STUDY AREAS

Prior to independence, Baroda was the capital of one of the most powerful Princely State of India. The character of this city closely reflects the legacy of His Highness Maharaja Sir Sayaji Rao Gaekwad III. Being a great city planner he was a progressive ruler. Successive rulers added palaces, lakes and parks, making the city one of the most charming urban centers in this region. Originally Vadodara was known as 'Vadapadraka' meaning a village amidst the banyan trees. It rises from the banks of River Vishwamitri. Britishers called it Baroda, however, that has been changed back to Vadodara (Long 73° 15" 18' E and Lat. 22° 17" 59' N). Initially it was a cultural capital, several industries originated in this region and thus became industrial capital of Gujarat State too. It is the third most populated town of Gujarat State and 16th most populated city of India. It is also a part of "Golden Corridor" of Gujarat State. After the formation of Gujarat state in 1960; the city experienced real boom in industrialization. National projects like Gujarat Refinery, Indian Petrochemicals Ltd., Gujarat State Fertilizer Company, Indian Petrochemical Co. Ltd., *etc.*, were set up in and around Vadodara.

The city to experience the first aspects of urbanization during the rule of Sir Sayajirao Gaekwad III (1875-1939 AD). He was a visionary person and he built this university, which was later named after him as the Maharaja Sayajirao University of Baroda. Under his able guidance, the princely state of Baroda had become one of the most progressive states in India. During recent time the increasing industries and development has led to the increase in the vehicular traffic, concrete constructions and expanded residential areas. During

1980s the city has seen the development of specified industrial estates in the outskirts at Makarpura, Ajwa and Waghodia areas now parts of the city and developed industrial area of Savli and Por just on the outskirts of the present Urban limits. This resulted in the physical growth of city from time to time. These industrial and commercial activities have developed along the major arterial roads running along North-South and East-West directions of the city. Initially, the development took place along the four axis of Mandvi the old city area that expanded outwards in West and North Western direction. Consequently, there was increase in the administrative limits from time to time. The city municipal area which was 22.68 Sq.Km in 1921 increased to 72.44 Sq.Km by 1964, 97.22 sq.km. in 1973 to 108.22 sq.km till 1996. At present, the city is subdivided into 10 administrative wards. Vadodara Urban Development Authority (VUDA) was established on 1st February, 1978. The VUDA Covers 714 Sq.Kms area including Baroda Municipal Corporation and area of Vadodara, Padra, Waghodia Taluka covering 104 villages. In Vadodara residential area spreads in 7560 acres and commercial areas is 2442 acres and roads and railways is 1688 acres (VUDA).

In past, Vadodara had good number of Banyan trees hence the city was named as "Vadodara". Because of developed high ways and industrial areas, the old vegetation has been removed and the concrete jungle has come up and country side is vanished. However, at many places, environment conscious people have either protected some trees or developed various green patches. A small river cutting across the city divides the city into two parts the old and the new city. The present study is aimed to document avifaunal diversity and density in these various parts-

the varied micro habitats of the city and find out influence of urbanization on bird density and diversity.

In the first part of the study twelve different areas of Vadodara city were selected. These were divided in to four categories depending up on the human disturbances. These were: ***I Disturbed areas (DA), II Moderately disturbed areas (MD), III Undisturbed areas (UD),*** **IV** ***Ponds (PS).*** Second part of the study was comparative study of avifauna, plankton diversity and quality of water of two water bodies. These were one Village pond (Savli Village Pond, SVP), under anthropogenic pressures and an Irrigation Reservoir (Jawala Irrigation Reservoir, JIR) without anthropogenic influence and both in same areas, facing similar climatic conditions.

Part I

The locations of 12 different areas selected in present study are shown in Plate I. these are:

I. Disturbed areas (Urban lands)

(a) **R. C. Dutt Road (RCDR)** (Plate II): It is situated on the west side of Vishwamitri river. It starts from the west side of Railway station and runs in east-west direction. It is also known as Alkapuri Area (22° 18' 35 N 73° 10' 17 E). At the beginning of road Government Circuit House is present with many large trees used for roosting by Rose- ringed Parakeet. This road is occupied by commercial buildings, hotels, malls as well as few residential buildings. The transect area covered was 0.03 Km^2.

(b) **City area (CA)** (Plate III) (22° 18' 06 N 73° 12' 27 E)**:** This area is situated on eastern side of the Vishawamitri River. It includes the old fortified city with a

small Lake called "Sursagar". It is the part of old city. This area possesses commercial as well as residential buildings with very less vegetation. The transect area was 0.05 Km^2.

(c) **Industrial area (IA)** (Plate IV) (22° 14' 53 N 73° 11' 14 E): The area selected is on Southern side of city. It is having large industrial shades surrounded by planted vegetation. This area is surrounded by few residential buildings too. The transect area covered was 0.05 Km^2.

II. Moderately disturbed area (Suburban lands)

(d) **Sayajibaug (Kamatibaug) (SG)** (Plate V) (22° 18. 53' N 73° 11 20' E): It was at outskirts of city during princely era but presently located in the center of city. It is present on the eastern side of University Campus separated by an old highway busy with traffic and located less than 1 Km from Vadodara railway station. It is a municipal public park with lawns and roads attracting joggers, strollers and tourists from morning to evening. It also has a famous Zoo, a Planetarium, a famous Museum, with art gallery, an aquarium, and a toy train. Children enjoy 3.5 Kms joy ride through the park by which this is a major attraction. Some part of the garden has green lawns as well as flowering plants. River Vishwamitri divides the park into two parts. The riverine area is comparatively less disturbed and there by attracts several species of birds. The transect area was 0.087 Km^2.

(e) **University Campus (UC)** (Plate V and VI) (22° 18. 46' N 73° 11 07' E): The transect area was 0.08 Km^2. This was the campus of The Maharaja Sayajirao University of Baroda named after Maharaja Sayajirao Gaekwad III, the former ruler of Baroda. Originally known as the Baroda College of Science (established 1881), it received the rank of a University in the year 1949 after India became an

independent country. It is being a residential university offers all its courses under a single roof. It has number of faculties. The varied habitats in this area are tributary of Vishwamitri River, botanical garden, cricket ground, other gardens with lawn and trees. It has moderate to high student disturbances. Though the numbers of concrete structures are increasing it still retains good natural vegetation in some areas and also has gardens with exotic species. The cricket ground provides open grassland type habitat for birds like wagtails, lapwings, mynas and also kites, besides tributary of Vishwamitri cutting across the campus provides lentic habitat with forest type of vegetation. When the university campus was established it was out of the city limits. After 6 decades it is now in the heart of the city situated near railway station as well as central S. T. bus Depot. It is separated from SG by only an old national highway now main road of city loaded with vehicular traffic.

(f) **Akota Garden (AG)** (Plate VII) (22° 17' 36" N 73° 10' 19" E)**:** It is situated on the western side of Vishwamitry River and just 3 Kms. from railway station. It is a small public park mainly surrounded by residential area and few commercial buildings. It has lawns with plenty of vegetation. It has moderate disturbances to birds by human activities like laughing club, yoga classes *etc.* The area transect in the garden is 0.03 Km^2.

(g) **Residential area (RA)** (Plate V and VIII)**:** There area total 4 different houses selected in different residential area of Vadodara city. One near Akota Garden (Mangalam , 22° 17' 27" N 73° 10' 08" E) one near Sayajibaug (Adhyapak kutir, 22° 18' 57" N 73° 11' 59" E) all surrounded by the plenty of vegetation, one North-East on the outskirts of Vadodara city (Sama, 22° 20' 22" N 73° 11' 58" E) and one

in North-West (Subhanpura, 22° 19' 13" N 73° 09' 23" E) of Vadodara city with commercial buildings and small gardens. The point count area was 0.2 Km^2.

III. Undisturbed areas

(h) **Model farm (MF)** (Plate IX) (22^0 17' 13" N 73^0 10'25" E): It is a Government agricultural Farm now almost in the center of the city. It was established in 1892 by Shrimant Maharaja with the aim to educate and train farmers of Vadodara and adjoining regions in agriculture and allied fields. In this context, Agricultural Diploma School was established. After establishment of Gujarat Agricultural University in 1972, this center was handed over to the Gujarat Agricultural University as sub station of Anand, engaged with education, research and extension activities. After the separation of agriculture campus in Gujarat now it is a sub institute of Anand Agricultural University. It is divided in to 3 parts. In one part, seasonal farming activities are carried. In second part, fruit and large trees are present. It has total 33.08 ha. area with 22.47 ha. area under cultivation and 20.07 ha. used for agricultural crops. The third part includes 2.40 ha area for horticultural crops, 10.21 ha area for irrigation purpose and 10.61 ha area occupied by farm structure, buildings and roads. The main source of irrigation is tube well. (http://www.aau.in/english/RES_PULSE.ASP) (Dr. Vallabhbhai Virabhai Sonani). This area is surrounded by residential areas as well as industries and few commercial buildings. The point count area covered here was 0.35 Km^2.

(i) **PTC Campus (PTCC)** (Plate X): The Department of Posts, Government of India started experimenting with the idea of franchising some postal services. For this purpose, 100 cities were selected in India to test the financial viability. Out of the ten cities selected in Gujarat, The Baroda franchises (Postal Training Center)

(22^0 19' 55" N 73^0 12' 40" E) are located at New VIP Road (Karelibaug) and Vishwamitri Township, (http://www.baroda.com/diaryJanDec06.html). The campus situated near Vadodara air port has good vegetation, lawns, a small pond, a ground and minimum disturbances of human being, and vehicles hence it was selected as one of the undisturbed study area. The transect area covered was 0.2 Km^2.

IV. Ponds

(j) **Lal baug Pond (LP)** (Plate XI) (22^0 16' 58" N 73^0 11' 47" E)**:** It is situated in the southern part of the city about 5 kilometers from the railway station located on north side of a municipal garden called lalbaug but separated from it by a railway line. It is surrounded by few commercial as well as residential buildings and large trees. The garden is occupied by the walkers and joggers during morning and evening. Pond has high level of eutrophication. The transect area was 0.03 Km^2.

(k) **Gotri Pond (GP)** (Plate XII) (22^0 18' 52" N 73^0 08' 08" E)**:** GP is situated on the Western outskirts of the city. Pond has minimum eutrophication and very sparse vegetation. It is surrounded by residential buildings. A small temple is present at the edge of the pond. GP receives domestic as well as sewage waste from the surroundings. Moreover, after Ganesh Chaturthi festival idols of Lord Ganesha along with lots of flowers and other materials are dropped in the pond. The area covered was 0.03 Km^2.

(l) **Harni Pond (HP)** (Plate XIII) (22^0 20' 18" N 73^0 13' 09" E)**:** About a decade ago HP was located outside the Vadodara city but now it comes within city limits. It is surrounded by various types of microhabitat with commercial as well as residential buildings in South and West, the Airport runway on the south eastern

side, a state highway on the West and slums and small industries on the North side. The pond receives sewage input from residential buildings constructed recently on the edge of the pond. This pond is used for various domestic activities like washing clothes and utensils, bathing, *etc.* Harni Pond has submergent as well as emergent vegetation. In 1950, the pond area was 45 acres (Pathak and Satakopan, 1957) which reduced to about 20 acres in 1995 (Padate and Sapna, 1996) and now it occupies only 2 acres (Deshkar, 2008). Padate and Sapna (1996) recorded 131 species of birds in 1990 at HP. The area covered was 0.05 Km^2.

PART II:

To measures the impacts of urban development directly on water birds, avifauna of two water bodies exposed to same climatic conditions but different anthropogenic pressures were studied with their plankton diversity as well as physicho-chemical characteristics of water. Plate XIV shows location of these two ponds in Vadodara District, Central Gujarat, India. These water bodies are:

1. Savli Village Pond (SVP) (Plate XIV, XV and XVI): It is located at Savli (22° 33' 50" N and 73° 13' 23" E), a developing town in Vadodara district of central Gujarat. It is about 33 kilometers North of Vadodara city. It has seven wards and from August 2005 was considered as a town. According to 2001 census it has a population of 15,742 (Anonymous, 2007). This town has a perennial pond that spreads in area which is under pressure of urbanization. Savli Nagarpalika has future plan for developing the Savli town.

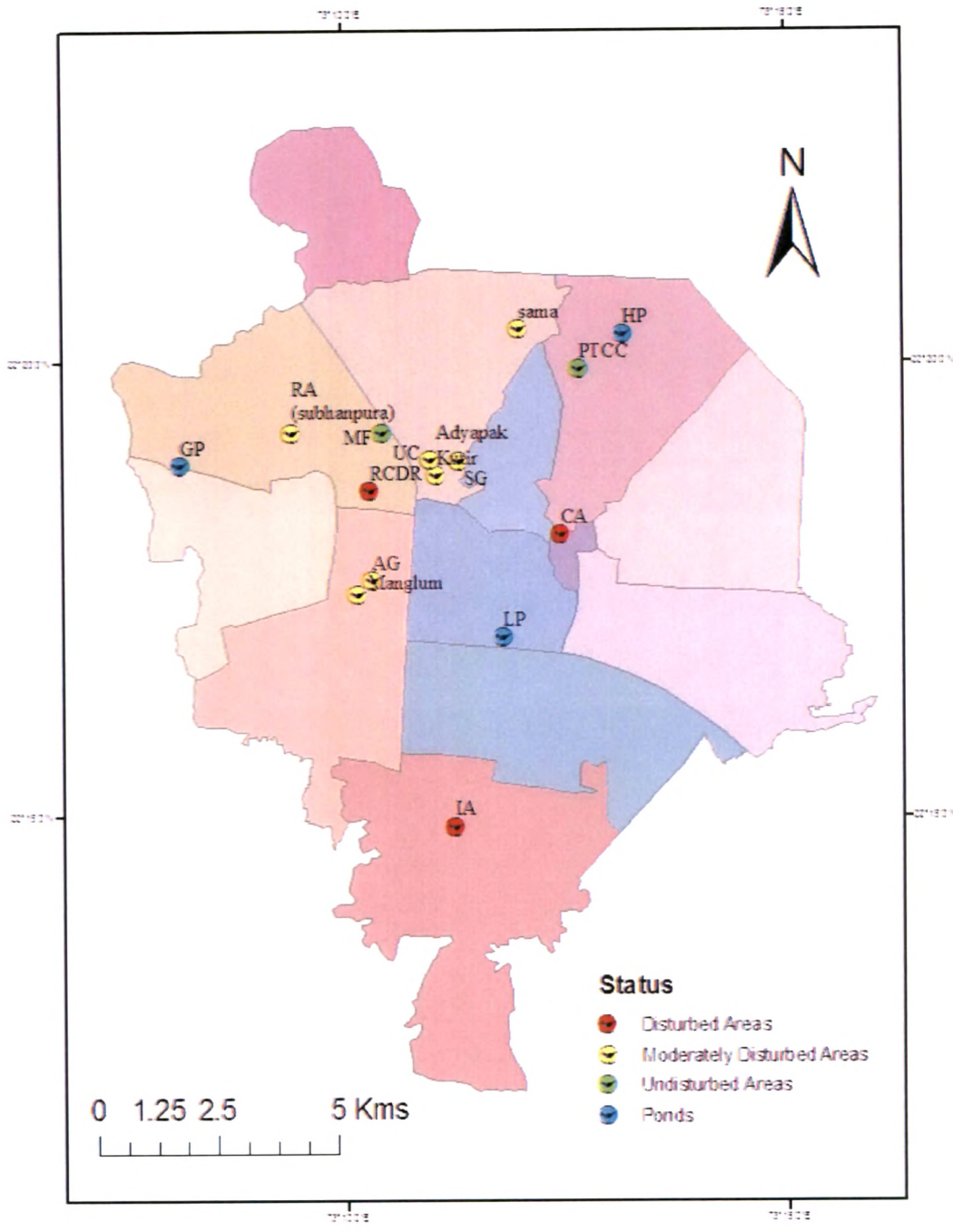
2. Jawala Irrigation Reservoir (JIR) (Plate XIV, XV and XVII): It is located about a kilometer South -West of Savli pond (22° 34', 20" N and 73° 19' 24" E). Jawala is a suburb of Savli Town. On East side of Jawala village, Jawala Irrigation

Reservoir is present. It is a monsoon dependent reservoir. This irrigation reservoir has almost no human disturbance as compared to the Savli pond. JIR is totally surrounded by the agricultural fields. It has a temple on earthen dam of 2 Km which marks the Western boundary and the reservoir spreads in 0.78 Km^2.

During present study all together about, 384 times these different areas, in the city were surveyed besides, 96 visits of Savli and Jawala water bodies were studied in detail from July 2005 to September 2007.

PART I

PLATE I
Location of different Study areas in Vadodara City



DISTURBED AREAS (DA)

PLATE II
R. C. Dutt Road (RCDR)
Google Earth Image

DISTURBED AREAS (DA)

PLATE III
City Area (CA)
Google Earth Image

DISTURBED AREAS (DA)

PLATE IV
Industrial Area (IA)
Google Earth Image

MODERATELY DISTURBED AREAS (MD)

PLATE V
Sayagi Garden (SG), University Campus (UC) and Residential Area (RA) (Google earth image)

Sayagi Garden (SG)

MODERATELY DISTURBED AREAS (MD)

PLATE VI
University Campus (UC)

MODERATELY DISTURBED AREAS (MD)

PLATE VII
Akota Garden (AG)
Google Earth Image

MODERATELY DISTURBED AREAS (MD)

PLATE VIII
Residential Area (RA)

UNDISTRUBED AREAS (UD)

PLATE IX
Model Farm (MF)
Google Earth Image

UNDISTRUBED AREAS (UD)

PLATE X
Postal Training Center Campus (PTCC)
Google Earth Image

UNDISTRUBED AREAS (UD)

PLATE X (Continue)
Postal Training Center Campus (PTCC)

PONDS

PLATE XI
Lal baug Pond (LP)
Google Earth Image

PONDS

PLATE XII
Gotri Pond (GP)
Google Earth Image

PONDS

PLATE XIII
Harni Pond (HP)
Google Earth Image

PART II

PLATE XIV

Location of Savli **Pond and Jawala Irrigation Reservoir.**

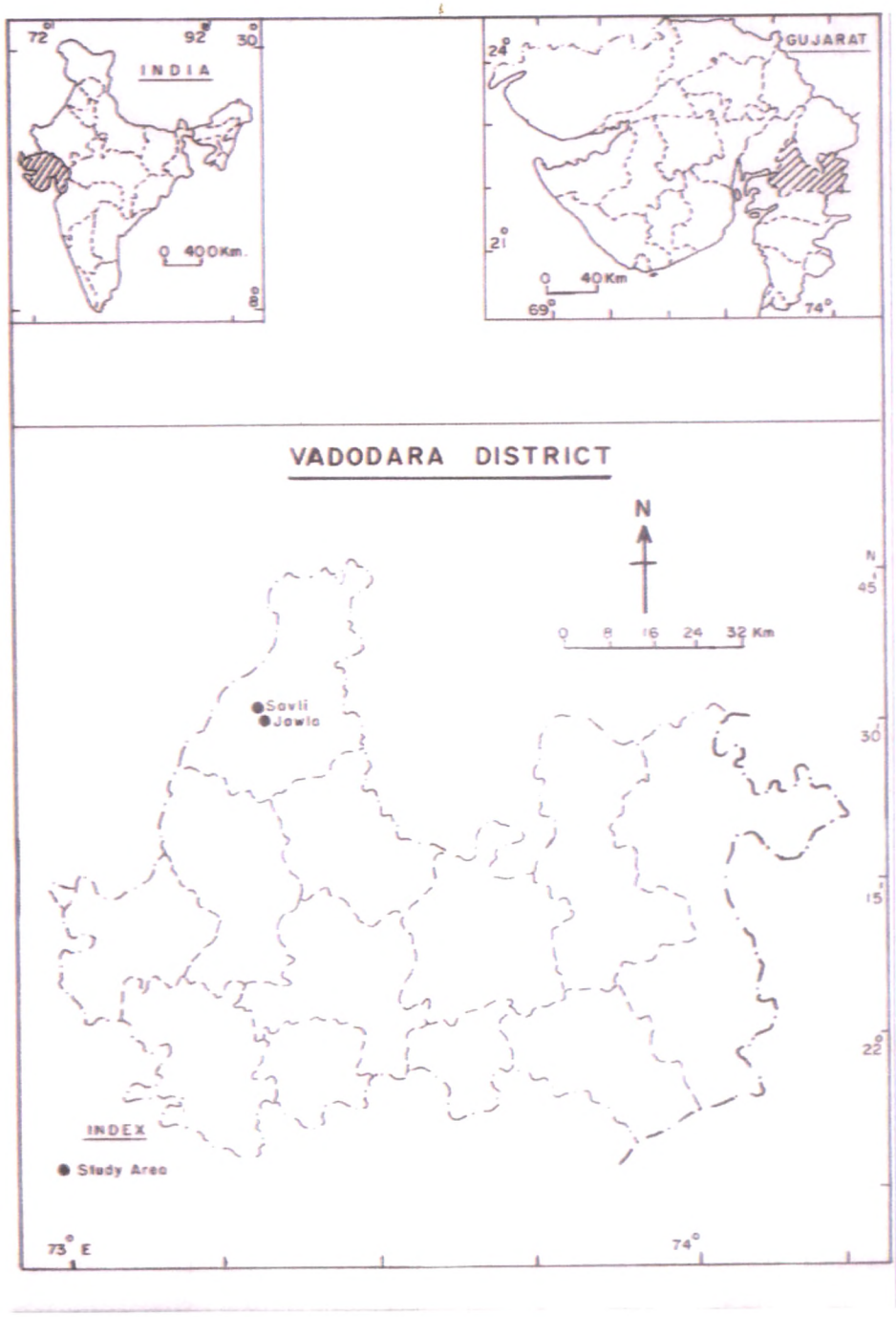


PLATE XV

Savli **Pond (SVP) and Jawala Irrigation Reservoir (JIR) (Google Earth Image)**

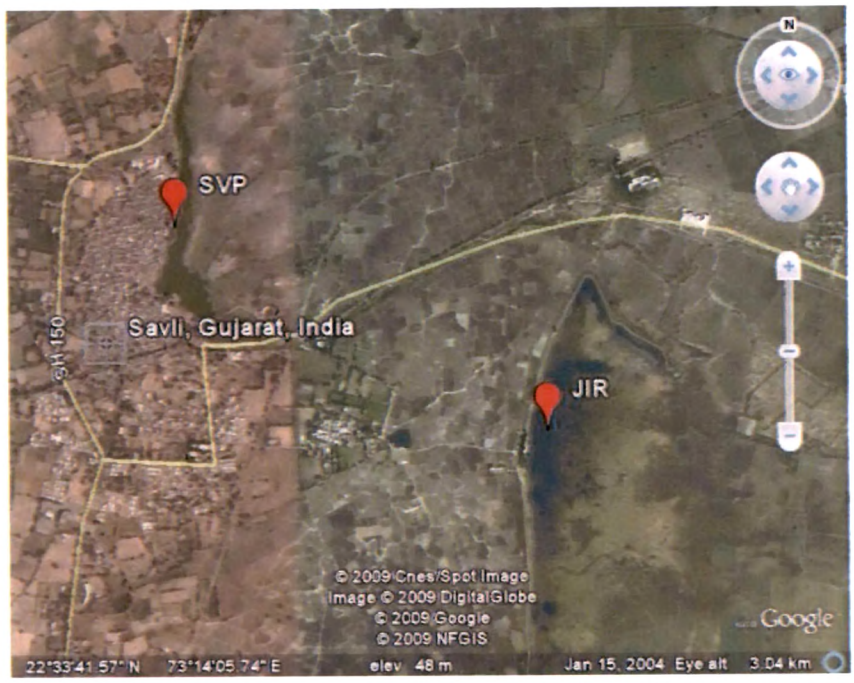


PLATE XVI

Savli Pond (SVP) during Summer

Savli Pond (SVP) during Monsoon

PLATE XVII

Jawala Irrigation Reservoir (JIR) during summer

Jawala Irrigation Reservoir (JIR) during Monsoon