Ecosystem Services, Poverty and Global Change: Understanding links in Gujarat desakota areas of India

By
Winrock International India

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A. Introduction

Desakota, an Indonesian word, means village-town. Thus the rural area having a characteristic of urban area is categorized under it. The natural as well as human resources are stressed at its optimum level to support the changing economic structure, like water of the area have to support the households and agriculture along with industries. On the other hand, these industries not only use the resources but dispose. Apathy of these areas is these are still considered as rural areas and the development plans are structured accordingly.

Most of the available studies have explored human pressure on ecosystem services in urban setups but the dynamics of this relationship remains relatively unexplored in the desakota areas that are in process to urbanization. The dual influence of traditional rural norms and the novel urban factors on the social, economic and ecological systems triggers unique responses from the human system in terms of changing interaction, dependence and demand of vital ecosystem services. The current study takes an insight into the changing status and condition of ecosystem services in these areas. The objectives of the study are to:

- Conduct preliminary assessment of the impact of global environmental change and political economy factors on the water based ecosystem services in these areas undergoing a process of urbanization and, in turn the poverty
- Highlight the gaps that exist in the secondary literature and ground reality in these areas on the marked issues.

B. Methodology and Data Aspects

Information and data related to the subject and area was collected from various government and non-government organizations. Also, web-based literature was reviewed on macro level, like information on policies, rules, acts and schemes for natural resources especially water resource management in India as well as the state level. This preliminary review helped to frame strategy to select desakota areas.

Based on the Ramachandran’s definition and classification of rural-urban fringe, the method for demarcation of desakota area was devised. A three level selection procedure was followed to select areas.

Level 1: Sabarmati Basin Area: The basin in Gujarat state with a rectangular corridor of 175 km by 75 kms, presents a unique combination of vulnerable environment and ecological variables, making it ideal location for the current study.

Level 2: Ahmedabad-Gandhinagar Districts: The selection was limited to desakota areas surrounding Ahmedabad city. A total of three talukas from these districts were selected based on demographic features, i.e. Sanand and Daskroi taluka from Ahmedabad district and Gandhinagar taluka from Gandhinagar district.
Level 3: **Selection of villages from the selected districts**: Based on the change in land use pattern and male working population in last decade - 1991 to 2001, two villages from each of the selected talukas were selected.

The selected villages for detail investigation include:

i. Lapkaman and Chosar villages from Daskroi Taluka

ii. Matoda: and Navapura villages from Sanand Taluka

iii. Tarapur and Jakhora village from Gandhinagar Taluka

Both primary and secondary data was collected for accomplishing the objectives of the study. The primary data on the demographic, social and political economy factors selected during preliminary survey was collected through various focus group discussions and semi-structured interviews with community groups from selected villages. This primary data was complemented with secondary data collected from various government and non-government organizations. Secondary data was collected at different levels: research reports, working papers, statistical information and policy documents. Finally the data was analysed to highlight the knowledge gaps that exist between the published data and the ground realities in regard to the water based ecosystem services.

**C. Sabarmati River Basin: It’s Present and Future Prospects**

a. **Physical Attributes of the Sabarmati River Basin**

Located in northwestern India, Sabarmati basin comprises of area from Rajasthan and Gujarat state. In total, Gujarat accounts for 17550 km² of total catchment (81%) area of the basin. Before emptying itself into the Gulf of Cambay in the Arabian Sea, the river passes through Gandhinagar and Ahmedabad city of Gujarat State. Average temperature of the basin ranges from 25°C to 27.5°C, with an average annual rainfall of 750 mm. High co-efficient of variation of rainfall in the basin results to droughts in the basin. The river is perennial in nature with three smaller sub-basins namely: Dharoi, Hathmati and Watrak. The average annual surface water resources of the basin in Gujarat have been estimated to be 3,256 million cubic meters (MCM), while the average recharge of the groundwater is estimated to be 2,570 MCM per year.

b. **Demographic Attributes of the Sabarmati River Basin**

In 2001, the basin’s population was 11.75 million, of which 11.44 million in Gujarat. The per capita water availability in the basin is 324 m³/person/year, which is the lowest in India. About 52 percent of the population in the basin is urban, all of which lives in Gujarat. Ahmedabad alone accounts for 74.2 percent of the basin’s urban population and 35.7 percent of the basin’s total population.

c. **Economic Attributes of the Sabarmati River Basin**

Agriculture accounts for 57 percent of the total geographic area of the basin. The cropping pattern shows a significant change over the years with commercial agriculture being predominantly practiced in areas close to the urban centres. Kharif and rabi season are the main cultivation seasons, summer crop depends on the
availability of irrigation facility in the area. About 19 percent of the land in the basin is not available for cultivation. This land is either naturally hostile to cultivation (bare, hilly, marshy, saline) or it has been developed (build up areas, roads, railways and other uses). Rest 24 percent is forest and pastures.

Within the Gujarat portion of the basin, there are 11 major and medium irrigation projects, five diversion projects, and many minor projects. In addition to the irrigation projects, the basin characterizes significant inter-basin transfer through network of canals and reservoirs, which import water from the Namada River and the Mahi River.

The region is witnessing industrial boom with water intensive industrial units coming up at rapid pace irrespective of the limited surface water supply. The basin supports a large diversity of industries comprising of both large and small scale textile industries followed by chemical industries, dairy and alcohol being other industries. In addition to these industries industrial estates developed by Gujarat Industrial Development Cooperation (GIDC) have come in all urban centres in past two decades.

d. Basins’ Water and its Uses
In general, 85 percent of rural drinking water comes from groundwater; rest is supplied from basin’s surface water. In the Sabarmati river basin’s urban centers, the majority of current water demands are met through a combination of groundwater wells and surface water imports. About 85 percent of the basins’ groundwater is used for irrigation, while 15 percent is used for industry and domestic purposes. Of 921 villages affected by poor groundwater quality in the basin, 58 percent are affected by fluoride, 23 percent by salinity, and 19 percent by nitrates.

D. Existing and Emerging Ecosystems Trends in the selected Region (Sabarmati Basin)

a. Groundwater Status: Trends in Groundwater Development
The basin have a high yielding aquifers, despite this the groundwater resource of the region is fast declining because of extraction of the ground water at a rate which far exceeds the recharge. Depleting state of groundwater in the region is evident from the fact that out of 6 districts falling in the basin, 3 namely Banaskantha, Gandhinagar and Sabarkantha are “over exploited” (draft >100% of recharge). At the taluka level out of 29 talukas, 8 are “over exploited” (draft >100% of recharge), 3 are in dark category (draft >85% recharge) and 5 in grey category (draft between 65- 85% of recharge). Declining water table is not the only issue related to ground water in the region, scarcity of water is further aggravated due to deteriorating water quality. The groundwater in the region is affected by multiple quality issues and suffers from high salinity and high fluoride and nitrate content making it unfit for domestic use.

b. Trends in Ecosystems Change
Various central and state government programmes are initiated towards ecological regeneration of natural resources, like Joint Forest Management (JFM), Integrated Watershed Development Programme (IWDP), and Participatory Irrigation Programme (PIM). Also, the Gujarat Ecological Commission (GEC) has formulated SEAP (State Environmental Action Plan), through which it has assessed the major environmental problems in the state and accordingly initiated an action plan. All these programmes has not only helped to restore the ecological balance in an area but also created immediate employment for the local people. Also, the assets generated through these programme have stabilized the employment and livelihood of people. Increased production of fuel wood and fodder through JFM programmes, and promotion of local water harvesting structures has enhanced the availability of fodder, fuel wood and water to a large section of people in villages. Easy accessibility of basic necessities has created positive impact on health and literacy of people in some cases.

c. Implications of Climate Change
The Global climate models (GCMs) and Regional climate models (RCMs) predict rising temperature and changing monsoon pattern for India. The climate change vulnerable regions of India include drought-prone areas including the States of Gujarat and Rajasthan and the flood-prone areas comprising of the north-eastern part.

In last 10 years (1997-2006), Gujarat has experienced cyclone (1999), droughts (2000, 2002), earthquake (2001) and floods (2000, 2006). A statistical analysis of the last couple of decades shows that the intensity and return period of major drought events has increased substantially, showing correlation with climate change impacts. The drought of 2001-2002 has affected 39.23 percent of the total population and 38.48 of the livestock of the State.

Contrasting to this observation of increasing intensity of the drought, the state currently is witnessing an increased occurrence of flood. In synchronization with the RCM predications of increased rainfall in the western region of India; the state has witnessed plenty of rainfall and five consecutive years of flood.

It can be predicted that similar trends would be witnessed in the Sabarmati basin although the uncertainty attached with climate change can result in contrasting scenarios. A study on climate change impacts on the hydrology of India reveals that the rainfall in Sabarmati basin will show an approximately 39% decrease from normal scenario to GHG scenario. A similar decline of about 57% and 33% is seen in river runoff and evapo-transpiration, respectively. Thus, this changing pattern of occurrence of extreme climatic events in the basin has serious implications on the social, ecological, economic and political scenario in the basin, as each of these aspect tries to reorient in a manner to cope with the changing climatic scenario.

E. Characteristics of Selected Districts – Ahmedabad and Gandhinagar

a. Introduction to the Study Area
Ahmedabad district, located in North Gujarat, encompasses a total area of 8087 km². The district has 11 sub-districts. Ahmedabad city is the major urban centre of the district and is witnessing rapid expansion. The district is bestowed with Sabarmati River and other seasonal rivers like Meshwo, Sukhbhadar and Bhogavo. Gandhinagar is an administrative capital of Gujarat, situated at the western bank of Sabarmati River. The district encompasses an area of 2163 km². Gandhinagar is bestowed with Sabarmati, Meshwo and Khari rivers.

b. Demographic Details
The total population of Ahmedabad district as per the Census of 2001 was about 58.16 lakhs¹. The district has been showing a growing trend towards urbanization as the urban population has risen from 78% during 1991 census to 80% during 2001. The sex ratio of the district is 892. The literacy rate in the district is 69.5 as per the 2001 census. However, the literacy among male population is as high as 76.4 percent, whereas only 62.7 percent of total female population is literates. Occupation attributes of the district follows the population composition, as 87.3 percent of the population is with non-agricultural sector (Census 2001). It was 75.9 percent in 1991. There are 3166 primary schools and 736 secondary schools in Ahmedabad district (2000-01).

According to the 2001 Census the total population of Gandhinagar district is 13.34 lakh. The urban population has risen from 29% in 1991 to 35% in 2001. This occupation feature of the district is also changing as the percentage male main working population 59 percent in 2001. The sex ratio of the district is 912 and the literacy rate is 76.6 as per 2001 census. There are 976 primary schools and 175 secondary schools in the district.

c. Performance of Agriculture
The share of employment at agricultural sector has declined rapidly from 22.29 percent in 1991 to 18.18 percent in 2001. In 1995-96, about 44.86 percent operational landholdings are of small and marginal farmers (less than 2 hectares) who operate only 13.1 percent of the cultivable area of the district. The net area sown is 62.5 percent of the total area of Ahmedabad district, of that only 26.2 percent is irrigated. Irrigation intensity of the district is 123.04 percent. The major sources of irrigation are tubewells & other wells (80.8 percent of net irrigated area), followed by canals (18.65%) and tanks (0.53%). About 48115 tonnes of fertilizer is used in Ahmedabad district. In total there are 9896 tractors in the district, 12076 oil engines with pumping sets and 6837 electric pumps in the district (as per the livestock census, 2003). There are 14002 dugwells in the district (2001-02), which irrigates 59200 hectares of gross irrigated area. The district has 2381 tubewells, which irrigates about 77500 hectares of gross irrigated area.

Agriculture sector in Gandhinagar uses 19521 tonnes of fertilizer. The district has 3762 tractors, 287 oil engines with pumping set, 5501 electric pump sets (2003). The district has 2171 dugwells and 5446 tubewells for irrigation purpose. Dugwells irrigate 4500 hectares and tubewells irrigates 123900 hectares of gross irrigated area in the district.

¹ 1 lakh = 0.1 million
The net area sown in the district is 73.8 percent of the total area of Gandhinagar district, of which 56.04 percent is irrigated. Irrigation intensity\(^2\) of the district is 143.46 percent. The only source of irrigation in the district is tubewells and other wells, which irrigates 89500 hectares of the net cropped area. Agriculture sector employs more than half of the total working population of Gandhinagar district, which is 51.24 percent. The share of agricultural labourers in the agricultural workforce has decreased from 22.94 percent in 1991 to 21.65 percent in 2001. In 1995-96, about 71.35 percent of operational landholdings were of small and marginal farmers accounting for just 36.9 percent of the total cultivable area of the district.

d. Industries
As per the CMIE data, there are 314 working factories in Ahmedabad district, which employs 18219 persons (2000-01). Number of registered SSI units in the district is 6591 (2202-03). Similarly, Gandhinagar district have 203 working factories employing 12914 persons (2000-01). Number of registered SSI units in the district is 61185.

e. Migration
About 83.4% of the migrants in Ahmedabad district are engaged with secondary and tertiary sector (other than HH industry). About 12.6 percent of the migrants in the district are agricultural labourers, followed by 3.27 percent of the cultivators. Similarly, 80.7 percent of the migrants in Gandhinagar district are engaged in secondary or tertiary sector. About 14.06 percent are agricultural labourers, 4.25 percent cultivators and rest workers in household industry. Its shows that mobility is high among the people engaged with secondary and tertiary sector.

f. Infrastructure
The road density of the Ahmedabad district is 0.42 per sq.km and of Gandhinagar district is 0.91. All the villages in Ahmedabad district and about 97 percent of the villages in Gandhinagar are electrified by 2001-02.

g. Water Resources: Demand, Supply and Distribution
The water supply within Ahmedabad city limits is catered by Ahmedabad Municipal Corporation (AMC), which is dependent on both surface water and groundwater sources. The rural water requirements are mostly catered through a total of 404 regional water supply schemes, reaching to 4675 villages. Irrigation water for agriculture is supplied to the rural areas of the district mainly through the Fatehwadi canal but this supply is always complemented with groundwater extraction from private and community bores present in the villages.
The water supply to Gandhinagar city is managed by the Gujarat State water Supply and Sewage Board (GSWSSB), Gandhinagar. The daily domestic water requirement of the city is 460 LPCD. This water requirement is jointly met by surface water and groundwater supplies but the dependence on groundwater in the area is very high, 76% of the water use is from borewells (1999). As regard agricultural, the cropping intensity is 116% with groundwater being the only source of irrigation in the district.

\(^2\) Irrigation intensity = Gross Irrigated area/Net Irrigated area x 100

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h. Groundwater condition of the area
With a groundwater development of 92.6% Ahmedabad district falls in the “dark” category as per the Central Groundwater Board (CGWB). The gross groundwater draft of the district is 701.7 MCM with gross annual withdrawal exceeding 90% of utilizable annual recharge (UNICEF/IRMA, 2000). Water quality is highly deteriorated. The groundwater drawn for domestic water supply to the urban residential area has high TDS level exceeding the permissible limit of 2000ppm in almost all areas (Moench et al 2003). Besides this out of 360 villages of the district, 359 are affected by fluoride, 34 with nitrate and 83 with salinity problem (WASMO, 2003)
Gandhinagar district falls in the over-exploited category as per the CGWB classification for groundwater development. The gross groundwater draft is 130.35 MCM/year resulting in declining groundwater levels and it faces a water deficit of 41.09 MCM/year (CGWB 1997). The depleting water table also has an adverse effect on the water quality. Out of 168 villages in Gandhinagar district 132 villages are affected by fluoride, 32 with nitrate and 9 with the problem of salinity (WASMO, 2003)
i. Key stresses due to human interventions
The urban- rural mix that is evident in desakota areas result in unique stresses on ecosystem services. As the area has to support industries along with agriculture and domestic, the existent water resources of the area have to be shared with new user - industry. On the other hand, these industries are also contributing to large scale deterioration of the water quality in the area as they usually dispose their waste water in existing surface or ground water. Deterioration in water quality inflicts a chain of events adversely impacting the health of the entire ecosystem. A direct consequence of deterioration of water quality is land degradation, reducing its productivity.

Urban influence and accessibility to technology further add on to the stress on the water resource in the area. Technologies like borewells and pumps are making, even the otherwise inaccessible water resource accessible to people thus, resulting in water mining in the region.

This water resource use scenario in the area of interest, clearly presents the enormous pressure that exists over the resource. As water becomes scarce and technology is growing the access to the resource has become a function of capital power, resulting in inequitable use of water. This has an important implication on the social system and is a potential source of conflicts between various resource users.
Besides these, another aspect which remains mostly untouched is the requirement of water by nature, the natural flow of water required for the sustenance of the ecosystem is often compromised for meeting human water requirements. This practice has serious long term implications which might lead to total lapse of the ecosystem.

F. Sampled Villages from the Selected Desakota Area: A Micro Level evidence
Considering only the male main working population (as available in Census), it is evident from the table below that number of villages in Class III has increased in all the selected talukas. Also, the total villages in Class II and Class III have increased in last census decade. This shows that vicinity to urban centres has changed the occupational pattern in the village – a step forward to urbanization.

Table 1: Number of Desakota Villages in Selected Talukas

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Desakota I (25-50% Main Non Agri Male Workers)</td>
<td>Desakota II (50-75% Main Non Agri Male Workers)</td>
<td>Desakota I (25-50% Main Non Agri Male Workers)</td>
<td>Desakota II (50-75% Main Non Agri Male Workers)</td>
</tr>
<tr>
<td>Daskroi Taluka</td>
<td>29</td>
<td>13</td>
<td>26</td>
<td>19</td>
</tr>
<tr>
<td>Sanand Taluka</td>
<td>13</td>
<td>1</td>
<td>29</td>
<td>8</td>
</tr>
<tr>
<td>Gandhinagar taluka</td>
<td>44</td>
<td>8</td>
<td>39</td>
<td>17</td>
</tr>
</tbody>
</table>


The following table gives the detailed information of the villages. Other than demographic and economic features, and available amenities in the villages, the last column presents the impact of urban influence in the villages.
<table>
<thead>
<tr>
<th>Village (1)</th>
<th>General features (2)</th>
<th>Demographic Attributes of the Area (3)</th>
<th>Economic Attributes of the Area (4)</th>
<th>Amenities in the village (5)</th>
<th>Impact of urban influence (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lapkaman</td>
<td>A village in Daskroi taluka of Ahmedabad district 12km from Gota char-rasta</td>
<td>Total population: 1856 Total households: 400 150HHs Patel’s and Thakore’s, 20HHs Rawad’s, 10HHs Vankar’s, 10HHs Rabaris, 7HHs Kumbhar’s and 45 HHs other castes Sex ratio: 719 Literacy Rate: 68.3% Current trends show emphasis on female education</td>
<td>Livelihood Basket Composition: 60% population in agriculture, 15% agricultural laborer, 25% in industrial labour Shift from agricultural to non agricultural sector although agriculture still principal occupation Occupational shift attributed to proximity to Vadsar Industrial area and Ahmedabad district. Youth prefer working in industries over working as agricultural labourer. Women also work in industries Growing real estate market, thus massive sale of land only 10% is left under agriculture Agriculture mostly rainfed and mostly complemented with dairying and work in industries 25,000/day milk supplied to cities, but decrease in agriculture also affecting this secondary source of income because of limited fodder supply Increase in neelgai population also working against agriculture.</td>
<td>Primary school, Higher secondary school, post office, PHC centre, Veterinary centre, para-medical college, and district old-people house present A complete village water supply system exists. Water from the village over tank filled through borewell, is supplied to the houses through a network of pipeline and received through taps MLA fund, village development fund used to maintain the water supply system as well as village ponds.</td>
<td>Diversifying livelihood basket with an occupational shift Enormous rise in land prices from 5-6 lakh/bigha(^3) to 1 crore/bigha in last 2 years due to growing real estate market thus, rapid sale of agricultural land to builders Money earned by sale of land invested in improving economic status, buying vehicles and reconstructing houses Rise in non-farm businesses, due to easier accessibility to city through cheap transport like jeeps, autorickshaws owned by village people Industrialization has adversely affected the natural habitat of stags who have shifted to agriculture land destroying the crops.</td>
</tr>
</tbody>
</table>

\(1\) bigha = 0.22 hectares
### Chosar

<table>
<thead>
<tr>
<th>Total Population: 1979</th>
<th>Total Households: 371</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 years ago 60HHs were BPL while now only 8HHs</td>
<td>225 hectare under agriculture, change in crop type pure paddy production currently, expansion of agricultural area with the advent of namada water. Fertilizer and water intensive agriculture</td>
</tr>
<tr>
<td>Minimal education to children and then sent to industries for work</td>
<td>Occupational shift of male population to non agriculture sector from 36.62% to 74.93% in last decade. Role of women in agriculture is rising</td>
</tr>
<tr>
<td>Sex ratio: 867</td>
<td>Livelihood Basket Composition: agriculture (25%), dairying (secondary activity), industrial workers</td>
</tr>
<tr>
<td>Literacy rate: 70.7</td>
<td>225 hectare under agriculture, change in crop type pure paddy production currently, expansion of agricultural area with the advent of namada water. Fertilizer and water intensive agriculture</td>
</tr>
</tbody>
</table>

#### Total Population: 1979

Total Households: 371

- 15 years ago 60HHs were BPL while now only 8HHs
- Sex ratio: 867
- Literacy rate: 70.7

#### Occupational shift of male population to non agriculture sector from 36.62% to 74.93% in last decade. Role of women in agriculture is rising

**Livelihood Basket Composition:**
- Agriculture (25%)
- Dairying (secondary activity)
- Industrial workers

**225 hectare under agriculture,** change in crop type pure paddy production currently, expansion of agricultural area with the advent of namada water. Fertilizer and water intensive agriculture

- 3-4 cattle/ HH although with decline of agriculture decline in livestock has been initiated.
- Milk production: 1200l/day sold to buyers from Ahmedabad at Rs.19/litre

### Tarapur

<table>
<thead>
<tr>
<th>Total Population: 2274</th>
<th>Total Households: 650</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-200HHs Patels and Thakores each, 50HHs</td>
<td>Village has a primary school and PHC centre while high school and post office are present 1km away in Adalaj village</td>
</tr>
</tbody>
</table>

#### Total Population: 2274

Total Households: 650

- 150-200HHs Patels and Thakores each, 50HHs
- Village has a primary school and PHC centre while high school and post office are present 1km away in Adalaj village

### Advent of Namada water canal has led to rise in water table although groundwater quality is under a potential threat because of illegal injection of industrial effluents in groundwater.

Diversifying livelihood basket. A negative land use change could be attributed to eucalyptus plantation

No land sale as such has been witnessed although people are looking forward to it

Rise in water level with the advent of Namada canal shift from 300ft to 150ft.

But deteriorated water quality, high in fluoride and salinity. First water of the day is red in color

Chosar presents a case of extreme water contamination due to unsafe disposal if industrial effluents into the groundwater

Diversifying livelihood basket and changing land use

Rise in land prices from 2-3lakh/ bigha to 22-25 lakh/bigha

60% land sold to builders

Money from land sale used
| **Jakhora** | **A village in Gandhinagar district, 12-13km away from Chiloda char rasta**  
A regular supplier of vegetables to Ahmedabad city |
|-------------|-------------------------------------------------------------------------------------------------|
| **Total population:** 2205  
**Total households:** 400  
150-170HHs each  
Patels and Thakores  
50-60HHs other castes including nais, rabaris and ST  
30-40HHs are BPL HHs  
**Sex ratio:** 994  
**Literacy rate:** 78.9% |
| **Manufacturing unit**  
Small landholdings, rising cost of agriculture and increasing work opportunities in neighboring cities have led to occupational shift.  
The village and surrounding area is a brick manufacturing zone with 25 units around Tarapur. These units attract seasonal migrant labourers from MP and Rajasthan.  
Agricultural lands are also rented to these units.  
Private salons and rearing goats are other income generating activities in village. |
| **Primary school, PHC Centre and milk cooperative present in the village. Secondary school 2-3km away.**  
**Tapped water supply to all houses from village overtank of 1 lakh litre capacity filled by means of a village borewell.**  
**80 tubewells in the village.**  
**Autorickshaws, jeeps and GSRTC bus are cheap mode of transport.**  
**Motorbikes present in each house.**  
600-700 mobile phones and 100 landline connection.  
40 tractors, threshers and trailers.  
**Greater connectivity with the urban centre has increased area under vegetable production. 2 vans engaged for regular supply of vegetables from the village to Ahmedabad market.**  
Middlemen play a key role between contractor and villagers for employment in industries. Cell phone is used for contacting contractor and villager as and when labour is needed.  
60% village land sold to builders, land prices have risen from 5-6 lakh/bigha to 1 crore/bigha and even higher right next to the highway.  
**Groundwater level has improved due to Hathmati water canal.** |

<p>| <strong>Winrock International India</strong> |</p>
<table>
<thead>
<tr>
<th>Village</th>
<th>Location</th>
<th>Total Population</th>
<th>Total Households</th>
<th>BPL: Year 2</th>
<th>Sex ratio</th>
<th>Literacy Rate</th>
<th>Occupational Shift</th>
<th>Primary School</th>
<th>Village Primary School</th>
<th>Landuse Change</th>
<th>Livelihood Diversification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matoda</td>
<td>A village in Sanand taluka of Ahmedabad district Located at a distance of 25 km from Ahmedabad city</td>
<td>1856</td>
<td>341</td>
<td>45HHs and now only 5 HHs</td>
<td>915</td>
<td>53.8</td>
<td>12% to 27% in last decade</td>
<td>Village community hall present and village milk cooperative</td>
<td>Primary school until 7th standard and village community hall present and village milk cooperative</td>
<td>13.87%</td>
<td>Landuse change of 13.87%</td>
</tr>
<tr>
<td>Navapura</td>
<td>A village in Sanand taluka of Ahmedabad district Located at a distance of about 17 km from Ahmedabad city</td>
<td>3005</td>
<td>587</td>
<td>90 HHs in 1991 and 70 HHs now</td>
<td>915</td>
<td>53.8</td>
<td>29% in 1991 to 59.4% in 2001</td>
<td>Village primary school until 7th standard and village community hall present and village milk cooperative</td>
<td>Village primary school until 7th standard and village community hall present and village milk cooperative</td>
<td>14.03%</td>
<td>Enormous sale of agriculture land</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Sex Ratio: 931</th>
<th>Emphasis on education but only a few girls sent out of the village for higher education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy Rate: 67.5</td>
<td>rising cost of production Immigration of Dahod tribals for working agriculture labourers Declining livestock rearing due to declining agriculture. Fodder preferably sold in Bavla, Sanand or Daskroi APMC Industrial growth of chemical and pharma industries in the surrounding area generating employment for villagers and a major pull factor for migrants from UP, Bihar and MP</td>
</tr>
<tr>
<td>Around 500 borewells in the village for irrigation Village has 350 bikes and 100 cars There are also 6-10 computers in the village</td>
<td>areas Water quality deteriorated, high fluoride content Air pollution due to emissions from nearby villages MTS, autorickshaws and private vehicles facilitate daily migration of people to city centre Presence of bhajan mandals and women saving groups; saving used for religious donations Water for irrigation sold at Rs.25-30/hour</td>
</tr>
</tbody>
</table>
G. Knowledge gaps and challenges

a. Conceptual
Rural population show direct dependence on natural ecosystems. All their livelihood options are linked directly to ecosystem and hence their well being is a direct function of the ecosystem health. Any macro- level change, be it social, political or economic will manifest at micro level in the form of changing human behavior which will inflict a subsequent change in the ecosystem. Poor people who are most closely associated with the ecosystems get directly impacted by this ecosystem change. Changing economic approach promoting rapid industrialization serve as a strong pull for the people and result in occupational change in the rural areas, but this growing industrialization hampers the sink capacity of the ecosystems leading to air, water and land pollution as evident from our case studies with a clear gap of assessing extent. This in turn indicates gaps in consequences of pollution on the marginalized classes who rely directly on nature for their subsistence and have limited access to modern technologies (water purifiers, filters) and health facilities. Although this inter-linkage between human well being and ecosystem health has been well established but the policy as well as the development planning fail to take this vital interlinkage into account. The accountability of this interrelationship is an even bigger challenge in mixed economies i.e. the Desakota Areas. Thus, the developmental planning of these areas in the back drop of rural areas (as they are considered in census) is not justifiable. The diversified livelihood basket, changes the resource utilization as well, water resource which in rural areas is mostly used for domestic and agricultural purpose is to a large extent diverted to industrial use along with domestic and agricultural uses in desakota areas. Thus, there is need to identify desakota targeted planning and management for maintaining the ecological resources.

b. Institutional
There are host of policies and acts at national level which govern management of ecosystems desakota areas directly or indirectly. This include the National Water Policy (2002), National Agriculture Policy (2000), National Environmental Policy (2004), Tariff Policy (National Electricity Policy), Water (Prevention and Control) Act, 1974 and Groundwater Regulations. These policies are aimed at environment conservation, sustainable and economic development. At the same time there are various programs and policies at the state level which operate under overall framework of national policies. These include, for example for Gujarat, Regional water supply Schemes (RWSS), Accelerated Rural Water Supply Programme, Swajaldhara Programme, Sujalam Sufalam Yojana, Industrial Policy of Gujarat, (2000), and Agro- industrial Policy (2000). The policies aim to cover all the aspects of conservation and development. However, the challenge remains in horizontal and vertical integration of these policies and programmes for overall development in Desakota areas. There is need for assessing scope for synergies and integration of policies and programmes. In addition, there is need to understand the type of community and market based models that will work.
c. Natural and Social Scientific Knowledge Systems
Better planning and management of ecosystem demands collection of data as well as integration of data from various sources for knowledge creation useful for decision making, implementation and monitoring. The data on various aspects including natural science—Global environmental change and ecosystem health and status, political science and economics are present in a highly scattered form, ranging from crude government data to highly specific project and annual reports of work done by NGOs as well as government bodies. The gap is in matching data/ knowledge demand with scale of decision making.

d. Data Issues
Consistency and comparability of data are two major issues arising because of diverse sources of data on same parameters. For example, Census data being available at decadal interval fails to account for changes in landuse and population parameters at intermediate intervals. Besides this, census only cover primary occupation of a person and fails to capture the diverse occupations in which the rural people engage during the year. Migration tables do not take into account the daily migration and covers migration if it is more than six months. Thus, these are some of the data inaccessibility issues.
## H. Linkages: Desakota characteristics, Ecosystem Services and Poverty

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<th>Desakota Criteria (sub-characteristics observed)</th>
<th>Water ecosystem service</th>
<th>Poverty</th>
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| 1. Greater Connectivity—physical, electronic and cultural.  
- Good road network  
- Public and private transport facilitates daily movement  
- Television and cell phones accessible to all | Connectivity promotes diversification of livelihood basket as evident from all villages. A mix of agriculture and industrial activity increases the water demand. In villages Matoda and Navapura the groundwater resource is being used by both villagers for agriculture and industries for industrial processes. Thus, overall water demand increases.  
- Facilitates accessibility to alternative sources of water like water tankers as observed in Tarapur  
- Promotes commercialization of agriculture sector thus, making it more water intensive as evident in Jakhora famous for vegetable cultivation | Greater connectivity provides employment opportunities, greater access to health and education facilities although education still not a primary concern. In Jakhora village cell phones serve as important mode of information dissemination regarding job opportunities in an industry. People from Navapura go to Ahmedabad city in case of serious health ailments and access to the city is facilitated by private vehicles as well as cheap transport like autorickshaws and jeeps.  
- Alternatively, it facilitates in-migration into the villages and as evident from Navapura 5 families who have migrated to Navapura from Bihar, MP etc. are BPL HHs, thus connectivity facilitating in-migration might lead to increase in poverty |
| 2. Greater penetration of cash economy, with remnants of exchange and reciprocity mechanisms on the decline.  
- Labor terms are mostly cash.  
- Traditional access to tubewells for irrigation water in exchange of agriculture produce weakening  
- Services are cash based | Although electricity is priced but inefficient subsidies and flat rates are responsible for over-extraction and wasteful use of groundwater, thus decline in water table as evident in all villages.  
- On the other hand nominal cess rate of Rs. 14/ year for Naramada water supply has led to rise in water table in villages like Matoda and Chosar  
- Fodder is generally sold at nominal prices to landless people while fuel requirements are complemented by the cheap fuels like cow dung cakes. | Penetration of cash economy is disadvantageous to the poor because earlier large farm owners used to allow them to cut fodder free of cost  
- Agriculture labour was given a share of foodgrains which helped them sustain their living while payment in cash is not sufficient to meet all needs  
- Lack of money also restricts them from access to irrigation water as water is also priced and thus, contributes to growing poverty. In Navapura, people who don’t own tubewells are charged Rs25- 35/hr and it takes 3 hours to irrigate 1bigha so the overall irrigation becomes expensive |
| 3. | Mixed livelihoods drawing upon local as well as non-local service, and manufacturing sector opportunities.  
- Substantial remittances from migrant workers.  
- Household members engaged in a variety of non-farm livelihoods. | Diversifying livelihood basket involving industrial as well as agricultural activity increase the overall demand of water.  
- In-migration (Navapura and Tarapur) leads to population rise thus, more food demand and higher water consumption for agriculture  
- Discharge of industrial effluents into groundwater seen in all villages lead to groundwater contamination  
- Direct discharge of domestic waste water in surface water bodies like ponds in Matoda and Navapura and river like Khari in Chosar lead to surface water pollution | Provides better work opportunities in industries, higher income generation; Rs.10,000 to 15,000/month income of a family with men working in industries and women engaged in agriculture in Chosar, thus help in alleviating poverty  
- Industrialization is generating income but also impacting human health through air and water pollution, flourio, gallstones are common ailments. Chosar is a clear case of these health problems where each member suffers from joint pains. People here are compelled to drink contaminated water as they don’t have access to any alternative.  
- Work pressure on women increases as they play a greater role in dairying as well as agriculture making them vulnerable to body ailments |
- Tubewells and Borewells main water extraction technologies.  
- Chemical fertilizers in use.  
- Tractors ubiquitous.  
- Use of crop harvesters | Tubewells and borewells along with subsidized electricity are two technologies currently leading to groundwater mining  
- Cheap cost of chemical fertilizers, increased fertilizer input to agriculture land led to land degradation thus, demanding even higher water inputs  
- Crop harvesters reduce fodder yield thus separate cultivation of fodder leading to increased water use  
- Over-extraction of water adversely affected the water quality, high fluoride and nitrate content and salinity are common issues | Penetration of modern technologies has widened the economic disparity  
- Poor farmers becoming landless subject to erosion of asset base  
- Modern technologies have provided access to even inaccessible groundwater resource, this groundwater mining has affected the water quality, poor people due to limited access to fuel as well modern technology (for water purification) are left with no option to use polluted water for domestic purpose.  
- Farm mechanization have increased the cost of production as was complained by poor farmers in Navapura village thus, threatening food security as well as making it an expensive activity for small landholders. Thus, reducing net income for family |
5. Greater penetration of formal institutions existing in a transformational tension with traditional informal institutions
   - Village panchayats for water supply
   - Groundwater markets
   - Bhajan mandals
   - Self Help groups, Saving groups

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<td>• Village panchayats have not been efficiently able to maintain quality and quantity of water supply as seen in Navapura where water is priced at Rs.50/year irrespective of water utilization by people leading to overuse of water.</td>
<td>• Increased social cohesion</td>
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<td>• Lack of irrigation water distribution systems between u/s and d/s fields leads to wastage of water as seen in Chosar where water to the downstream farm reaches only if upstream farmer allows</td>
<td>• Water pricing effects the accessibility to water and leads to inequitable distribution of water.</td>
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<td>• Women saving groups, save money, in Navapura the saving is Rs. 4000/month and this money is given to the distressed families when need arises, thus, it serves as a helping hand for the poor.</td>
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Bibliography

Papers
Bentinck J.V., 2000, Unruly urbanization on Delhi’s fringe changing patterns of land use and livelihood. Phd. Thesis
This is a study done on the rural urban fringe around Delhi. This study describes how a rural area progresses towards urbanization and what are the steps involved. It also gives detail account on the unique characteristics of rural-urban fringes and describes the changing land use and occupational pattern in these fringes.

The paper describes the availability and demands of water resources in India and the impact human influence has on these resources. It also discusses the water management strategies in India inorder to highlight the major issues in the sustainable development and management of water resources in India.

The paper discusses the study of urban sprawl in the fast growing Southeast Asian city called Metro Manila. Both Census Data and GIS have been used to examine the land use change and see the population growth. The paper was of relevance because it dealt with concepts of land use change and urbanization in urban fringe which is a similar term to Desakota.

Books
The objective of this research paper was to assess the potential of the traditional rainwater harvesting structures still present in old part of the Ahmedabad city to meet the growing water demands of the city. The paper describes the water supply and demand scenario persisting in Ahmedabad, taking this as the baseline, it evaluates the potential of the rainwater harvesting as an alternate source of water for the city which can help reduce pressure over the groundwater sources for meeting the water requirements.


This is a GOG publication which describes the economic growth in different sectors and also compares the overall economic growth of Gujarat with that of India.
This is a Government of Gujarat directory containing data on various parameters like rainfall, population, agriculture, infrastructure etc. Temporal data for each parameter is presented for entire Gujarat state while district wise data is provided for the current year.

Hirway Indira and Darshini Mahadevia, 2003: Gujarat Human Development Report 2004, Mahatma Gandhi Labour Institute, Ahmedabad, Gujarat, India
The report looks at human development as the goal as well as the development paradigm that is conducive to the promotion of development. The report analyzes the status of human development with the help of variety social, environmental as well as economic factors. The report also recommends a strategy to strengthen the linkage between economic growth and human development.

This is a comprehensive work on the position of the Indian legal system with regard to Groundwater. It gives a brief description on the vulnerable state of groundwater resource of the country and then discusses the existing legal provisions for regulating and managing the groundwater use. It also touches upon the complexity involved in the management of the resource due plurality of the laws which govern the usage of the resource.

It is comprehensive report dealing with various aspects of water resource in Gujarat. It discusses the water resource profile of Gujarat with emphasis on the pattern of water demand and supply in different sectors. It also discusses the issues related to water resource in the State and recommends strategies and directions for better management of the existing resource.

Reports

It is a review of the NEP2004. A section wise review is done for specific sections like legal framework, land degradation, forests, water systems etc.

Provides the data on various aspects of population and land use of the respective districts.

The report provides the monthly review of the state's economical factors.

This report is a reflection of the experiences of a group of stakeholders working in drinking water, hygiene and sanitation sector of the state. The report begins with the discussion of the present status of drinking water and sanitation in the State within the context of conservation and management in all sub- sectors. It further discusses the water and sanitation condition during the drought of 2000. After a preliminary discussion of the water and sanitation scenario the report highlights the policies in place and how they have been shifting to deal with changing water resource scenario inorder to ensure regular water supply to rural areas as well as maintenance of sound sanitation condition. Thus, the focus of the report is on the discussion of core points, guiding principles, policy framework and strategies as well as challenges and scope of Gujarat Jal-Disha 2010.

ICID 2005a. Water Resources Assessment of Sabarmati River Basin, India. International Commission on Irrigation and Drainage, New Delhi, India

This report is a part of the a program initiated by ICID to analyse the demand-supply of all 3 sectors- food, people and nature in an integrated manner. This programme is refered to as “Strategy for Implementation of Sector Vision on Water for Food and Rural Development. Under this study, in order to capture the situation in India a water deficit basin i.e. the Sabarmati Basin was selected. The paper provided the detailed description of Sabarmati basin in terms of geology, demography as well as the water conditions, use and demand in the Basin. A model based approach has been applied to analyse the supply-demand issues of all 3 sectors. This model is called ‘Basin- wide Holistic Integrated Water Assessment’ (BHIWA).

ICID, 2005b. Water Policy Issues of India: Study outcomes and suggested policy interventions. International Commission on Irrigation and Drainage, New Delhi, India

The paper discusses the state of water resources in India and reviews the policies which directly and indirectly impact the water resources in India. Finally it recommends the some policy interventions to attain better management of the resource.


The report is a compilation of research done on water management systems in 5 case study areas, namely Gujarat, Rajasthan, Tamil Nadu and parts of Nepal. In Gujarat, Sabarmati Basin and specifically Ahmedabad city was selected for the study. The paper describes the water situation in each of the selected areas, the issues related to water and the governance structure and institutional mechanisms for management of water in the case study areas.

This study accounts the observations of climate change impacts on the hydrology and water resources in South Asia and assesses the vulnerability of the region to climate change. It focuses on the adaptation analysis and assessment of the selected hydrological units in the area.


Web Links
GPCB. Gujarat Pollution Control Board http://gpcb.gov.in/faq.asp

www.gwssb.org/impact/gandhinagar.pdf
This is an groundwater evaluation report of Gandhinagar district. This evaluation was carried out by GWSSB in October 2006 and it reports rise in the groundwater level in the district as a consequence of large scale recharge activity undertaken by the government in the district.


http://www.envfor.nic.in/nep/nep.pdf

http://www.powermin.nic.in/indian_electricity_scenario/national_electricity_policy.htm

Tariff Policy, 2005.

http://wgbis.ces.iisc.ernet.in/energy/urban/preface.htm