CHAPTER II

OBJECTIVES, METHODOLOGY AND DATABASE

Objectives of the Study

The major objectives of the study are as follows:

- To assess the water resources (surface groundwater) in the study area to understand the water availability and scarcity problems.
- To examine the pattern of domestic water use in the study area and to factor responsible for existing situation.
- To evaluate of the dwindling quantity and deteriorating quality of water resource in the study area.
- To evaluate the ground water potential zones in the city using one satellite based as well as conventional data available with various government departments and other organizations.
- To examine the existing water demand in the city and to suggest possible measures for improvement of water supply.
- To suggest appropriate measures for rational utilization of available surface water in the city.
- To study the environmental status, human interference and geo-environmental condition of water in the city.
- To examine the water management policy currently being followed in the city.
- To formulate a perspective plan for consumptive use of both surface and groundwater in the metropolitan area based on scientific study of the existing humanized environment and its tentative trends.
- To suggest water harvesting and other local solutions for a sustainable water supply in the area.
Hypotheses

- The rising proportion of built surfaces in the study area has resulted in an increase of runoff and decrease in the groundwater recharge.
- Pattern of water use in the study area is determined by the availability of water and socio-economic condition of the population.
- Water scarcity is largely caused by external factors such as increase of population pressure and economic activities.
- Water stress exists in the study area for extended periods irrespective of the time of the year.

Methodology

To fulfill the objectives and test the hypothesis of the study, the data have been collected from both primary and secondary sources. The collected data are analysed using appropriate computer assisted analytical procedures. The analysed data are presented with the help of a series of maps, tables, charts and graphs using appropriate cartographic techniques. Remote sensing and GIS techniques are used for the study to achieve the objectives.

The research design has the following major components:

- Choice of the study area and its delimitation.
- Collection of data: Primary and Secondary.
- Site selection and collection of water sample, sample preservation method.
- Computation and laboratory analysis.
- Database creation, analysis, and integration.
- Presentation and interpretation of data.
Study Area Delineation

The study area has been demarcated ward wise to examine the water availability and scarcity condition both in spatial as well as temporal contexts.

Database

Collection of Data

Database has been proposed from both secondary and primary sources. The primary data were collected through sample survey covering selected households in each ward for achieving the objectives and testing the hypotheses. The secondary data have been collected from official sources, published documents, Govt. and other agency reports.

Primary Data Sources

The primary data comprise household information pertaining to water use and other related socio-economic parameters collected using a structured questionnaire specially prepared for the purpose (Appendix -1) based on stratified random sampling technique. The database consists of a total of 2117 households spread over all the wards of the city. The number of households surveyed in a ward was decided based on a weightage related to total number of households in the ward.

Secondary Data Sources

The secondary data are collected from the following sources.

- Assam Remote Sensing Application Center (IRS-IC & ID Imagery on 1:50,000 scale and SPOT (MLA) and Landsat (TM) Imagery on 1: 50,000 scale).
- Central Ground Water Board (borewell data, aquifer characteristics data and hydrological data).
- Indian Meteorological Department (Precipitation and other climatic data).
Remote Sensing

The ground water potential zones of the city (ward wise) were identified based on satellite data available with ARSAC, Guwahati, Assam. The satellite imagery provides synoptic coverage of the area and helps to identify the geological, geomorphological and structural elements which are generally considered as controlling factors for the occurrence and movement of groundwater. Remote sensing data indicate spatial signature of surface features whereas drilling data provide subsurface information. A combination of these methods could probably be used more effectively to differentiate the various hydrogeographic units and identify the potential
groundwater zones. For the purpose of zoning, the areas covered by different hydromorphological units are measured on the map with the help of planimeter and summed up category wise accordingly. Thus the groundwater potential map of Guwahati is prepared. It was also used for updating the information extracted from the topographic sheets such as settlement, road and existing water bodies.

Database Creation and Data Integration

**Hardware used**

Intel Pentium IV processor 866 MHZ

256 MB RAM

40GB HDD

**Software used**

Arc view 3.1

Autocad 2002

Map info

Adobe Photoshop 7.0

Microsoft pain brush

Microsoft Office 2003

Visual Fox pro etc.

Data base software for analysis the quantitative data is developed in visual FoxPro and integration of multithematic data is done with the help of pc based Geographic Information System (GIS).

Ancillary data

A number of data from other sources have been used. To create a GIS database, different thematic layers were generated by scanning these maps Georeferencing it is UTM projection and Everest spheroid on screen digitizing and topology building.
Analysis and presentation

Following the objectives, the methodologies used to analyse the data and present the results are as follows:

(1) Assessment of Water Availability of the Study Area

On the basis of personal observations the situation of the surface water storages such as ponds, depression, lakes, wet lands, rivers and seasonal streams have been noted.

An assessment of the local water resources including surface water and ground water has been carried out with the help of various secondary sources of data.

- Topographic map and satellite imagery to understand the surface water situation.

- Borewell data, hydrological data, aquifer data to understand the groundwater situation over time.

- Landuse, soil and rainfall data to understand the hydrological requirement of water.

- Landuse map was used to find out the Available Water Capacity (AWC) of the area in conjunction with the hydrogeomorphological map of the area with the help of glue operation (map overlay with a main command) in a GIS environment.

(2) Observed Pattern of Water use in the Area

Water availability has been observed on the basis of physical and socio-economic indicators such as groundwater depletion, state of surface water resources, price of water, availability of municipal water (numbers of hours and amount) and the minimum requirements as per the standards of WHO. Water use has been measured at two different levels, i.e. the situation of the ward as a whole and at the individual household level.
- For determining the 'water use' of the ward as whole, the allocation of the water by Guwahati Municipal Corporation has been compared with the minimum water requirement of the area.

- For determining the pattern of water use at the individual level, household survey has been conducted with focused questions on a chosen set of water use indicators.

A total number of 16 indicators pointing directly or indirectly towards water related problems have been considered.

**Site Selection for Water Quality Monitoring**

The factors identified for proper selection of groundwater sampling as well as supply water sites within the Guwahati city include objectives of the study, location of the site, surrounding environmental conditions, public interference, general use of the wells and industrial activities in the area (fig.2) and supply water samples are collected from PHED, NF Railway and GMC (table 2).

**Table 2: Identification and General Use of the Wells and other Piped Water Sources**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Sample No.</th>
<th>Sampling Source</th>
<th>Location</th>
<th>Well type</th>
<th>Use</th>
<th>Ward No.</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>Tubewell</td>
<td>Satgaon</td>
<td>Personal</td>
<td>Domestic</td>
<td>46</td>
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<td>2</td>
<td>2</td>
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<td>Chandmari</td>
<td>Community</td>
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<td>3</td>
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<td>PHED</td>
<td>Govt.</td>
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<td>Well</td>
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<tr>
<td>5</td>
<td>5</td>
<td>Tube well</td>
<td>Hatigaon</td>
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<td>6</td>
<td>6</td>
<td>Tube well</td>
<td>Birubari</td>
<td>Personal</td>
<td>Domestic</td>
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<td>7</td>
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<td>UWSSB</td>
<td>Statutory org.</td>
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<td>8</td>
<td>Bore well</td>
<td>Mathura Nagar</td>
<td>Personal</td>
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<td>51</td>
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<tr>
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<td>Rupnagar hill</td>
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<td>Domestic</td>
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<td>Fatasil Ambari</td>
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<td>NF Railway</td>
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<td>Public</td>
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<tr>
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<td>Jalukbari</td>
<td>Personal</td>
<td>Personal</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>Piped water</td>
<td>GMC</td>
<td>Govt.</td>
<td>Public</td>
<td>19</td>
</tr>
</tbody>
</table>
Fig. 1: Location Map of Guwahati Municipal Area
Sampling and Preservation of Water Sample

The water samples collected were stored in pre-cleaned polyethylene bottles and preserved by adding a appropriate reagent as per slandered procedure (Jain and Bhatia, 1987).

Water Quality Parameters Selected for this Study

The quality of drinking water should be determined with respect to large number of parameters to ensure the supply of safe drinking water to the mass. Also the rapid advancement in science and technology has been adding new parameters to be monitored regularly. In this study, however is confined to a limited number of parameters because of several factors, the prime of which is availability of experimental facilities. Some parameters are studied by using previous work done by different researchers.

The parameters are:

**Physical Parameters:** Temperature, Colour, pH, Conductance, Hardness, Total Dissolved solids (TDS), Total Suspended Solids (TSS), Total Solids (TS)

**Major Anions:** Chloride, Sulphate, Bicarbonate, Phosphate, Fluoride.

**Major Cations:** Sodium, Potassium, Calcium, Magnesium, Iron

**Trace Metals:** Lead (Pb), Cadmium (Cd) Copper (Cu) Zink (Zn), Cn, Selenium (Se) and Nikel (Ni).

All these parameters have been estimated using standard methods.

Sampling Season

The collection of water samples in each of the seasons (summer and winter) was decided after careful study of the climatic conditions and other physiographic characteristics of the study area.