sorting of wastes, and are mostly equipped with facilities that can grind wastes.
3) Their end product will be sold to recyclers, who will turn recyclable wastes into the next product.
4) Some waste collectors who fall into the category of "dealer" by their equipments and collection volume, may claim they are "traders" since they are directly selling to recyclers.
5) Trader is aware of the whole picture of the recycling system, and thinks in a business manner. For example, although traders are generating profit, they see more opportunities of increasing efficiency and quality by collaborating with larger industries and the government.

Dealers

Dealer's collection site in Sachin, Surat.
Several dealers are sharing one land as a collection point. Buyers come here to buy.

Incardinated textile wastes that are going to be fuel.

Plastic Wastes.
Each pile of waste belongs to different dealer, even though there are several dealers who collect same wastes.

Rubber wastes.
They are mostly shoe soles. At this point, shoe soles are taken off from shoes, which mean a preliminary sorting is occurring.

Mixed wastes. Sorting will be occur 1) plastic bags, 2) textile wastes that will be turned into fuel, and 3) clean textile wastes that can be turned into ropes.

Clean textile wastes.

Plastic Wastes.

Two women sorting wastes.

Clean textile wastes piled up. They will be sold to a buyer in Rajasthan, where textiles are weaved into ropes.

PVC cord in first stage recycling. (Rs. 28/kg)
1st stage PVC means it never recycled before. They are usually bendable, and more flexible.

PVC cord in 2nd stage. (Rs. 25/kg)
2nd stage means it was recycled once. During the recycling process, calcium is added (40%) and makes the material harder, and less flexible.
Although PVC can be recycled upto 4 times, the dealer interviewed will not buy PVC recycled more than twice because the value of PVC will become lower, the more recycled it is.

PVC cord without color and in 1st stage (Rs. 32/kg). This kind has the most value, since it is flexible, and can be colored.

PVC taken from raincoat material (Rs. 20/kg)

Aluminum taken by AC. They are separated from steel pipes, and flattened, and broken into pieces before sold to recyclers.

Aluminum is flattened manually.

Aluminum broken into pieces. There will be 10% reduction in weight after processing and cleaning.

PVC pellet from PVC that was recycled twice. These are not easily moldable. The dealer is now searching for a way to use these, and a place to sell.

Each truck carries 8-9tons, and the dealer transports PVC loaded trucks 8-9 trucks/month.

Mixed Plastic Bags (Dealer)
The dealer does not know what plastic bags will become after recycle. They just gather in a form buyers buy.

4-5tons/truck is transported, and sold at Rs.4/kg.

E-Waste (Dealer): E-waste has relatively a small quantity compared to other recyclable wastes. This is mainly because, people previously had no idea e-waste will be recyclable. Knowing the value of e-waste, recently the amount trade has been growing. Motor pieces in the picture are sold at Rs.30-40/piece.

E-waste is first collected at dealer's storage→broke into pieces→sort→send to Delhi.
The dealer is not fully aware what e-wastes will become after Delhi, he assumes that they are either sold to domestic or oversea industries.

During the process of sorting e-wastes, plastic and metal are first separated. Plastic are scrapped and recycled. Metal are sold to traders, who will be processing before it reaches to recyclers.

The dealer interviewed collects e-waste about 10tons/month, and make a profit of about USD150,000/month.
They work based on clients' needs.

Textile waste dealer.
They collect from larger factories in a large volume, or individual pickers in smaller quantity.
The quantity of collection is larger. White color textile waste (cotton>polyester) has the highest price.
The price range are;
1) Clean: Rs 5-12/kg (price depends on the kind, and the softness)
2) Dirty: 1.5-2/kg

Cotton has the highest price, but it is rare to have a large quantity of cotton wastes in India.

Colored textile waste.
They separate in terms of dirtiness, color, and the kind of the textile waste (cotton <viscos>, polyester, and brassso <blending of polyester and viscos>).

Dealers are not fully aware what the textile wastes will be turned into. They just collect and sell.

Traders

A different textile waste trader.

A process of sorting textile wastes.

Plastic waste trader (only PET)
They buy from dealers, and sorted/grind.
Because their reputation is very high, dealers come to contact them from all over the country. They only deal with a quantity of more than 10 tons for buying/selling.

Non-colored plastic waste
This color is sold as the most expensive. The size of particles is custom-made for each recycler. They first receive an order from recycler on what color, quality, and quantity they would like to have with a deadline of collection. Based on the order, they start collect from their stock or collect more from dealers.

Slightly colored white/cored PET has lower price.

Plastic is sorted by color, and quality. Colored pet has lower price than the white pet.

Other colors include brown and green

Storage of PET recyclers.

Used tires and tubes trader.
Tires are bought at Rs. 2/kg, and sell at Rs3.5/kg.

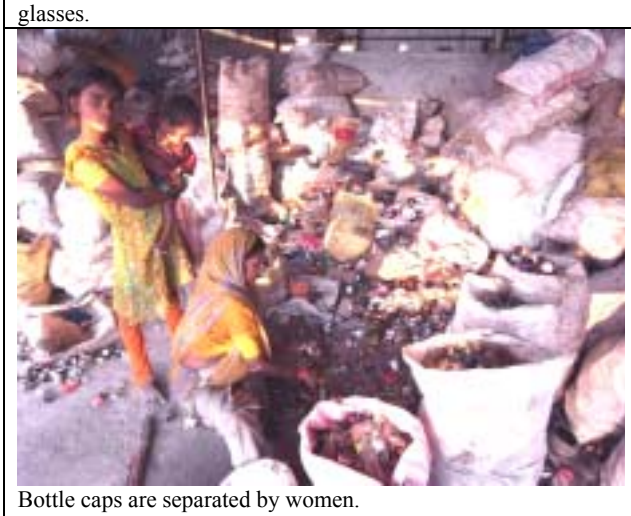
Tubes that are made 100% by raw natural rubber are exported to Pakistan, Sri Lanka, and Korea to be used for road construction. Tubes went through a recycling process usually is hard, and have less quality.
Tubes are bought in 50-70tons/month quantity.

Tires are cut to be able to store more tires in one limited space. Although separated, all parts of a tire will be turned into fuel.

Dealers arrived with a truck loaded with tires.
The trader normally purchase at Rs.27-8/kg.

Pet Bottle Trader
They collect unwashed pet bottles, take off caps and labels, grained into pieces, and sell to recyclers unwashed. The dealer

Women usually take off caps and labels, and men grin into pieces. One woman can sort 75kg/day. The dealer collects about 15tons/month, and sells 10tons/month.

sells grinded pet bottles at Rs.23/kg. Buying price is not told. The selling price will increase about Rs.5/kg if washed. Major buyers are Katodra, Somani Traders, Kishen Goil, and Reliance group.	
 Glass Trader. Glasses are sold to a recycling company, where they will be melted and turned into no color transparent glasses. The collector buys and sells 2 trucks/day, each truck loaded with 10tons of glasses.	 Glasses with wires (ex. windows) are crushed into pieces to separate from wires. Glasses with films are burned to make the film melt. Recycled glasses can be turned into a container for foods because it is treated in high temperature.
 Bottle caps are separated by women. They purchase at Rs.2/kg, and sell at Rs.3/kg. The margin is lower compared to other recyclable wastes because quantity is higher for each piece.	 Families engaged in the glass recycle business lives in the same plot of the yard glasses are collected. Small children plays with bare foot on the ground glass pieces are scattered, or plays with glass pieces.

Printed circuit boards from e-waste are segregated manually for further recycling mainly non-ferrous metal recovery in other location including abroad.

Metal parts are manually segregated. Workers are not wearing gloves or any protection items.

Waste tube lights are collected and crushed with no pollution control measures.

Silver recovery from accessory and lady's clothing is conducted. Pollution control measure is not sufficient.

7.2.3 E-wastes

Metal, plastic, glass parts, cable as well as printed circuit boards from e-waste are segregated manually for further recycling mainly for non-ferrous metal recovery in other location including abroad. Workers are not wearing gloves or any protection items. Hydro metallurgical process for recovering metal such as gold and silver is not yet widely common practice in India. Although the ESM guidelines for the recovery of such metal issued by the Ministry of Environment and Forests already exists, some improvement is needed in order to be effectively implemented reflecting the situation in Gujarat fully.

7.2.4 Tube lights / bulbs

Waste tube lights are collected and simply crushed with no pollution control measures to prevent mercury discharge. In initial stage disposing tube light in environmentally sound manner is expected.

7.2.5 Textile/clothes waste

Gujarat is major hub of textile industry in India which again is one of the highest contributors of the textile waste generation. There are two types of recyclable textile wastes. One is textile/clothes made of organic cotton and the other is polyester. The generated volume in Gujarat is estimated 45,000 t per annum for cotton, and 20,000 t per annum for polyester. The piled up textile waste can be observed in the road sides in that efficient collection and value chain system are not applied. Thus appropriate guideline to utilize textile waste into more valuable ways needs to be placed.

7.2.6 Construction material waste

Central Pollution Control Board has estimated current quantum of solid waste generation in India to be 48 million tons per annum of which waste from construction industry accounts for 25%(10 – 12 million tones). Management of such high quantity of waste puts enormous pressure on solid waste management system in India. While retrievable items such as bricks, wood, metal, tiles are recycled, the concrete and masonry waste, accounting for more than 50% of the waste in weight-wise from construction and demolition activities, are not being currently recycled in India. Recycling of concrete and masonry should be considered with utilizing mobile crusher at the construction site for recycling/reusing waste material for other usages.

7.2.7 Tinplate

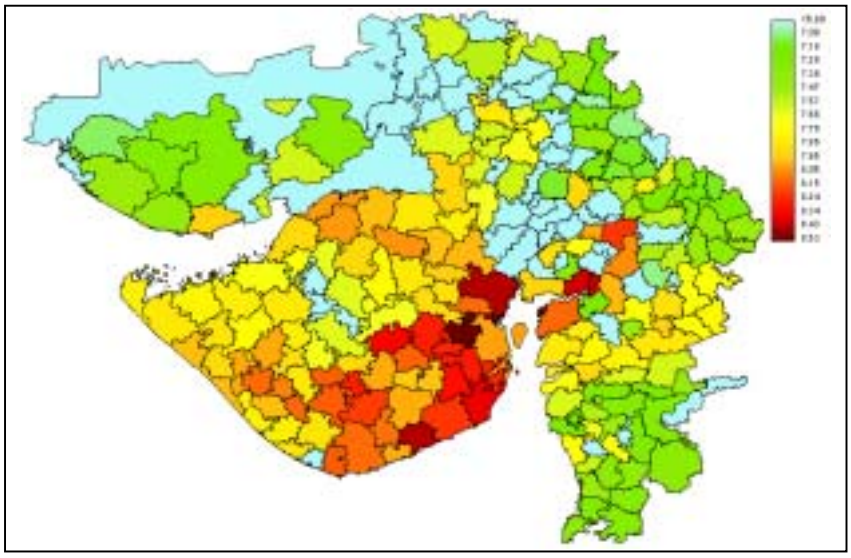
Tinplate packaging is picking up in India. The market size of tinplate packaging is estimated to be around 300,000 tons. In India, tinplate is mainly used for packaging in three categories: edible oil, processed food and non-food package. As compared with global consumption patter of tinplate, India is still low level in per capita consumption of tinplate. Yet consumption volume of tinplate is estimated to have grown two times more compared with 10 years back. Although recycling tinplate is relatively widespread,innovative collection system together with tinplate manufacturing technology could improve the recycle rate dramatically.

7.3 General condition of water and air pollution in Gujarat

7.3.1 Water pollution

Below figure shows groundwater condition (ph) in Gujarat state collected from GIS Data. In the large area around Bhavnagar and Amreli districts, and some part of Vadodara and Panchmahals indicate high pH level of ground water.

Figure. 7-10 Groundwater condition of Gujarat (pH)



Source: Ground Water Year Book 2007-2008, Central Ground Water Board, prepared by study team

7.3.2 Air pollution

The following thematic maps illustrate SPM, NOx and SOx level in Gujarat.high level of SPM is depicted in Banaskantha and Patan districts. As for NOx and SOx, Surat district has the highest level of NOx and SOx, whereas it is illustrated that Ahmedabad has a moderately high level of SOx.

Figure. 7-11 Air Condition (SPM µg/m^3)

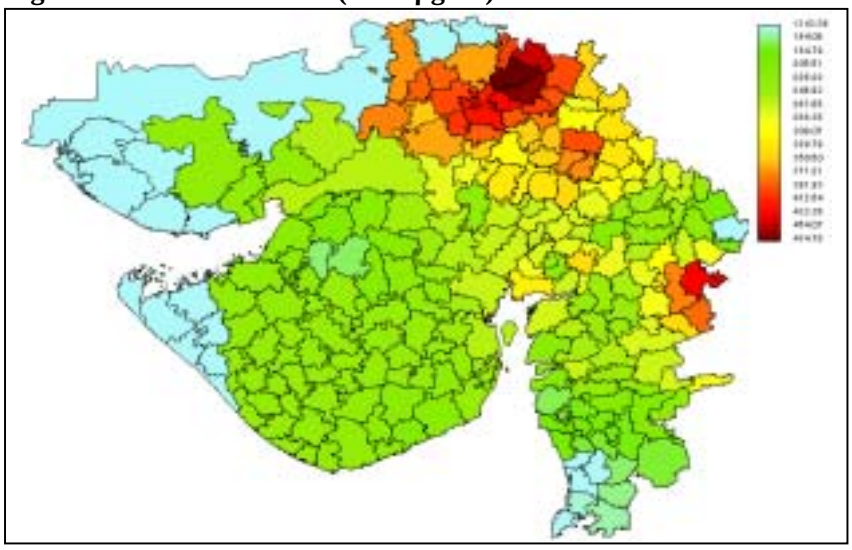
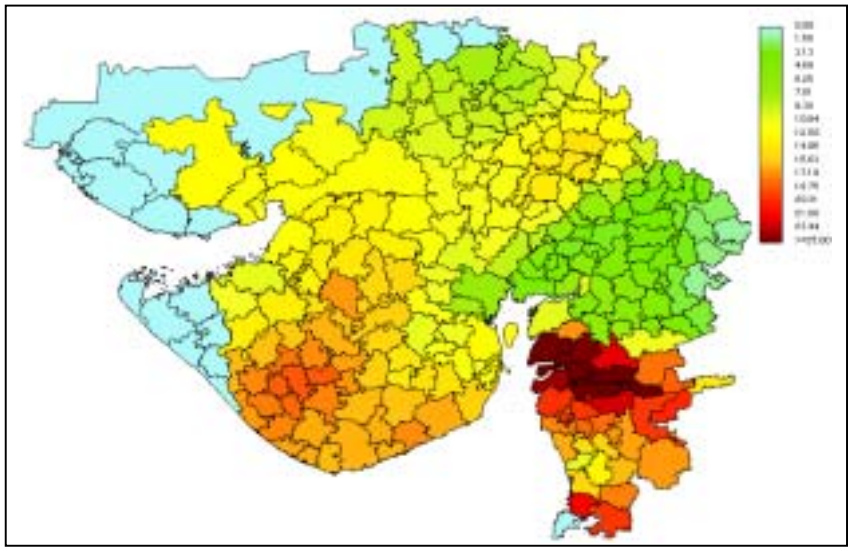
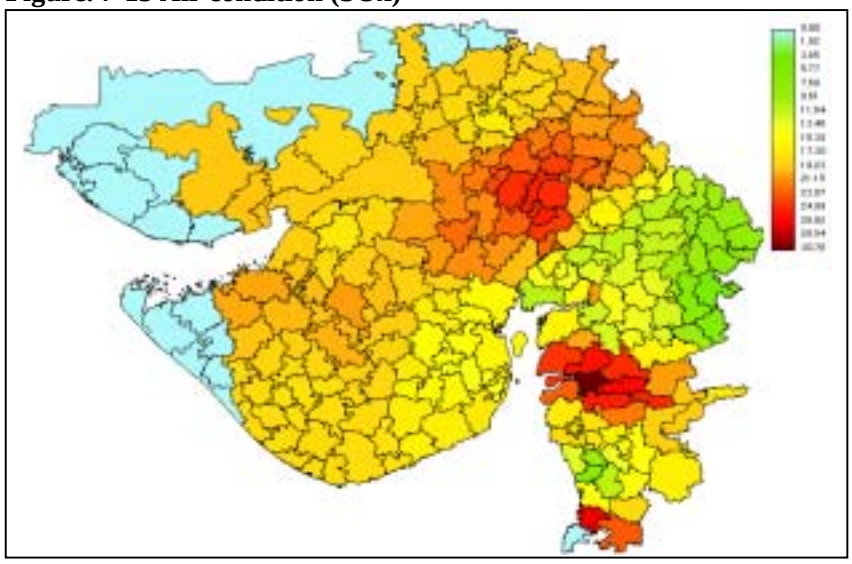


Figure. 7-12 Air condition (NO^2)



Source: GPCB Annual Report 2008-2009, prepared by study team

Figure. 7-13 Air condition (SOx)



Source: GPCB Annual Report 2008-2009, prepared by study team

As shown above, there are some areas air and water pollutions are heavier than other area. Although it is not the case of possible pollution caused by hazardous waste generation, they are interrelated and improvement in the industrial pollution in terms of water and air can also be expected.

7.4 Proposal for more advanced waste recycling & management system

7.4.1 Objective

As mentioned in the early part of this study, the primal objective, in this study project, to attempt

a systematic correspondence for the improvement of the industrial waste recycle/management practice in Gujarat state, is to pursue a formation of the public and private collaboration for project preparation, and create a governmental cooperative relationship between India and Japan for promoting 3R concept together with its guideline for implementation. The initiative would ultimately lead to both countries' stronger relationship on developing environment business industries. In specific, requirements for preferable technologies and applicable knowhow shall be identified in relation to needs of the present local state of the industrial waste management situation, and ideal policy/regal framework settings shall be proposed.

Beside the upgrade of waste management manner into more resource conscious and technology-oriented manner, monitoring of Air/Water/Land Pollution levels through sensors in vulnerable areas would be further to be facilitated together with an initiative from GPCB. This would help to generate data on pollution prevention and better environmental compliance which would make us understand more comprehensive environmental conditions and formulate necessary counter measures. Moreover, it would raise the objectivity of the people engaged in pollution control business and encourage them to behave in a more disciplined and responsible manner, keeping ethical values of environment in their pursuit. This will enhance the image of the state of choice for more business and also as promising investment destination.

7.4.2 Proposed TORs

The following are proposed Terms of Reference to be considered for implementing environmentally sound management of hazardous waste in Gujarat. Required expertise is also suggested in the following section.

1. Concept making on suitable hazardous waste management scheme in Gujarat/India
2. Identify potential obstacles for hazardous waste management scheme as well as the requiring policy measures for its development
3. Study what possible legal and policy needs as well as human resource development demand that are necessary and appropriate from the assistance of Japanese experienced counterpart
4. Develop a draft guidelines/action plan for the environmentally sound management of hazardous waste among social and industrial sectors

Required expertise is full knowledge of current situation of hazardous waste management and difficulties as well as requiring legal and policy measure options to implement. Knowledge and experience is expected for mobilizing society and industry for more environmentally sound practices.

With regard to the required MM it will be identified after the specific activities become clear after the consultation discussion both India and Japanese sides.

7.4.3 Pilot model locations

As for the pilot project location for hazardous waste management development, one of the leading waste management companies, GEPIL, has proposed to develop a site for waste management project at Dahej where they have 300 ha of land (the area is proposed to expand to 700 ha) for this purpose, and collection centre to be located around the state is also proposed. In terms of the pilot model project for demonstrating smart usage of wastes and recycling, several projects are already undertaken in Gujarat. At Palsana in Surat, the waste heat recovery by incinerating hazardous waste to steam project is underway now. Similar hazardous waste incinerator project in Panoli is proposed. Also pretreatment facility for hazardous waste to provide alternate fuel to the cement industry has been proposed by a waste management company.

In such manner, Gujarat possesses prevailing conditions where willing private sector has already mobilize their business plan, yet these are confined to relatively small scale. Consequently public sectors' intervention for paving ground for private sector's more advanced initiative to promote environment business in the most potential location in Gujarat.

7.4.4 Capacity

The further survey is required to address the areas of intervention required in terms of skill enhancement for a specific sector, provision of credit access and any other facilitation which may be critical to the informal sector workers.

7.5 Role of informal sector

7.5.1 Informal sector

For informal sector waste collectors to be successfully integrated in hazardous waste management project their characteristic and business model need to be understood. For example they are intending to specialize in a particular kind of non-hazardous waste which has no close competitors engaged in collection and treatment. "Plastic" has a total of 16,000 different kinds, and there is no way that a collector (in every level) to know the treatment and uses of 16,000 kinds. In addition, unless one specializes in a particular waste, collectors in a lower level have no idea which waste to bring to, and ended up collecting only a small quantity. Therefore, a collector needs to have a specialization, and build reputation in the particular waste collection. Then both buyers and sellers gather at a collector's place. These networks are important asset of informal collectors.

If the new collection system to be brought, it is essential for project developer to build an integrated waste management system, thus from the point of integrating informal sector, it needs to carefully understand what type of waste is collected by whom, and sold to which recycler. By understanding a stream of waste, the way to incorporate with informal sector in an efficient manner may be formulated.

7.5.2 Pros and cons to integrate informal sector into recycling project

The pros and cons recognized at the recycling business are different among the levels of players. Those in the lower level of the chain than dealers are generally satisfied with the current state. They have constant flows of waste coming in and selling out with adequate profit margin. Some dealers own more than average people engage in formal business sector. They expressed that when they first entered into the business, there were difficulties, such as low knowledge on how to treat wastes, and almost no network of buyers and sellers. However, as they build experiences in the industry, they became aware of the minimum treatment they need to apply to wastes, and received contacts with constant clients.

Traders generally have more complicated concerns by seeing the bigger picture of the recycling business. They have concerns in efficiency of the business and ethics applied to workers/working environment. A plastic bottle trader interviewed says he hope to have more governmental support in managing the collectors in the lower stream, and collaborating with industries that generate wastes to increase efficiency, decrease cheating, and improve the way of waste treatment in lower level of the waste collection stream.

Although the informal sector is recognized by the government, there is limited support from it because the recycle industry is treated as a third grade industrial sector. To engage in waste collection is treated for a business engaged by people with lower education and skills. With a

formal waste treatment company getting involved in the collection chain, the trader expects to receive more recognition on the importance of their business by the government.

Traders are also aware of the loss of efficiency because of the lack of help, and standards from the government. Because there is no standard, traders cannot check the quality of wastes until they actually see. Some dealers deceive the quality, however, there is a rule that wastes once traded cannot be returned. In addition, because there is no standard on waste treatment in the informal sector, the trader is aware that some people need to work in a risky environment where they can injure or inhale toxic, without realizing it. In fact, through the field observation, a few risks were identified. For example, the glass waste trader observed and interviewed was not aware of the danger little children are facing by living and playing on the field where glass pieces are scattered.

To increase the efficiency and educate the people in lower level of the waste collection stream, the trader welcome the idea of collaborating with a formal sector, either with a company generating waste, or a company treating waste. In this way, they assume that private recyclers can formally teach on the environmentally sound waste treatment at every level of the waste management chain to increase environmental and social ethics, and decrease the level of faulty dealings between buyers and sellers. If the waste management chain can work in a more integrated way, their recycling business will be known in a wider region (domestic and international), which may result in wider range of clients.

8 Project Implementation Organization Structure

8.1 Steering committee

In March 2010, the additional committee for the preparation of the legal guidelines for promoting waste to Reuse, Recycle & Reuse in the State of Gujarat was formed as per below.

The committee for legal guideline preparation is expecting to be assisted by the technical corporation from Japan.

Table. 8-1 Steering Committee Members as of January 2010

Sr. No	Name of Person	Designation	Role in the Committee
1	Dr. S.K. Nanda, IAS	Principal Secretary, Forests and Environment Department, GoG	Chairman
2	Shri. C. L. Meena, IAS	Ex Chairman GPCB & Principal Secretary, Finance Department, GoG.	Member
3	Shri J. K. Vyas	Director (Environment) & Additional Secretary, Forests and Environment Department, GoG	Member Secretary
4	Shri. R. G. Shah	Member Secretary, GPCB, GoG	Member
5	Shri. Bimal Patel	Gujarat Law University	Member
6	Shri. K. P. Nyatti	Ex Environment Head, CII	Member
7	Shri P. D. Bhatti	CEO, GEPIL	Convener

Source: Study team

In addition, the formation of steering committee for Eco town development and the way forward were discussed with Government of Gujarat and the member list is given below as reference.

Table. 8-2 Steering Committee Members as of January 2010

Sr. No	Name of Person	Designation	Role in the Committee
1	Dr. S.K. Nanda, IAS	Principal Secretary, Forests and Environment Department	Chairman
2	Mr M. Sahu, IAS	Principal Secretary, Industries & Mines Department, GoG.	Member
3	Shri. J.K. Vyas	Director & Addl Secretary, FED, GoG.	Member Secretary
4	Shri R. G. Shah	Member Secretary, GPCB	Member
5	Mr. Girish Luthra	V.P., Pandesara Green Environment Society	Member
6	Mr. Bharat Jain	Nodal Officer	Member
7	Dr. S. Kobayashi or his Representative	Chairman, JDI	Member
8	Shri Arvind Agrawal, IAS	Vice Chairman & Managing Director, G.I.D.C, Gandhinagar	Member
9	Ms. Neel Kumar Darbari	Jt. Secretary, (Chemical & Petrochemicals) Ministry of Chemicals & Petrochemicals, GoI.	Member
10	Mr. M. Sekhar	GEPIL-GRAMZ	Member Secretary

Source: Study team

8.2 Implementation organization

As an implementation organization of the establishment and promotion of the new legal setting for recycling and smart waste management in Gujarat as a pilot model case in India, the focal agency should be the Department of Environment and Forest. In the process of formulating an implementation program, it would be more credible that the implementation organization shall be established in close coordination with the Department of Industries and Mines in the state government. Certainly it should not be forgotten that if the technical and financial assistances intent to be brought from ODA of Japanese government, official request is required to be sent from Ministry of Environment and Forest through protocol of Department of Economic Affairs, Ministry of Finance in central government of India. However a strong initiative needs to be placed in top management of the state of Gujarat so that the challenging but meaningful initiative of proceeding new venture in India to develop recycling system should surely face difficulties. If the strong commitment is granted from the top leaders of the implementing state, the success of project could be more assured.

9 Major issues and recommendations

9.1 Key Problems and Issues

1) Impact on environment and health through informal recycling activities
There is a concern recycling activities by the informal sectors cause some negative impact to environment and health as almost no cost is paid for controlling the potential pollution and safety for the workers. Currently activities that can be observed in the area are very preliminary stage such as manual segregation or dismantling Also there are no activities such as extracting non-ferrous metal like gold and silver by simply heating printed circuit board in the oven or soaking in cyanide solution with very poor pollution control that is common in other part of Asia can be seen yet. Though the impact may not be severe, some measurement is necessary for preventive reason.

2) No legal framework established for collection and recycling for the newly emerged waste such as e-waste and plastics
While some regulating law and rules are established for hazardous wastes from the industrial

sources, there is no regulating legal framework for such wastes as e-waste and plastics is established. Numbers of these wastes are increasing because of the rapid economic growth, urbanization and upgraded income level of workers. Thus some measurement is expected to be taken for these new types of waste. There are also some interests for setting up organized business as the waste items can be recycled and have some economic value. In order for the potential market driven activities to become economically feasible, the proper collection system and cost payment based upon the legal requirement is expected to be established.

It is becoming a common recognition among high ranking officers of Gujarat and CEO of relevant organization who is promoting infrastructure development including eco-friendly township development to formulate the legal framework for proper waste management.

3) Lack of awareness among some waste generators and waste treaters
Among the some waste generators as well as waste treating facility, level of the awareness for paying proper cost for the waste management in environmentally sound manners is not high enough. Awareness raising activities are necessary to improve the situation so that the waste treating industries are more economically viable and trigger further investment of the state of the art waste recovering technology.

4) Management, monitoring and implementing capacity can be enhanced among the regulators
Regulating body has the important role to make sure the proper waste treatment activities being conducted in environmentally sound manner. To this end, training could help for more effective implementation.

5) Finding out the detail data/information for the waste management and recycle projects is difficult and incomplete
Since the many of small-scale non-hazardous industrial waste recycle projects are currently undertaken by the informal sector, finding actual waste data/information is neither easy nor perfect. In many cases, we must use the educated guess rather than complete set of data/information. Hence even if the result of study indicated promising, we may need to start testing first the market and find out more about the actual market situation later.

9.2 Involvement of Informal Sector

Possible impacts and implications by conducting the proposed project for improving waste management system in Gujarat are highlighted as follows.

1) Application of an Environmentally Sound Waste Treatment
In the recyclable waste collection chain, 60-80% of the work and profit are generated in the informal sector, thus it is efficient to incorporate the informal sector into the waste management chain formally. The work for developing waste management project should be coordinated with the informal waste collection chain. Although the mechanism of collection is organized, their way of treating wastes are not organized. For example, those wastes collected but what could not be sold are discarded without care, or some dealers/traders who cleaned wastes will dump dirty water into rivers without being aware of the risk. Low environmental awareness in the informal sector is caused by a lack of formal rules.

However, if a waste treatment entity in formal sector that is governed under the rules of the State Pollution Control Board comes into the collection chain, and assumes part of the role of processing (cleaning, granulating, melting) or mechanical operation (grinding, sorting,

crushing), which was previously operated by informal sector, was conducted, waste treatment will be operated in a more environmentally friendly way. By joining the waste collection chain with informal sector, the profit received at the informal sector is assumed to be reduced to about 50% of the total profit in the chain. Yet, the community will benefit by having an environmentally sound waste treatment, less risk on health of workers/residents, and higher awareness on environment by the proposed project educating the informal sector on waste treatment.

2) Application of New Technology to Increase Efficiency
The advantage of collaboration between formal and informal sector in waste collection/treatment can also be seen in the introduction of new waste treatment technology that may increase the efficiency. A company in a formal sector has an access to another formal sector with a high technology both from the domestic and international market. For example, there is currently a plan to introduce a technology that separates rare metals in e-waste from a Japanese company. A Japanese company came into the picture only because there is a partner in India in a formal sector that has governmental recognition and sufficient fund. If the recycling business was only operated by an informal sector, it would have been never, or it would have took a long time for the informal sector to reach to the latest technology. However, with collaboration with a formal sector, these technologies will be available, and the efficiency in recycling wastes will be improved.

3) Decrease Losses at Industries, and Spread More Profit to the Society
Currently, the industries in the Gujarat state are generating about 1.7 million tons of wastes per year, which all cannot be treated with the current waste treatment facilities' capacity. According to the interview to an operator of waste treatment facility in Ankleshwar, the current treatment facilities in Ankleshwar (including other companies) can only treat about 30-40% of the generated waste. Because of the limit in the treatment volume, the cost of waste treatment is increasingly affecting the production cost. In addition, since even the current waste volume cannot be handled, the Gujarat state is currently limiting a new investment, and the existed industries to expand their business. The slow-down in the industries affects the level of employment, as well as the state's income through taxes that will be used to improve public services.

4) "Clean" Reputation Attracts Top Companies
Recently, the attention to corporate responsibility to the society and environment has been raised. This trend is especially high among global companies which have wider influences on the society. With improved waste treatment facility, the state can appeal to the global companies that a clean and environmentally friendly business is possible in Gujarat, and increase incentives to invest in the region. If one top company chose Gujarat, the reputation of the state will increase to attract other companies to follow, especially those industries that need supporting industries. More investments will create more employment opportunities, thus higher and stable income for households.

5) Potential of Less Players Needed in the Recycling Business
By improving recyclable waste collection system, it can be said that the profit within the informal sector may decrease about 10-30%. Since traders and recyclers, who are in the higher level of waste collection understands the benefit of formal waste treatment company to involve, in terms of efficiency and ethics, they may understand the logic of it. However, those in the lower grade than dealers may not understand the non-monetary profit they may receive. In fact, increased efficiency often means less players needed. Small scale dealers and

individual pickers have a chance of going out of business if larger players get involved. Therefore, in order to implement the project it needs to think carefully of who may be potentially be out of the chain of waste collection if they are going to participate. Once identified, there is a responsibility for the project developer to provide alternative opportunities for them.

9.3 Recommended Actions

1) Understanding that waste management/recycle projects are still a pioneering, uncertain and vulnerable, the implementation organization should try to use the experiences of the best practice in the world especially from the Japanese experiences as a forerunner of waste management practices.
2) Since many projects are in the beginning stage, the implementation organization should seek for application of TA and soft loan from Japan to reduce the project cost and risks to secure the steady and sustainable development of the projects.
3) Development of guidelines for promoting environmentally sound treatment can be recommended. Along with the guidelines development, pilot project in the selected area should be conducted to find out whether it can work or needs modification.
4) Through the pilot project on segregation and collection of the waste items in the selected area where the pollution is severe and needs countermeasure, necessary component of regulating framework shall be identified. It can eventually be a valuable suggestion for drafting legal framework.
5) Awareness raising activities such as seminars and workshop on ESM of hazardous waste are recommended for waste generators and waste treatment facility. Development of information education and communication (IEC) materials is also recommended.
6) Training programs for regulating officers is recommended to enhance the implementing capability.

To identify the specific target wastes such as e-waste, fluorescent lamps or ‘hot spots’, most problematic area, which to be covered by the any of the abovementioned actions, there may be necessity for further discussion or research.

For bringing out effective outcome, abovementioned actions can also be combined and expect synergy. In this regard, discussion on prioritizing specific action shall be expected.

If the activities bring out successful outcome, it will also eventually be serving as a firm base for the eco industries to become legally and economically feasible.

10 Source of funding

10.1 Initial Stage (May or June 2010 to March 2011)

- Japanese Ministry grants: F/S for E-Waste and other specific wastes or activities,
- Indian government Viability Gap Funding: available through GIDB for innovative non-PPP projects, -Government of Gujarat will provide financial support,
- AOTS: Training of private sector in the Hazardous Waste and Recycling Management field in Japan and in India, or
- JODC: Dispatch of Private Experts to India from Japanese Company in a case of JV and License arrangements.

10.2 Second Stage (April 2011 to March 2014)

- UNEP Secretariat of Basel Convention has the partnership program Environmentally Sound Management of e-waste project fund for pilot collection and awareness raising,

- JICA: Technical Assistance in Master Plan and Capacity Building,
- JBIC: Feasibility Studies for specific Recycling & Hazardous Waste Management Project and soft loans in the case of implementation,
- UNEP: TA mainly for Master Plan and Capacity Building, or
- ADB, IFC: TA and Loans for specific projects.

The brief about each funding source is given below

10.1 Gujarat state government

Within the Indian government financial assistance framework, viability gap funding would be made available through GIDB. For innovative non-PPP projects, as stimulated in the state government industrial policy, GoG would provide financial support to the project under following categorization.

- Use of innovative technology for recovery of useful material from E-waste, Electroplating Waste and photography waste.

For encouraging green practices in SMEs, GoG has a scheme to provide financial assistance for installation of solar system for energy saving. Moreover the following scheme can be positively employed that for all projects in the area of environment and waste management, the state government would reimburse the electricity duty for 5 years

10.2 JICA

JICA has experienced in waste management project through a capacity building project for a small scale pilot project on the household garbage/municipal waste collection system in Kolkata from the beginning of 2000. Household garbage collection network development in Kolkata is progressing now. Although the public awareness raising program has been started, implementation of garbage collection project is suspended for further works. However, because PPP scheme for municipal waste management has been promoted, it can be understandable that the same waste management project model can be applicable in the industrial waste recycling projects. Notably the division of works between government and the private needs to be effectively deployed for the successful implementation of the waste recycle projects. The upgrade of industrial waste management system might be able to appeal to JICA as a part of the assistance for infrastructure development with which the Japanese companies can gain confidence to advance their business in India.

There was a proposal on formulating M/P of municipal solid waste management in Delhi, yet it was not successful in the past. Possible reason of the result is accrued from miscommunication and conflict of interest among Municipal Corporation of Delhi, Ministry of Environment and Forestry, and Ministry of Urban Development, and Ministry of Economic Affairs which is in charge of requesting ODA to Japanese Government. Since political bodies governing each central and state levels (namely Gujarat) are different, the same conflict could be emerged. Hence there is a need to minimize or avoid the conflict of interest among the public side. Especially a central body is a key only if we seek for an ODA to make a legal framework and master plan with Japanese concessional loan.

Up to now, there is no similar proposal in the field of industrial waste management, yet there would be enough interest in JICA to examine the proposal and explore the possibility of technical and financial assistance. JICA provides the technical assistance programs such as master plan development of hazardous waste management, based upon the official request from Government of India to the Government of Japan. Assistance could become long-term activity to upgrade the situation of hazardous waste management state wide.

10.3 JETRO and DMICDC

JETRO is also thinking to tie-up with Indian government to promote environmental business cooperation between India and Japan. In this course, JETRO supposed to be very keen on supporting the waste management recycling projects. As CEO of DMICDC and IL&FS both show a keen interest in proceeding the project implementation of waste management project development in cooperation with Japanese team, Project Development Fund (PDF), which is half financed by Indian Government and the half financed by JBIC (yen loan) can be used for the project and program formulation purpose. Tendering process of PDF is not yet confirmed, yet DMICDC indicated some possibility to allocate some portion from PDF for further study and programming of our project.

11 Activities to be undertaken

The value-added of industrial waste management and recycling system development of a functional legal framework for industrial waste management and recycle activities in Gujarat in cooperation with Japanese various knowledge and technology providers are important.

The legal framework of the waste management and recycling system operation is a crucial element for realizing sound social and industrial development among the society. Yet public sectors intervention in balancing the social development level and industrial sectors cost sharing sense should be provided only after the world best practice and knowledge was studied. After the successful implementation of the program, the model is intended to be roll over to various states in the frame of DMIC and even to whole country. The following is the summary of the project concept and way forwards.

(1) Upgrade of waste management technical co-operation

The industrial hazardous waste of 1.7 million tons is generated in a year in Gujarat (There are a lot of industrial clusters of heavy industries from which waste is generated in a significant amount), and the current treatment capacity is not sufficient enough to manage such volume of waste. Moreover efficiency can be increased in the use of resources and energy has been seen in recyclable and reusable materials treatment, most of which is currently simply landfilled or incinerated. Hereafter, waste management necessary to treat the existing industrial wastes in more environmentally sound and energy and resource conscious manner needs to be retained in the upcoming value chain of wastes in Gujarat state.

- The industrial waste recycle system can be attained with technical co-operation from the Japanese private companies. The industrial wastes that can be recycled (precious metals in E-waste, iron in steel slag and etc.) is being studied its treatment with Japanese technologies, and prospective matchmaking between Indian local needs and Japanese technological transfer shall be pursued.
- Training and capacity development program for the informal sector on which the prominent amount of recyclable waste is collected in the system is also addressed in this project.
- Master Plan (M/P) may be required to lay out recycle system development

programs to attain an efficient industrial waste management, and its road map to follow.

(2) Legal framework for supporting environmentally friendly social and industrial development

To invite private environment-related project developers and technology providers, the formation of the legal framework needs to be addressed, and the establishment of such framework/platform is expected to provide private sector with a chance of developing a more environmentally sound operations and new arena of environmental business development. Thus mutual cooperation between government and business community for nurturing an environmental industry in India within the framework is of importance. The idea behind for promoting such cooperative platform is, consequently, that the advancement of the cooperation between public and private sectors will facilitate the technical advancement, mitigation of environmental degradation, employment creation, and new business development in the field of the environmental industry in India.

For the promotion of environmental project in India, moreover the following financial tool is to be deployed in the process of considering the prospective legal framework for waste management and recycle in that currently energy-saving fund is available from SIDBI which is financed by JICA. And possibility of developing Environmental Fund from which private companies can get a concessional loan in order to install environment-related facilities could be newly proposed.

11.2 Recommendation and implications for project implementation

1) Waste management in more advanced environment sound manner proposed in our project is a field that gained interest from JICA, though it is not an emphasized field of JICA's operation at this moment. It is, however, "measures against pollution" is in a wider meaning of sustainable development which JICA places priority for its cooperation.
2) Because JICA basically shall initiate an assistance program based on the request from the host country, an official request from the central government needs to be sent to the government of Japan to initiate the further study as well as possible assistance for hazardous waste management project development. And the receiving entity of the assistance needs to be basically a public entity, for instance, training program concerning the industrial waste management shall be provided to the government officials of the host country'. Moreover, JICA loan to the host country is deemed to be provided to the central government and then descended to project owners to install, for example, common equipments/facilities. Beside JICA loan, there is JBIC concessional loan is available, yet its usability is limited to the projects under the premise that environmental facilities and technologies shall be either brought from Japanese private companies or such facilities could produce services and goods to Japanese companies.
3) M/P and capacity development program of the waste management and recycle can be explored more in cooperation with JICA if there is a request from the central government through a strong initiative from state government of Gujarat. Although the distribution of the recent ODA capital tends to have concentrated in the business cooperation (SAPROF in old JBIC), this proposed project is more business oriented and the concrete scenario of PPP project implementation approach is present, there is a good chance for JICA to pick up the project proposal from many of the pipeline ODA projects which all have been proposed by various project owners.
4) Yet it is important to remind that a lot of ODA request in environmental projects have

come out from India every year, and moreover, this hazardous waste management project must be nominated as a priority pipeline project in JICA assistance projects with the strong support from the India's central government. And the sense of anxiety, which India's central government have in using STEP project loan with JICA, shall need to be carefully addressed and mitigated in the cooperation with relevant agencies for example DMICDC, because this waste management and recycle project could be a prioritized early bird project which should be mutually materialized with India and Japanese cooperation in a relatively short time period.

5) The application of two step loan (JICA) can be also used for developing and installing the individual recycle technologies and equipments for private projects.
6) Once a project is claimed as an Early Bird Project, the project is more likely to get PDF as well further necessary supports from both Government of Japan and India. Yet, there is one condition for a project to be claimed as an early bird project, which needs to have a Japanese investor or project partner in the project. In this sense, JV in hazardous waste management development or technical cooperation in respective recycling projects should be explored in the course of upcoming dialogue as well as continuing mission exchange programs.

Appendix

The following is a summary of geo-environmental profiles of the State's regions

Regions	Physiography and drainage	Structure and stratigraphy	Climate	Soils and Land use	Water regime	Surface water resources	Groundwater resources
1. Northern Rocky Highland	The average altitudes range from 300-500m. The terrain is characterized by bold ridges of folded metamorphic rocks and prominent hills of granites. The area is drained by rivers and controlled by the structural and lithological features of rock formations.	The highland is predominantly composed of Precambrian rocks of Aravalli and Delhi Supergroups, gneisses, granite basement, and intrusives. There are also minor occurrences of Mesozoics and Deccan Trap.	A typical semi-arid climate, average rainfall is 700-1000 mm with 30-45 rainy days. Mean annual temperature is 26-27 c with mean maximum and minimum temperatures of 41-11 c. The average humidity is 60-65%.	The region falls under tropical dry deciduous forest. Soil resource is rock outcrops, steel slopes, severe water erosion, shallow soil-depth and low AWC (50-100 mm/m). Large part of the area is either barren or covered with sparse vegetation, and the remaining is cultivated for rainfed crops like maize, perimillet and sorghum.	Since the water resource is distributed on the higher side, it creates chronic shortage of water during summer months.	Banas, Sabarmati, Mahi and Orsang rivers extend beyond the area, covering about 32,000 sq km. The total watershed for the region spreads over 56,000 sq km. Thus the area is characterized to have tremendous surface water potential.	Groundwater is restricted to the soil, regolith cover, weathered, fissured zones, and occurs under phreatic unconfined conditions upto the depth of 50-100m. Aquifer yield is 50-150 lpm.
2. Southern Rocky Highland	The terrain is shared by three terminations of mountain ranges namely, Vidhya, Satpura, and Sahyadri. The area has an altitude of about 100-1,000m. The overall topography is highly rugged and hill ranges. The region is drained by numerous rives flowing from East to West, such as Narmada, Tapi, Mindhola, Purna..etc.	Almost entire regions is composed of the rocks of basaltic lava of Deccan Trap, which volcanic action occurred around the Cretaceous period (60-65 M Y ago). Other minor occurrences are infra-Trappean and post-Trappean sedimentary rocks.	The region has typical sub-humid to humid climate with average rainfalls of 1,300-2,200mm. The mean annual temperature is about 26 c with mean maximum and minimum temperatures of 41-22 c. The mean humidity is 70-75%.	The dominant soils occurring on gently sloping to moderately steep dissected hills of Lithic Ustorhents and Lithic Ustochrepts. The soil is shallow (10-50cm), and excessively drained to well drained. They are severely eroded and generally stony at the surface. The major part of the region is under tropical moist deciduous type forest. Small areas of upland is cultivated for sorghum and pulses, and the valleys are cultivated for paddy.	Although the region has abundant water availability, its distribution is extremely uneven that the region chronically suffers from shortages during summer.	The surface water potential is very high due to high rainfall and dependability, and interstate rivers like Narmade and Tapi. The total effective watershed is about 150,000 sq km. However, because the area being a typical hard rock hilly terrain, most of the runoffs flows down to the plains without any significant local intercepts.	Groundwater potential is limited due to the consolidated and impervious nature of the rocks and steep ground slopes. Groundwater availability is restricted to weathered zones, joint planes, shear planes, fault breccia and vesicles.
3. Northern Alluvial Plain	The area has the highest elevation of 200m in the northeast, and the lowest elevation of 20m in west. The slope is rather gentle. The region has sparse drainage. While eastern and central part has a few rivers, southern and northwestern area is devoid of drainage. An artificial drainage system was constructed to solve the problem.	The sediments of the plain belong to the youngest geological formation (upper Quaternary), which consisted with a thick succession of sandy and clayey layers of fluvial, fluviomarine and Aeolian origin.	The region has a semiarid climate, where aridity index is higher in western part. The average annual temperature is about 26 c, where maximum and minimum temperature reaches 41c and 10c. The average humidity is 60-65%. The average rainfall is low, about 400-650mm.	The soil is composed by three categories: aeofluvial plain, Aeolian plain and paleo-mudflat. The soil belongs to Inceptisols, Entisols and Vertisols orders. The soils of the region are very deep (more than 150cm), ranging from excessively to well drained and sandy to fine loamy in texture. The land in western area is covered by tropical scrub forest, but the major part of the area is cultivated for Kharif crops like sorghum, pearl millet, cotton, castor, etc.	The water regime is characterized by a poor surface potential and moderate to good groundwater potential.	The availability of surface water is limited due to a low proportion of rainfall. The rivers in the upper catchment area are dammed, but this irrigation cover less than 10% of the region. There were used to be numerous village ponds containing significant quantities of water, but this water source was neglected, and usable potential has been greatly reduced.	The region has an ideal hydrological conditions that enables to form a great thickness of a compound aquifer system. However, the aquifers have been over-exploited at the rate far beyond the natural replenishment creating the groundwater mining condition in the central parts. The deterioration in the quality is also observed with higher salinity.
4. Central Alluvial Plain	The highest elevation range of the region is about 100－150m in NE, and the lowest falls about 20m in SW. The region shows a flat topography with series of sections cut by deeply incised	The alluvial deposits of the region belong to the Quaternary period, and having almost the same characteristic as in the Northern Alluvial Plain.	The region has a semiarid climate with aridity index of 15-20%, indicating adequate moisture in the soils. The average annual temperature is about 27-28 c, where maximum and minimum temperature	The major types of the soils are Inceptisols (Ocrepts) and Vertisols (Usterts). The soils are dominantly very deep, well drained, and fine-loamy to fine in texture. The major portion of the region is cultivated for Pearl	The region got the highest potential of both surface water and groundwater. However, the area is also suffering from overuse of water resource and quality deterioration.	The region has abundant surface water potential due to very high availability of river runoff. The major sources of surface water are the several dam reservoirs built across these rivers. However, the area created an	The area has a rich aquifer system with copious supply. The natural recharge index is also high. However, the area between Mahi and Narmada is suffering from lower groundwater level, and degraded quality due to

	channels of rivers. The region is drained by rivers having the capacity of carrying large discharge of water and sediments. The rivers are prone to heavy floods and land erosion, thus artificial drainage was provided to solve monsoon inundation.		reaches 40c and 11c. The average humidity is 60-65%. The average rainfall is low, about 700-1,100mm.	Millet, Sorghum, Maize, Tobacco, Wheat, Cotton, Pulses, Paddy, and Banana etc. However, there is hardly any natural forest.		environmental imbalance due to over-irrigation.	overstressed needs on irrigation.
5. Ranns and Banni of Kachchh	The region is formed by low level Rann rising about 4-8m above sea levels, and plains rises about 3-5m above Ranns. Ranns get flooded by the river discharges, direct rainfall and the long tidal push from the sea side. On the contrary, Banni plains remain free of the tidal ingress, thus providing excellent conditions to grow variety of grasses.	The region consists of Recent and Sub-Recent sediments deposited during Holocene age of Quaternary period. The deposition of the Ranns take place under fluctuating sea level, and the sediments mainly comprise clays, silts and sands forming 50m thick composition.	The region has arid climate with aridity index of more than 40%, producing a dry desertic condition. The average annual temperature is about 26 c, where maximum and minimum temperature reaches 40c and 1c. The average humidity is less than 60%. The average rainfall is low, about 250-450mm.	The soils of Rann are highly saline with salt encrusted surface, thus incapable of supporting any vegetation. The soils of Banni plain classified as Aridisols, which soils are very deep, poorly drained, fine loamy, calcareous with very severe salinity and slight erosion.	The water regime is characterized by enormous availability of saline water and very limited fresh water. Human intervention in this harsh area is very limited.	The flat basin of the Ranns collect a substantial quantity of fresh water during monsoon, but sooner it gets contaminated by the inherent salts of the Rann sediments. The Banni area has several small village ponds holding rain water.	At Rann, it is possible that at some depth there are sandy pockets containing sweet water of fluvial depositional cycle. During summer, village ponds at Banni gets dry, but by digging shallow pits, some sweet water is provided. This becomes the major source of water supply for people.
6. Peninsula of Kachchh	The peninsula is formed E-W tending hill ranges of the mainland plateau, the Wagad upland, and the Island belt. All hill ranges and the intervening low ground run parallel. The region is drained by around 100 ephemeral streams radiating in all directions. The landscape of peninsula is formed of dominantly erosional, with flat topped hills and long stretching ridges intervening broad open sand valleys.	The peninsula is composed of Mesozoic and Cenozoic sedimentation of 2,500m and 1,000m thickness respectively. The Kachchh basin is the E-W trending uplifts, highlands and islands, are surrounded by the residual depression of Rann plains.	The region has arid climate with high aridity index of more than 40%, indicating high deficiency of soil moisture and desert type of dry xerophytic vegetation. The average annual temperature is about 26 c, where maximum and minimum temperature reaches 38c and 10c. The average humidity is less than 60%. The average rainfall is low, about 250-450mm.	The soils of the hilly terrain are characterized by alkaline and calcareous, moderately eroded and have surface stoniness. They are classed as Camborthids and Palargids. The soils of pediment surface are dominantly very shallow to shallow, excessively drained and loamy in textures, severely eroded and generally stony on surface. The hilly terrain is mostly barren while pediment areas partly support light rainfed kharif crops. The natural vegetation of the area represents a tropical scrub type.	The region is characterized by poor water resources due to its arid climate. The water resource is highly stressed due to increasing demands.	There are 100 watersheds which produce approximately 1,300 MCM runoff at an average rainfall. However, due to diverse pattern of the drainage, arid climate and very low dependability of rainfall, the harnessable potential is about 55% of it.	The groundwater occurs in semi-consolidated formations of the Tertiary and Mesozoic sedimentary rocks within restricted confined aquifers with moderate yield. The quality is generally poor under the Teritiary aquifers. The Mesozic sandstone is the dominant source of water forming a confined aquifer system. However, the use is heavily stressed, thus the quality of the water is degrading.
7. Peninsula of Saurashtra	The region forms a tableland with undulating surface broken by hills and checkered by various dissecting rivers that flow out in various directions. The peninsula provides a criss-cross outline and an overall rugged topography. The peninsula shows a more or less radial drainage pattern, where several rivers stretching out in all directions.	The region contains extensive exposures of basaltic flows of Deccan Trap and to a limited extent that of sedimentary rocks of Mesozoics and Cenozoic. The bulk of the trap is made up of a thick succession of lava flows.	The region has a semi-arid climate with aridity index range of 20-40%, indicating a general deficiency of soil moisture for major part of the year The average annual temperature is about 26-27 c, where maximum and minimum temperature reaches 40c and 11c. The average humidity is less than 65-70%. The average rainfall is low, about 450-600mm.	The peninsula shows a variety of soils belonging dominantly to the Entisol and Inceptisol Orders. The soils of higher level hilly terrain are very shallow somewhat excessively drained showing loamy-skeletal texture, and severally eroded and generally stoney at surface and subsurface. The soils on foothills and inter-hill basins are moderately shallow, well drained and fine textured. They are slightly alkaline and slight to moderately calcareous. The hilly terrain is mostly barren, while the pediment areas mostly show scrub vegetation.	The region has overall poor water regime both in respect of surface and underground resources. This is because of the low rainfall and impermeable nature of rock formations.	There are about 90 river basins, but most of them are seasonal and have a general runoff index of about 40% of the rainfall. Though the potential is low, the topography provides good sites for constructing storage reservoirs. Taking advantage of this, 80 dams have already been constructed creating approximately 2,500 MCM storage.	The consolidated terrain makes the groundwater prospect generally poor. However, the moderate rainfall and favorable terrain condition produce a fairly high recharge index of about 15% of the rainfall. However, like other regions, the extraction rate of water has been exceeding the safe limit, which clearly indicating overexploitation.
8. Coastal Zone							

Kachchh Cost	Drainage of rivers generally sluggish and small, with low detrital load.	The western-half facing the Arabian sea is muddy, made up of extensive tidal flats. The inner segment lies inside the Gulf is sandy and silty.	Arid climate and low rainfall of 250-400mm.	Coastal zone soils are mostly Claciorthids and Camborthids types supporting rainfed crops.	The water is clear to turbid and saline to hyposaline.	The over extraction of aquifers have rendered them saline due to sea water intrusion.	
Saurashtra Coast Navalakhi-Dwarka Segment	The shoreline is rocky and its configuration is highly crenulated and characterized by extensive mudflats, offshore islands and rocky platforms with narrow beaches. It has prominent drainage between Jodia and Salaya.	The substate is uneven and formed of coralline rocky subcrops of hard trappean basalts and soft Tertiary sediments. The littoral zone is covered with a veneer calcareous mud.	It has a general semiarid climate with low rainfall of 350-400mm.	The coastal tract is covered by Halloquepts and Ustocrepts type of soils. The area is generally barren with light rainfed crops.	The water is turbid and hyposaline.	Sea water has intruded the coastal aquifers for about 2,000 sqkm.	
Saurashtra Coast Dwarka-Div Segment	The shoreline is comprised of variety of landforms, such as continuous beach with projecting rock mounds, wave cut platforms, occasional cliffs, backshore dunal ridge complex of calcareous sands and tidal creeks with backshore tidal flats. The drainage is fairly well developed	The coastline facing Arabian sea is characterized as very smooth and straight, and marked by well developed sandy beaches. However, this straight shore line is at places cut by river mouths filled with tidal mud	The area has semiarid climate, which average rainfall is 350-550mm.	The soils of the area are mostly Halaquept, Salorthid and Ustochrept types. The area supports rich irrigated crops of wheat, sugarcane, and a variety of horticultural crops.	The water is clear and saline.	The coastal milioltic rock forms a good aquifer system due to extensive development of secondary porosity. However, due to exploitation, the salinity of water has peen increasing, affecting soils, crops, and drinking water supply.	
Saurashtra Coast Div-Bhavnagar Segment	The area is characterized by mudflats, cliffs, rocky platforms, beaches and dune ridges. The drainage is generally sluggish with moderate detritus load.	The area is formed of terrigenous sandy shingle and mud, transferred by tidal waves. The substrate is uneven made up of hard milliolites and soft sediments of Quaternary rocks.	Semiarid climate with average rainfall of 500-600mm.	The soils of the area between Div and Talaja belong to Halaquept and Salorthid Great group types, while between Talaja and Bhavnagar belong to Ustorthnt, Ustochrepts and Halaquept Greatgroups.	The water is saline to hyposaline and turbid.	The rocks in the area created a good system of phreatic aquifer, however, the excessive drawl in recent years increased the sea water intrusion and contaminated the aquifers.	
Gujarat Coast Bhavnagar-Bharuch Segment	The coast between Bhavnagar~Khambhat is highly muddy and made up of vast open onshore mudflat. The area between Khambhat to Bharuch is a drowned alluvial coast characterized by steep and cliffy river mouths. The drainage on western side is sluggish while on the eastern side it is active.	The substrate is formed of soft alluvium.	The area has semiarid to subhumid climate, but the Bhavnagar side has a relatively higher aridity index of 20-30%. The average rainfall is 600mm on Bhavnagar, and 800mm on the Bharuch side.	The soils of the western side of Sabarmati are Halaquept-Slolorthid types, while those on the eastern side are Ustocrapt and Chromustat types. The salinity range from strong to very severe in the soils.	The fresh water prospects on the surface or underground are almost negligible	There used to be several village ponds storing water almost round the year, however, these ponds were lost due to neglect. The entire domestic water supply is now dependent from long distances on Narmada river through pipe lines.	

Gujarat Coast Hansot-Umbergaon Segment	The shoreline exhibits a variety of landform of alluvial plain, mudflats and prominent estuarine river mouths. The drainage is rather active with high proportion sediment load.	The substrate is made up of soft alluvium of clay and sand. The littoral zone is formed by sandy and silty deposits.	The climate in the area is subhumid in the north to humid in the south. The aridity index is about 20% in the north while it is 10% in the south. The mean rainfall also increases southward from 800mm to 1,800mm.	The soils of the trat are dominantly Chromusterts and ustocrepts derived from the trappen uplands.	The water is turbid to clear and hyposaline to saline.	The estuaries and reeks have been polluted by the discharge of toxic effluents from the industries.	The groundwater in the coastal plains occurs under phreatic conditions with moderate yields of 50-100lps but has generally higher salinity above 2,000 ppm. The overdrawals of aquifers caused sea water ingress and contamination of groundwater.

Source: Gujarat Ecology Commission, summarized by Study Team

The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008.

SCHEDULE I

LIST OF PROCESSES GENERATING HAZARDOUS WASTES

S.No.	Processes	Hazardous Waste *
1.	Petrochemical processes and pyrolytic operations	1.1 Furnace/reactor residue and debris 1.2 Tarry residues 1.3 Oily sludge emulsion 1.4 Organic residues 1.5 Residues from alkali wash of fuels 1.6 Still bottoms from distillation process 1.7 Spent catalyst and molecular sieves 1.8 Slop oil from wastewater
2.	Drilling operation for oil and gas production	2.1 Drill cuttings containing oil 2.2 Sludge containing oil 2.3 Drilling mud and other drilling wastes
3.	Cleaning, emptying and maintenance of petroleum oil storage tanks including ships	3.1 Oil-containing cargo residue, washing water and sludge 3.2 Chemical-containing cargo residue and sludge 3.3 Sludge and filters contaminated with oil 3.4 Ballast water containing oil from ships.
4.	Petroleum refining/re-processing of used oil/recycling of waste oil	4.1 Oily sludge/emulsion 4.2 Spent catalyst 4.3 Slop oil 4.4 Organic residues from process 4.5 Spent clay containing oil
5.	Industrial operations using mineral/synthetic oil as lubricant in hydraulic systems or other applications	5.1 Used/spent oil 5.2 Wastes/residues containing oil
6.	Secondary production and/or industrial use of zinc	6.1 Sludge and filter press cake arising out of production of Zinc Sulphate and other Zinc Compounds. 6.2 Zinc fines/dust/ash/skimmings (dispersible form) 6.3 Other residues from processing of zinc ash/skimmings 6.4 Flue gas dust and other particulates
7.	Primary production of zinc/lead/copper and other non-ferrous metals except aluminium	7.1 Flue gas dust from roasting 7.2 Process residues 7.3 Arsenic-bearing sludge 7.4 Non ferrous metal bearing sludge and residue. 7.5 Sludge from scrubbers

8.	Secondary production of copper	8.1 Spent electrolytic solutions 8.2 Sludges and filter cakes 8.3 Flue gas dust and other particulates
9.	Secondary production of lead	9.1 Lead bearing residues 9.2 Lead ash/particulate from flue gas
10.	Production and/or industrial use of cadmium and arsenic and their compounds	10.1 Residues containing cadmium and arsenic
11.	Production of primary and secondary aluminium	11.1. Sludges from off-gas treatment 11.2. Cathode residues including pot lining wastes 11.3. Tar containing wastes 11.4. Flue gas dust and other particulates 11.5. Wastes from treatment of salt slags and black drosses
12.	Metal surface treatment, such as etching, staining, polishing, galvanising, cleaning, degreasing, plating, etc.	12.1 Acid residues 12.2 Alkali residues 12.3 Spent bath/sludge containing sulphide, cyanide and toxic metals 12.4 Sludge from bath containing organic solvents 12.5 Phosphate sludge 12.6 Sludge From staining bath 12.7 Copper etching residues 12.8 Plating metal sludge
	Production of iron and steel including other ferrous alloys (electric furnaces; steel rolling and finishing mills; Coke oven and by product plant)	13.1 Sludge from acid recovery unit 13.2 Benzol acid sludge 13.3 Decanter tank tar sludge 13.4 Tar storage tank residue
14.	Hardening of steel	14.1 Cyanide-, nitrate-, or nitrite-containing sludge 14.2 Spent hardening salt
15.	Production of asbestos or asbestos-containing materials	15.1 Asbestos-containing residues 15.2 Discarded asbestos 15.3 Dust/particulates from exhaust gas treatment.
16.	Production of caustic soda and chlorine	16.1 Mercury bearing sludge 16.2 Residue/sludges and filter cakes 16.3 Brine sludge containing mercury
17.	Production of mineral acids	17.1 Residues, dusts or filter cakes 17.2 Spent catalyst
18.	Production of nitrogenous and complex fertilizers	18.1 Spent catalyst 18.2 Spent carbon 18.3 Sludge/residue containing arsenic 18.4 Chromium sludge from water cooling tower
19.	Production of phenol	19.1 Residue/sludge containing phenol

20.	Production and/or industrial use of solvents	20.1 Contaminated aromatic, aliphatic or napthenic solvents may or may not be fit for reuse. 20.2 Spent solvents 20.3 Distillation residues
21.	Production and/or industrial use of paints, pigments, lacquers, varnishes, plastics and ink	21.1 Process wastes, residues & sludges 21.2 Fillers residues
22.	Production of plastic raw materials	22.1 Residues of additives used in plasticsmanufacture like dyestuffs, stabilizers, flame retardants, etc. 22.2 Residues and waste of platicisers 22.3 Residues from vinylchloride monomer production 22.4 Residues from acrylonitrile production 22.5 Non-polymerised residues
23.	Production and/or industrial use of glues, cements, adhesive and resins	23.1 Wastes/residues (not made with vegetable or animal materials)
24.	Production of canvas and textiles	24.1 Chemical residues
25.	Industrial production and formulation of wood preservatives	25.1 Chemical residues 25.2 Residues from wood alkali bath
26.	Production or industrial use of synthetic dyes, dye-intermediates and pigments	26.1 Process waste sludge/residues containing acid or other toxic metals or organic complexes 26.2 Dust from air filtration system
27.	Production of organo-silicone compounds	27.1 process residues
28.	Production/formulation of drugs/ pharmaceuticals & health care product	28.1. Process Residues and wastes 28.2 Spent catalyst / spent carbon 28.3 Off specification products 28.4 Date-expired, discarded and off-specification drugs/ medicines 28.5. Spent organic solvents
29.	Production, and formulation of pesticides including stock-piles	29.1 Process wastes/residues 29.2 Chemical sludge containing residue pesticides 29.3 Date-expired and off-specification pesticides
30.	Leather tanneries	30.1 Chromium bearing residues and sludges
31.	Electronic Industry	31.1 Process residues and wastes 31.2 Spent etching chemicals and solvents
32.	Pulp & Paper Industry	32.1 Spent chemicals 32.2 Corrosive wastes arising from use of strong acid and bases 32.3 Process sludge containing adsorbable organic halides [AOx]

33.	Disposal of barrels / containers used for handling of hazardous wastes / chemicals	33.1 Chemical-containing residue arising from decontamination. 33.2 Sludge from treatment of waste water arising out of cleaning / disposal of barrels / containers 33.3 Discarded containers / barrels / liners contaminated with hazardous wastes/chemicals
34.	Purification and treatment of exhaust air, water & waste water from the processes in this schedule and common industrial effluent treatment plants (CETP's)	34.1 Flue gas cleaning residue 34.2 Spent ion exchange resin containing toxic metals 34.3 Chemical sludge from waste water treatment 34.4 Oil and grease skimming residues 34.5 Chromium sludge from cooling water
35.	Purification process for organic compounds/solvents	35.1 Filters and filter material which have organic liquids in them, e.g. mineral oil, synthetic oil and organic chlorine compounds 35.2 Spent catalyst 35.3 Spent carbon
36.	Hazardous waste treatment processes, e.g. incineration, distillation, separation and concentration techniques	36.1 Sludge from wet scrubbers 36.2 Ash from incineration of hazardous waste, flue gas cleaning residues 36.3 Spent acid from batteries 36.4 Distillation residues from contaminated organic solvents