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RESEARCH ARTICLE

Baseline Impact Assessment Studies on Flora & Fauna around Goa Industrial Development Corporation (GIDC), Goa Zone

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ABSTRACT

This study projected for environmental impact driven by the pharmaceutical activity on regional biological environment quality. This Environmental Impact Assessment (EIA) study based on one season primary environmental quality data, environmental impact statement based on the identification, prediction, and evaluation of impact. Detailed studies were carried out about biological components of the environment in the study area of 7 km radial distance from Usgaon as a central point. The paper is dealing with, Study of the biological environment includes the topography, the vegetation type and the flora and fauna of the region along with crops for prediction of impacts due to the existing pharmaceutical effluents and bulk drugs at Marvasodo, Usgaon, and Phonda (Goa).

Keywords: Biological Environment, Impact Assessment, Goa

INTRODUCTION

The Indian Pharmaceutical Industry today is in the front rank of India's science-based industries with wide ranging capabilities in the complex field of drug manufacture and technology (Kumar & Sharan, 2013). A highly organized sector, the Indian Pharma Industry is estimated to be worth $ 4.5 billion, growing at about 8 to 9 percent annually. It ranks very high in the third world, in terms of technology, quality, and range of medicines manufactured. The Indian Pharmaceutical sector is highly fragmented with more than 20,000 registered units. It has expanded drastically in the last two decades. The leading 250 pharmaceutical companies control 70% of the market with market leader holding nearly 7% of the market share. It is an extremely fragmented market with severe price competition and government price control. (WP1; WP3–WP5)

Thus, every leading pharma company wants to retain its share in the Indian market and therefore, companies are expanding their production limits day by day. Due to this activity, there is tremendous pressure on the surrounding environmental components such as air, water, soil, flora, fauna and noise levels. This is an attempt to study the ground truth and predict the possible impact of such activities on environmental components as compared to the standards mentioned by the Pollution Control Board in India.

STUDY AREA

The study area comes in the major gaps in the range of mountain of Sahyadri, known as Goa gap between the Maharashtra and Karnataka sections. Goa Industrial Development Corporation (Fig.1) is the most favorite site for the development and expansion of the pharma unit due to flourishing Trading Culture and excellent Port services at Mormugao - a major, modern and thriving port, the highest exporter in the country. Study site Panjim is located at longitude 15°3' N and latitude 73°55' E. (WP2). The study area was limited to 7 km radial distance from the proposed plant site (Fig.2). The identified impact zone is covered by agricultural land, forest, wasteland, marketplaces, and other rurally inhabited localities. Within the study area, there are some other big and small industries. Mining, stone quarrying, and crushing are the major activities in the study area. Viz. Merk Pvt. Ltd., Finolex cables Ltd, Heing India Pvt Ltd., Marico Ltd, Madras Rubber Factory, Nestle India Ltd, Sanjivani Sahakar Sakhar Karkhana Ltd, Goa Meet Complex, Hindustan Foods Ltd & Goa Cattle Feed are the industry prevalent in the area.

METHODOLOGY

The reconnaissance survey was undertaken within the study area to collect information regarding the topography of the study area, and other features relevant

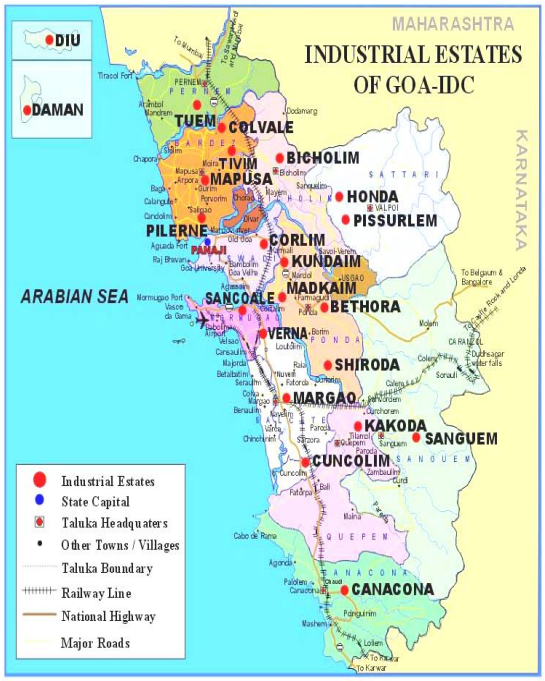

Fig.1: Study Area Map (Courtesy- http://www.goaidc.com)

Fig. 2: Study Area (7 Kms radius from Usgaon)

to the flora and fauna. The study was conducted for the summer season (February 2007 – March 2008). Secondary data collection from various government departments and NGOs were collected to know the past and present status of the various components under study. First hand on-site information and data collection done by authors compared with the standard values for analyzing the impacts.

Identification of the collected plant specimens was made with the help of Standard Floras (Gamble, 1919; Hooker, 1872-1897; Mukherjee, 1984; Almeida, 1990; Naik, 1998; Sharma et al, 1996; Singh & Karthikeyan, 2000). Soil microflora plays an important role as soli quality depends

upon the population of Bacteria, Fungi, and Actinomycetes which are vital components of the land environment. The microbial samples collected from various locations in the study area were observed with Compound Research Microscope in the laboratory. Identification of sampling locations was done for the study on biological environment based on topography, vegetation structure, pattern, and distribution. The details of sampling locations are presented in **Table 1.**

Table 1 : Sampling Locations for Plants Identification

Sr. No.	Name of the Villages
1.	Bondla a
2.	Bondla b
3.	Bondla c
4.	Bondla d
5.	Paikul
6.	Guleli
7.	Ganjem
8.	Guleli Irrigation
9.	Usgao
10.	Candepar
11.	Tiskar
12.	Piliem
13.	Codar
14.	Candepar OPA
15.	Vagurmem
16.	Candepar Curti

Typical land use pattern in Goa state is mentioned in the graph (WP2). The structure and composition of vegetation cover in the phyto-sociological association were studied by the quadrate method adopted by Clements (1960). In the study of a vegetation community, quadrates equivalent to one hectare (100x100 Sq.m.) for trees; the quadrates of smaller sizes (20x20 sq.m.) for shrubs and quadrates of smallest size (5x5 Sq.m.) for grassland/low herbaceous community were used for the study. To characterize the community as a whole, certain parameters are used. The parameters like Frequency, Density, Importance Value Index (IVI) and Simpson's Diversity Index (SDI) were used in quantitative analysis of plant community. Average density of plants per hectare is shoe in **Fig. 3 and** Land use pattern is shown in **Fig. 4**. The formulae incorporating different parameters analyzed and assessed for obtaining the Baseline Terrestrial Environmental Status are presented in **Table 2.**

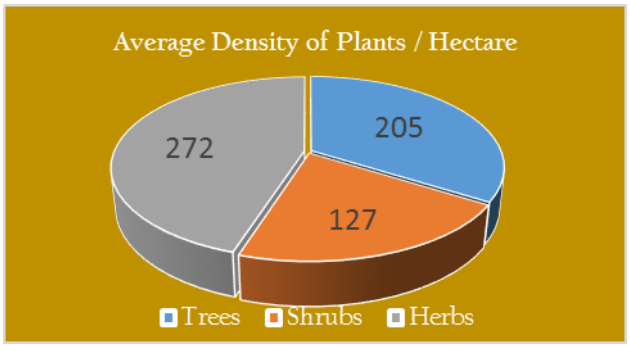

Table 2: The formulae Used to study Baseline Terrestrial Environmental Status

$$\text{Density} = \frac{\text{Number of individuals species A or B, C etc}}{\text{Area sampled}}$$

$$\text{Relative Density} = \frac{\text{Density of species and A}}{\text{Total density of all species}} \times 100$$

$$\text{Dominance} = \frac{\text{Total cover of basal area of species A}}{\text{Area sampled}}$$

$$\text{Relative dominance} = \frac{\text{Dominance of species A}}{\text{Total dominance of all species}} \times 100$$

$$\text{Frequency} = \frac{\text{Number of plots in which species A occurs}}{\text{Total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency value for species A}}{\text{Total frequency values of all species}} \times 100$$

$$\text{Importance Value Index} = \frac{\text{R.Density} + \text{R.Dominance} + \text{R.Frequency}}{3}$$

$$\text{Simpson's Diversity Index} = \sum_{i=1}^{n} \frac{ni(ni-1)}{n(n-1)}$$

ni - is the number of individuals of the species in the sample and

n - is the total number of individuals in the sample.

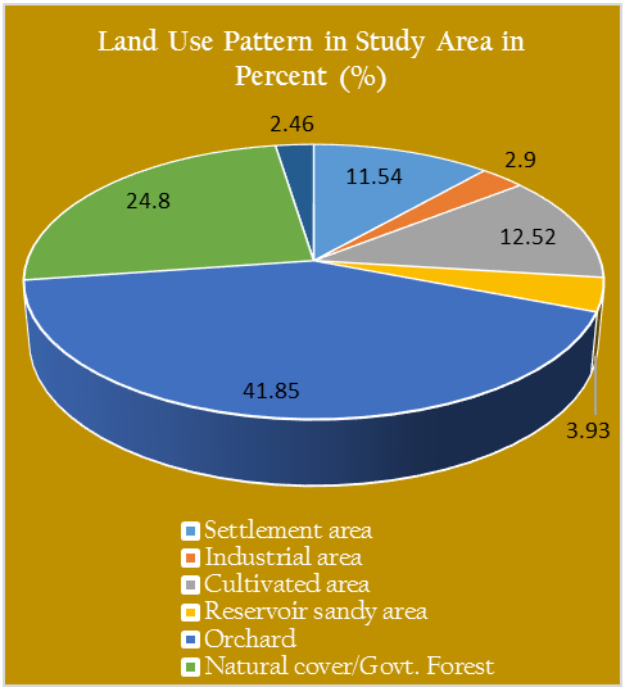

Fig.4 : Land use and Land Cover in Study Area

Fauna

Actual counts method of the animals is used by following the census technique. At each station, a walk-through census of animals is made. Line transects of 1km selected for the study and covered by walking. Numbers of animal species were counted directly. Bird fauna was observed through binoculars. Standard field identification guides were used for identifying animal species.

Local fishermen were interviewed for the impact of the effluent discharge on the Fishes. Identification of fishes is done with standard manuals. Fish catch analysis was done with the help of Experts present at National Institute of Oceanography, Goa. The fisherman population is estimated about 24,051 out of which 5,258 are active fisherman in the district (WP2).

OBSERVATIONS & RESULTS

The changes in a biotic community are studied in the pattern of distribution, abundance, and diversity. The reconnaissance revealed that the land around project site is covered with vegetation developed by surrounding pharmaceutical industries. *Anacardium, occidentale* (Kaju), *Cocos nucifera* (Coconut), *Mangifera indica* (Mango) are observed to be dominant along the roadside and species of *Avicennia, Rhizophora, Brugueria, Kandellia, Sonneratia* near the seashore.

The coast is silty to clayey silt substratum with some sandy part. The major riverine planes in Goa are those of the Mandavi and Zuari which, together constitutes a major alluvial embayment.

Floral Diversity

List of plants dominants in the region is prepared based on visual observation during site visits. Data available with various agencies is referred for identifying rare or endangered species in the region. The wasteland is the areas without any productive usage but left wild with growth of vegetation in natural state. The plants growing are *Grewia spp, Woodfordia spp. Vitex spp. Adhatoda spp. Calotropis procera*, etc. along with wide variety of herb and shrub species.

During the floristic survey, a total of 110 plant species comprising 55 trees, 35 shrubs and 20 herb species were recorded from the study area belonging to 45 families. The list of the plant species (trees, shrubs and herbs) are shown in **Table 4**

Table 4: Plants growing in the Region

Sr. No	Botanical name	Habit	Family
1.	*Crossandra undulifolia*	S	Acanthaceae
2.	*Adhatoda vasica*	S	Acanthaceae
3.	*Ammania baccifera*	H	Scrophulariaceae
4.	*Spillanthus acmella*	H	Asteraceae
5.	*Cuscutta reflexa*	H	Convolvulaceae
6.	*Spondisis oinnata*	T	Rubiaceae
7.	*Cayrtia carnosa*	T	Vitaceae
8.	*Mangifera indica*	T	Anacardiaceae
9.	*Alangis lamarokki*	S	Clusiaceae
10.	*Kaeampfria rotunda*	S	Clusiaceae
11.	*Bauhinia racemosa*	T	Caesalpiniaceae
12.	*Cassia sophora*	T	Caesalpiniaceae
13.	*Cassia auriculata*	S	Caesalpiniaceae
14.	*Acacia arabica*	T	Mimosaceae
15.	*Artocarpus hirsute*	T	Artocarpaceae
16.	*Cassia fistula*	T	Caesalpiniaceae
17.	*Ipomoea biloba*	S	Convolvulaceae
18.	*Ipomoea muricata*	S	Convolvulaceae
19.	*Morinda citrifolia*	T	Morindaceae
20.	*Jasminum sambac*	S	Apocyanaceae
21.	*Adansonia digitada*	T	Malvaceae
22.	*Terminalia bellerica*	T	Combretaceae
23.	*Aegle marmelos*	T	Rutaceae
24.	*Grewia orientalis*	S	Tiliaceae
25.	*Sterculia balanghas*	T	Sterculiaceae
26.	*Terminalia catappa*	T	Combretaceae
27.	*Mallotus philippensis*	T	Euphorbiaceae
28.	*Amaranthus spinosus*	H	Amaranthaceae
29.	*Amaranthus viridis*	H	Amaranthaceae
30.	*Cissampelos pareira*	S	Menispermaceae
31.	*Syzygium Caryophyllatum*	T	Myrtaceae
32.	*Thespecia populnea*	T	Malvaceae
33.	*Acacia latronum*	T	Mimosaceae
34.	*Ipomoea digitata*	S	Convolvulaceae
35.	*Ocimum basilicum*	S	Lamiaceae
36.	*Semecarpus anacardium*	T	Anacardiaceae
37.	*Averrhoa bilimbi*	S	Rutaceae
38.	*Flacourtia montana*	T	Flacourtiaceae
39.	*Dioscorea alata*	S	Dioscoreaceae
40.	*Jatropha multifida*	S	Euphorbiaceae
41.	*Acacia intasia*	T	Mimosaceae
42.	*Punica gramatum*	T	Punicaecae
43.	*Ficus gibbosa*	T	Moraceae
44.	*Bauhinia purpurea*	T	Caesalpiniaceae
45.	*Crotalaria juncea*	H	Fabaceae

46.	*Anogeissus latifolia*	T	Fabaceae
47.	*Synsyzigium zeylanicum*	T	Myrtaceae
48.	*Ficus microcarpa*	T	Moraceae
49.	*Nerium indicum*	T	Apocyanaceae
50.	*Ixora barota*	S	Verbenaceae
51.	*Bauhinia tomentosa*	T	Caesalpiniaceae
52.	*Holarrhena antidysenterica*	T	Apocyanaceae
53.	*Woodfordia fruticosa*	S	Malvaceae
54.	*Vateveria indica*	H	Poaceae
55.	*Hiptage benghalensis*	H	Bignoniaceae
56.	*Withania Somnifera*	H	Solanaceae
57.	*Solanum indicum*	S	Solanaceae
58.	*Ricinus communis*	S	Euphorbiaceae
59.	*Jatropha curcas*	T	Euphorbiaceae
60.	*Pithacellolum dulce*	T	Mimosaceae
61.	*Melia azaedirach*	T	Meliaceae
62.	*Flacouritia latifolia*	T	Flacourtiaceae
63.	*Elephantopus scaber*	H	Asteraceae
64.	*Borreria hispida*	H	Boraginaceae
65.	*Cayratia pedata*	T	Vitaceae
66.	*Adiantum lunulatum*	H	Adiantaceae
67.	*Portulaca oleracea*	H	Portulacaceae
68.	*Terminalia bellerica*	T	Combretaceae
69.	*Cayratia trifolia*	S	Vitaceae
70.	*Terminalia bellerica*	T	Combretaceae
71.	*Tinospora cordifolia*	S	Menispermaceae
72.	*Terminalia chubula*	T	Combretaceae
73.	*Jasminum suriculatum*	S	Apocyanaceae
74.	*Hardwickia binata*	T	Balanitaceae
75.	*Lagerstrosmia indica*	T	Lythraceae
76.	*Murraya Koenigii*	S	Rutaceae
77.	*Strychnos nuxvomica*	S	Liliaceae
78.	*Bambusa arundinacea*	S	Poaceae
79.	*Asteracantha longifolia*	H	Acanthaceae
80.	*Celastrus paniculatus*	S	Celastraceaeae
81.	*Sterculia urens*	T	Sterculiaceae
82.	*Diescorea esculenta*	S	Dioscoreaceae
83.	*Kydia calicina*	T	Malvaceae
84.	*Pongamia pinnata*	T	Fabaceae
85.	*Averrohea carambola*	S	Rutaceae
86.	*Ptrerospermum acerifolium*	T	Combretaceae
87.	*Dioscorea hispida*	S	Dioscoreaceae
88.	*Solanum surattense*	H	Solanaceae
89.	*Sterculia colorata*	T	Sterculiaceae
90.	*Magnolia gtandiflora*	T	Magnoliaceae
91.	*Saraka indica*	T	Anacardiaceae
92.	*Musa sapientum*	H	Musaceae
93.	*Terminalia paniculata*	T	Combretaceae
94.	*Helictares isora*	T	Tiliaceae
95.	*Dioscorea pentaphylla*	S	Dioscoreaceae
96.	*Barleria prionitis*	S	Acanthaceae
97.	*Alternanthera sesillis*	H	Amaranthaceae
98.	*Dendrocalamus strictus*	T	Poaceae
99.	*Curculigo orchioidos*	H	Hypoxidaceae
100.	*Citrus medica*	T	Rutaceae
101.	*Dolichandrone falcata*	S	Sapindaceae
102.	*Cissus quadrangularis*	T	Vitaceae
103.	*Indigefera tinctoria*	H	Fabaceae
104.	*Cymbopogon citratus*	H	Poaceae
105.	*Lawsonia inermis*	T	Lythraceae
106.	*Vitex altissima*	S	Verbenaceae
107.	*Cocos nucifera*	T	Arecaceae
108.	*Areca catechu*	T	Arecaceae
109.	*Piper longum*	S	Piperaceae
110.	*Phoenix dactilifera*	T	Arecaceae

Dominant families of plants recorded in the study area are Combretaceae and Caesalpiniaceae and Acanthaceae.

Simpson's Diversity Index of plants in the study area is based on the total number of individuals of different species to the total number of all species. The Simpson's Diversity Index for herb, shrub, and trees is shown that the area has a low diversity of herbs (0.025) › shrubs › (0.116) › trees (0.176).

The percentage of medicinal plant species for particularly these observations is about 45%. Medicinal plants are divided into three categories on the basis of their trade and local use with high, moderate and low medicinal values as presented in **Table 5**.

Natural forests do exist in the area surrounding the project site. However, forest cover on the south-east side has been damaged due to destructive activities. The area of Bondla Wildlife Sanctuary falls in the study area.

Sparse to the dense growth of mangroves are seen in the muddy creeks off coastal belts of the Goa. The present area of survey along the stretch of coast showed the presence of mangrove species viz. *Avicennia marina* var. *marina*, *Rhizophora*, *Bruguria spp. Acanthus ilicifolius* and *Salicornia brachiata*.

Table 5
Medicinal plants growing in the Study Area

Sr. No	Botanical name	Habit	Medicinal Value
1	*Crossandra undulifolia*	S	M
2	*Adhatoda vasica*	S	H
3	*Spillanthus acmella*	H	H
4	*Acacia Arabica*	T	H
5	*Cassia fistula*	T	H
6	*Morinda citrifolia*	T	H
7	*Terminalia bellerica*	T	H
8	*Aegle marmelos*	T	H
9	*Ocimum basilicum*	S	H
10	*Holarrhena antidysenterica*	T	H
11	*Withania somnifera*	H	H
12	*Terminalla bellerica*	T	H
13	*Tinospora cordifolia*	S	H
14	*Strychnos nuxvomica*	S	H
15	*Asteracantha longifolia*	H	H
16	*Ptrerospermum acerifolium*	T	H
17	*Helictares isora*	T	H
18	*Barleria prionitis*	S	H
19	*Cuscutta reflexa*	H	L
20	*Cissampelos pareira*	S	L
21	*Solanum indicum*	S	L
22	*Terminalia chubula*	T	L
23	*Murraya koenigii*	S	L
24	*Saraka indica*	T	L
25	*Lawsonia inermis*	T	L
26	*Bauhinia racemosa*	T	M
27	*Cassia sophora*	T	M
28	*Mallotus philippensis*	T	M
29	*Semecarpus anacardium*	T	M
30	*Averrhoa bilimbi*	S	M
31	*Bauhinia purpurea*	T	M
32	*Bauhinia tomentosa*	T	M
33	*Ricinus communis*	S	M
34	*Adiantum lunulatum*	H	M
35	*Celastrus paniculatus*	S	M
36	*Pongamia pinnata*	T	M
37	*Averrhoea carambola*	S	M
38	*Curculigo orchioidos*	H	M
39	*Citrus medica*	T	M
40	*Vitex altissima*	S	M
41	*Cocos nucifera*	T	M
42	*Piper longum*	S	M

H- High M- Medium L- Low

Fauna

During the present survey 28 species of avifauna were recorded (**Table 6**). The highest index of diversity was recorded at Usgaon village. Based on data collected by the authors' faunal elements found in the region are presented in **Table 7**. The faunal elements listed in **Table 7** are categorized as per Schedule I to IV based on Wild Life Protection Act 1972 and subsequent amendments.

DISCUSSIONS

The floristic structure and species composition in forestland is mainly dominated by *Bischofia*, *Macranga*, *Hoppea sp.* The nature of vegetation cover is mixed, dry, and uneven-aged stands with uneven distribution of *Phoenix sylvestris*, *Anacardium occidentale*, *Cocos nucifera*, *Pteris spp*, *Borassus flabellifer*, *Cassia sp*, and *Caesalpinia sp.* Most of the human population is dependent on agriculture for their livelihood. The grazing on uninhabited wasteland by livestock is a common practice because of more number of cattle and openly available land for grazing.

Few medicinal and economically important plants *Salacia chinensis*, *Rubia cordifolia*, *Spillanthus paniculata*, *hollarhena antidysenterica*, *Tylophora indica*, *Hemidesmus indicus*, *Withania somnifera*, *Curculigo orchioides*, *Gloriosa superba*, *Asperagus racemosus*, *Strychnos nux-vomeca*, *Gymnema sylvestre*, *etc.* and *Anacardium*, *Mangifera*, *Ananus*, *Areca*, *Piper*, *Artocarpus*, *Garcinia*, *Myristica*, *Murraya*, *Citrus*, *Flacourtia*, *Averrhoea*, *etc.* were recorded. Regeneration of trees is poor as compared to herbs and shrubs in the study area except for *Cassias* and *Caesalpinias*.

The density and composition of vegetation hardly change with a change in locations. Grasses and herbs mainly cover open land. Herbs and shrubs are abundant only during monsoon, whereas during rest of the year when the land turns dry, herbs wither and get wiped away from the vicinity. The ground vegetation is composed by seasonal herbs (annual/biennial) with some perennial forms, accounting to 8 species i.e. *Grewia asiatica*, *Cassia tora*, *Tridax*, *Aerva*, *Cyperus*, *Amaranthus*, *Achyranthus*, *Aegeratum* etc. The reduction in vegetation cover is attributed to biotic pressures like fuelwood, livestock grazing, clearing for industrial setup, agriculture, human habitation, loss of fertility, erosion, salinity ingression etc.

The vegetation type is subtropical coastal thorny scrub jungles with trees predominantly moist deciduous type but rarely evergreen. The natural vegetation is scarce, scattered and open. The reserve forest is found only at Gangem. In all other areas, the trees are dominated by *Grewia spp*, *Woodfordia spp*. The forest falls under two major categories like a open Scrub jungle and moist deciduous forests. The forest near Valpoi fall under this category and much of the Goa forest fall under this category.

The major components of the moist deciduous forest are the species belong to the families like Rubiaceae, Bignoniaceae, Anacardiaceae, Sapindaceae, Fabaceae, Caesalpiniaceae, and Mimosaceae. The ground flora also contains species of *Pteris*, *Sellaginella*, etc. The tree components of this forest are belonging to the families like Clusiaceae, Ebenaceae, Fabaceae, Moraceae, Combretaceae, Euphorbiaceae, and Rutaceae. The tallest and largest trees are belong to the species of *Michelia*, *Cryptocarya*, *Actinodaphne*, *Ficus*, *Lagerstroemia*, etc. the shrubby species are *Ixora*, *Calophyllum*, *Garcinia*, *Canarium*, *Artocarpus*, *Mallotus*, *Bischofia*, *Macranga*, *Hoppea*, *etc.*

An average density of plants in Study area is 205 trees, 127 shrubs and 272 herbs/ha in an average noted on the 16 survey locations in the study area. A total of 3280 trees, 2032 shrubs and 4352 herbs were examined in the entire plot area of 1600 x 1600 sq. m. for tree, 320 x 320 sq. m. for shrub, and 80 x 80 sq. m. for herbs. Dominant tree species listed are *Terminalia crenulata*, *Terminalia bellerica*, *Pterocarpus Marsupium*, *Borassus flabellifer*, *Anacardium Occidentale*, *Cocos nucifera and Phoenix sylvestris.* Most dominant shrubs are *Calotropis procera*, *Alangis lamarokki*, *Kaeampfria rotunda*, *Crossandra unduliformis*, *Adhatoda vasica etc.* and in case of herbs *Withania somnifera* , *Indigefera tinctoria*, *Hiptage benghalensis*, *Vetiveria indica*, *and Cymbopogon citratus* are dominant.

The common herbal medicinal flora of the study area consists of *Crossandra undulifolia*, *Adhatoda vasica*, *Spillanthus acmella*, *Acacia arabica*, *Cassia fistula*, *Morinda citrifolia*, *Terminalia bellerica*, *Aegle marmelos*, *Ocimum basilicum*, *Holarrhena antidysenterica*, and *Withania somnifera.*

The faunal species have been categorized in Schedules I, II, III, IV and V as per the Wild Life Protection Act, 1972. In general, the rarest, endangered and almost extinct species are classified under Schedule I. The Department of Forests periodically reviews the list and is empowered to shift the species to any other schedule depending upon rarity of the species. According to Wild Life Protection Act 1972 hunting of animals in Schedule I is prohibited and as per amendment (1991) made to this act none of the animals mentioned in Schedule I to IV can be hunted.

CONCLUSIONS

After the collection of baseline data and subsequent identification and possible impact, the following environmental impact statement have been prepared for Biological component which is likely to be affected or benefited due to growing pharma units in the area.

The Simpson's Diversity Index for herb, shrub and trees is shown that the area has low diversity of herbs (0.025) › shrubs › (0.116) › trees (0.176). The percentage of medicinal plant species for particularly these observations is about 45%.

Regeneration of trees is poor as compared to herbs and shrubs in the study area except for *Cassias* and *Caesalpinias*. Average density of plants in Study area is 205 trees, 127 shrubs and 272 herbs / ha in an average noted on the 16 survey locations in the study area.

During the present survey 28 species of avifauna were recorded. The highest index of diversity was recorded at Usgaon village. In general, the Rare, Endangered and Almost extinct species are classified under Schedule I. Only two species of Mammals ie. *Lepus nigricollis*, *Canis lupus* and one species from Reptiles ie. *Python molurus* noted in Schedule I.

Most of the reserved forest area is on the West and South of the Pharma Industries zone. South-east and East being the most prevalent wind direction, thus, no adverse impact on reserve forest is predicted. The liquid wastes to be generated during processing is being treated by conventional method so as to meet the stipulated standards. The resultant effluent, after discharge in receiving water body, will not have any adverse impact on aquatic ecology.

There is no negative impact observed on the existing natural vegetation and there will not be the change in the existing biodiversity due to pharmaceutical industry in GIDC zone. The wind flow pattern is in opposite direction of the Bondla wild life century. Thus, Wild life is not at all affected air and noise pollution provided there must be scientifically developed Greenbelts. India has a list of threatened species published in Red Data Book by the Botanical Survey of India and Zoological survey of India. No species enlisted in present survey are recorded in Red Data Book as threatened, rare or endangered.

Green Belt Development

As the GIDC is surrounded by lush green forest area along with Bondla Wildlife Sanctuary region. But it is observed that Southeast region of the industrial zone is almost barren. Therefore, it is recommended that green belt should be develop on the basis that it should absorbs air pollutants, fast growing, thick canopy, perennial and ever green and large leaf area index.

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Table 6
Dominance and diversity of Common Birds

Sr. No.	Location	Most Dominant Species	Diversity Index	Dominance Index	Species Richness	Total Density (Km^{-2})
1.	Bondla	Little egret	1.86	40.54	9	185.00
2.	Candepar	Common myna	2.05	25.00	10	200.00
3.	Usgaon	House crow	1.36	35.00	6	100.00
4.	Peliem	Blue rock pigeon	2.00	30.31	8	82.50
5.	Codar	House swift	1.60	43.48	6	57.50
6.	Vaghurmem	House sparrow	1.17	76.93	4	32.50
7.	Palle	Blackwinged stilt	2.01	58.35	6	30.00
8.	Cothambi	House sparrow	1.00	77.78	5	135.00
9.	Paikul	Little egret	1.60	31.25	8	200.00

Table 7
Faunal Elements in the Region

Sr. No.	Name	Zoological Name	Family	Feeding status	Status in Wildlife Protection Act-1972
	Mammals				
1	Langur	*Presbytis entellus*	Cercopithecidae	Herbivore	Sch-II
2	Hare	*Lepus nigricollis*	Leporidae	Herbivore	Sch-I
3	Squirrel	*Funambulus sp.*	Sciuridae	Herbivore	-
4	Wild Boar	*Sus scrofa*	Suidae	Omnivore	Sch-III
5	Wild Dog	*Cuon alpinus*	Canidae	Carnivore	Sch-II
6	Wolf	*Canis lupus*	Canidae	Carnivore	Sch-I
7	Jackal	*Canis aurcus*	Canidae	Carnivore	Sch-II
	Snakes				
8	Python	*Python molurus*	Boidae	Carnivore	Sch-I
9	Indian Cobra	*Naja naja*	Elapidae	Carnivore	Sch-II
10	Pit Viper	--	Crotalidae	Carnivore	Sch-IV
11	Krait	*Bungarus candidus*	Elapidae	Carnivore	Sch-IV

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