CHAPTER VI

GROUNDWATER ASSESSMENT
For proper assessment of potential, present use and additional exploitability of optimal level, of both surface and groundwater resources, it is widely acknowledged that a basinwise approach yields the best results. A hydraulic budget is a quantitative statement of the balance between the total water gains and losses of basin, for a particular period of time. It takes into account many aspects, such as precipitation, run-off, percolation, evapotranspiration, groundwater recharge, discharge, change in soil moisture, groundwater evapotranspiration, groundwater run-off and changes in groundwater storage.

Groundwater assessment for the study area has been made on the basis of the norms recommended by Groundwater Estimation Committee (GEC) CGWB, India and Groundwater estimation methodology (Government of India, Ministry of irrigation, 1984). The details of the assessment are given in Table 5.1.

The usable groundwater resource is essentially a dynamic resource which is recharged annually or periodically by rainfall, irrigation return flows, canal seepage, influent seepage, etc. The most important component of recharge to the aquifer is the direct infiltration of rain water, which varies according to the climate, topography, soil and subsurface geological characteristics. A part of applied irrigation water, both from groundwater and surface water
resources, reaches groundwater depending on the efficiency of irrigation system and soil characteristics. Influent streams also recharge the groundwater body depending on the drainage density, width of stream and the texture of river bed material. Other sources of recharge are percolation from canal systems, reservoirs, tanks etc.,

6.1 RECHARGE

The recharge component is determined by considering recharge from rainfall, surface water bodies and recharge through the applied irrigation. In rainfall infiltration method, the area covered by hills and part of the reserved forests are considered as unsuitable for recharge, since these areas are mostly covered by rocky exposures. From rainfall infiltration method it is estimated that 2795 ha.m. of groundwater is recharging the study area through rainfall. The remaining area of the study area is considered suitable for recharge through water seepage from tanks/ponds. The seepage factor is considered as 0.55 m./year. From water bodies the recharge is estimated as 193.6 ha.m. From the recharge through the applied irrigation the quantum of groundwater applied without monsoon rainfall is estimated as 3005 ha.m. But 40% of this quantum is only considered as rechargeable to groundwater that is estimated as 1202 ha.m.
6.1.1 TOTAL RECHARGE

Total recharge of the study area is calculated by summing up all the input components (i.e. rainfall recharge, recharge through water bodies and through applied irrigation). The total recharge of study area is 4191 ha.m. The net recoverable recharge is taken as 70 percent of total recharge. The remaining 30 percent is being left or omitted by surface flows and maintaining ecological balance. The net recoverable recharge of the study area is calculated as 2933 ha.m.

6.2 DRAFT

Groundwater draft is estimated by two methods, which are based on the well density, and on the extent of area irrigated, and an average of these two is considered for the estimation of groundwater balance.

6.2.1 DRAFT BASED ON WELL DENSITY

The number of wells fitted with electric motors and diesel pumpsets in the study area is estimated to be 2051. In addition to these wells, hand pumps, bores with handpumps, and draw wells are under use for domestic purposes. According to the information furnished by the farmers, it is observed that for many irrigation wells, the pumping period during the summer months ranges from 2 to 4 hours per day and in winter months it varies from 6 to 12 hours per day.
The average pumping rate of the energised well is about 16 m³/hour. Considering 180 days of irrigation (as per the farmers information) in a year at an average pumping period of 6 hours per day at the rate of 16 m³/hour, the annual groundwater draft for irrigation through wells is estimated to be about 3098 ha.m. (Table 6.1)

6.2.2 DRAFT BASED ON THE EXTENT OF IRRIGATION

The irrigation draft has been estimated with the help of the extent of crop being irrigated. The details of the different crops irrigated under wells are given in Table 6.1. The water requirement for each crop has been taken from the standards (Ministry of Agriculture, 1971; Water technology Centre, 1977). The particulars of crop extent and groundwater draft estimates are given in Table 6.1 as 3005 ha.m. The estimated draft based on the actual number of wells is higher than the consumptive utilisation of crops grown because the wells fitted with motors both for domestic and industrial purposes are also considered. Due to this fact, the draft value based on energised wells is found to be higher than the cropping extent.

6.2.3 DRAFT FOR DOMESTIC LIVESTOCK

The groundwater draft for domestic and livestock purposes forms a sizable quantity and can not be neglected in the estimates of total groundwater draft of the area.
Considering the average per capita requirement of 70 litres per day and taking the livestock consumption to be 10% of the human consumption, the estimated draft for domestic and livestock is 681 ha.m.

6.2.4 TOTAL DRAFT

The groundwater draft for irrigation purposes is the average of the draft based on number of energised wells and area extent irrigated. The draft for domestic purposes is added to give the total groundwater draft. Hence, the total groundwater draft is estimated as 3732 ha.m. Net annual draft is estimated as 70 percent of the total recharge i.e. 2612 ha.m. The remaining is allowed for recirculation.

6.3 GROUNDWATER BALANCE

Groundwater balance deals with aspects of balancing (budgeting) various components of groundwater supply (recharge) and disposal (draft) with storage changes in the groundwater reservoir. From the recharge and draft components, it is estimated the groundwater balance as 321 ha.m., which can be utilized in the study area mostly for future purposes. But the quantum of groundwater resource is very less. It is not advisable to go for exploitation of groundwater in future.
6.4 CATEGORISATION OF THE STUDY AREA ON THE BASIS OF LEVEL OF GROUNDWATER DEVELOPMENT

Level of groundwater development is taken as the percentage of the net draft to the net recoverable recharge (Table 6.1). From this formula the level of groundwater development is estimated as 89%. The levels of groundwater development categorised as per CGWB norms are given below.

<table>
<thead>
<tr>
<th>Level of groundwater development in percentage</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 65%</td>
<td>Safe or white</td>
</tr>
<tr>
<td>65% to 85%</td>
<td>Grey or Semi critical</td>
</tr>
<tr>
<td>Above 85%</td>
<td>Dark or critical</td>
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</tbody>
</table>

From this study, the study area comes under dark or critical. So it is recommended that the area cannot sustain further other exploitation of groundwater. This is due to the over exploitation of groundwater from the irrigation wells for growing sugarcane and paddy which require more water. So it is advisable for farmers to go for dry crops (economic crops) like groundnut and cereals to cultivate in the study area.

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TABLE 6.1
GROUNDWATER RESOURCE EVALUATION

I. RECHARGE

A. Groundwater recharge by rainfall

1. Total geographical area of the basin = 35900 ha.
2. Area unsuitable for recharge occupied by hills = 6450 ha.
3. Area considered suitable for recharge = 29450 ha.
4. Representative IMD Normal yearly rainfall (in mm) = 791 mm.
5. Assumed infiltration factor = 12 %
6. Rainfall recharge = 2795 ha.m.

B. Recharge through water bodies

1. Water spread area by tanks/ponds = 352 ha.
2. Seepage factor = 0.55 m/year
3. Total recharge to the ground = 352 x 0.55 = 193.6 ha.m.

C. Recharge through applied irrigation
(See draft for details)

1. Quantum of water applied without monsoon rainfall = 3005 ha.m

40 \% recharge to groundwater is considered out of quantum of water applied for irrigation = 1202 ha.m.

TOTAL RECHARGE (A + B + C) = 4190.6 ha.m
say 4190 ha.m.

Net recoverable recharge = 70 \% of the mean gross recharge = 2933 ha.m
II. DRAFT

A. Draft due to the pumping wells

1. Number of wells present in study area : 1793
   (All the wells are fitted with pumpsets)

2. Rate of pumping from each well : 16 m³/hr

3. Total pumping of water from each well in a day (assuming 6 hours per day as pumping time) : 96 m³/day

4. Total withdrawal of groundwater from the wells (assuming 180 days as pumping days) : 3098.3 ha.m

B. Draft based on crop extent irrigated under wells

I. For Paddy crop

<table>
<thead>
<tr>
<th></th>
<th>Kharif</th>
<th>Rabi</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Extent of area irrigated</td>
<td>400 ha.</td>
<td>750 ha.</td>
</tr>
<tr>
<td>ii. Water requirement of the crop</td>
<td>1240 mm.</td>
<td>1240 mm.</td>
</tr>
<tr>
<td>iii. 50 % of the useful rainfall</td>
<td>400 mm.</td>
<td>195 mm.</td>
</tr>
<tr>
<td>iv. Quantum of groundwater applied</td>
<td>840 mm.</td>
<td>1045 mm.</td>
</tr>
<tr>
<td>v. Groundwater draft</td>
<td>336 ha.m</td>
<td>784 ha.m</td>
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</table>

II. For Sugarcane

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>i. Extent of area irrigated</td>
<td>1455 ha.</td>
<td>9 ha.</td>
</tr>
<tr>
<td>ii. Water requirement of the crop</td>
<td>1600 mm.</td>
<td>1600 mm.</td>
</tr>
<tr>
<td>iii. 50 % of the useful rainfall</td>
<td>400 mm.</td>
<td>195 mm.</td>
</tr>
<tr>
<td>iv. Quantum of groundwater applied</td>
<td>1200 mm.</td>
<td>1405 mm.</td>
</tr>
<tr>
<td>v. Groundwater draft</td>
<td>1746 ha.m</td>
<td>13 ha.m</td>
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III. For Groundnut

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</thead>
<tbody>
<tr>
<td>i. Extent of area irrigated</td>
<td>21 ha.</td>
<td>53 ha.</td>
</tr>
<tr>
<td>ii. Water requirement of the crop</td>
<td>530 mm.</td>
<td>530 mm.</td>
</tr>
<tr>
<td>iii. 50 % of the useful rainfall</td>
<td>400 mm.</td>
<td>195 mm.</td>
</tr>
<tr>
<td>iv. Quantum of groundwater applied</td>
<td>130 mm.</td>
<td>335 mm.</td>
</tr>
<tr>
<td>v. Groundwater draft</td>
<td>3 ha.m</td>
<td>18 ha.m</td>
</tr>
</tbody>
</table>
IV. Others (Millets, Grams, and Cereals)

i. Extent of area irrigated 492 ha.  403 ha.
ii. Water requirement of the crop 425 mm.  425 mm.
iii. 50% of the useful rainfall 400 mm.  195 mm.
iv. Quantum of groundwater applied 25 mm.  230 mm.
v. Groundwater draft 12 ha.m  93 ha.m

Total draft in Kharif 2097 ha.m.
Total draft in Rabi 908 ha.m.

C. Draft due to population & Livestock

1. Population in the study area 242208

2. Draft due to population (2.555 ha.m./1000) 618.8 ha.m

3. Draft due to livestock (10% of the above) 61.88 ha.m

Average Draft \[ A + B = \frac{3544 + 3426}{2} = \frac{3485}{2} \] ha.m.

III. TOTAL DRAFT = 3051.7 + 681 = 3732.3 ha.m
say 3732 ha.m

Net annual draft = 70% of gross Annual draft = 2612 ha.m.

IV. GROUNDWATER BALANCE = 2933 - 2612 = 321 ha.m
V. CATEGORISATION OF THE BASIN ON THE LEVEL OF GROUNDWATER DEVELOPMENT

Level of Ground water development in percentage =

\[
\frac{\text{Annual net draft} \times 100}{\text{Annual net recharge}}
\]

\[
= \frac{2612 \times 100}{2933} = 89 \%
\]