CHAPTER V

ESTIMATION AND DEVELOPMENT OF GROUND WATER POTENTIAL

Systematic assessment of ground water resource is a pre-requisite for proper planning and development of any basin/area. In the present investigations resource estimation is attempted by rainfall infiltration method, water level fluctuation method (as per GEC 1982) and also through geomorphological studies.

5.1 Rainfall Infiltration Method:

This is an indirect method which involves quantitative study of water balance by assessing various inputs and outputs of the area taking into account of the rainfall infiltration factor as described in the following paragraphs.

The major inputs of the ground water system in the investigated area is rainfall and the return flows from surface water bodies like tanks/ponds and applied irrigation. The details of the recharge estimation is presented in the Table No.5.1.

5.1.1 Details of Estimation:

For the purpose of calculating the infiltration factor, the entire investigated area is demarcated into hilly terrains and plain areas as per the norms suggested by the Ground Water Estimation Committee (GEC 1982) constituted by the Government of India as presented in Table No.5.1.

It can be seen from the table that approximately 1/5 of the area i.e., 247 sq.km. is occupied by undulating and hilly terrains where the infiltration factor
### Table - 5.1 Estimation of Recharge Due to Rainfall

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Basin area</strong></td>
<td>247 sq km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infiltration factor considered</td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1027 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>247 x 0.027 = 6.64 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total rain area</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Area</td>
<td>1133 sq km</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infiltration factor considered</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1027 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>113 x 0.027 x 100 = 116.55 MCM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total recharge to ground water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recharge due to rainfall + Recharge due to surface water bodies + Recharge due to applied irrigation + Recharge due to return seepage from applied irrigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>= 1264 x 0.5 = 632 MCM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Actual depth of water: 20 - 125 mm
- Seepage factor: 0.5 mm/m
- Seepage factor: 0.47
- Seepage from applied irrigation: 0.15 to 0.30
- Seepage from applied irrigation: 0.15 to 0.30
- Total recharge: 116.55 MCM
- Total recharge: 1264 MCM
- Total recharge: 632 MCM
is 2% while for the remaining area of 1133 sq.km. which is plain country, the infiltration factor is 10%.

A systematic inventory on number of tanks and ponds is carried out during the present investigations. It is observed that 15 major tanks are in Krishna river sub-basin and 55 ponds are spread over in second and third order drainage in the entire area. According to GEC (1984) irrespective of the Geological formation, the seepage factor for tanks can be considered as 0.50 metres/year and accordingly the seepage is estimated and presented in Table No.5.1. Irrigation return flow is estimated taking into account the main crops that are grown in the area. Average monsoon rainfall, seepage factor, area considered for recharge and the estimated recharge values are presented in the Table No.5.1.

It can be seen from the table that the ground water contributed by rainfall, surface water bodies and the irrigation return flows works out to be 125 MCM.

Although, the basin outflow is considered to be negligible as the major area is predominantly a plain, this component is however included in 10% over all losses.

Actual evapotranspiration values are arrived at from the nearest meteorological station located at Khammam in the investigated area and these are already presented in Table 1.1.

Runoff estimation is computed as per Inglis and De souza's formula:

\[ R = \frac{(P-17.8)P}{254} \]

where, \( R \) = Runoff in centimeters
P = Precipitation in centimeters

Percolation, infiltration, including unaccounted seepage losses considered to be 10 per cent of monsoon rainfall, for arriving the amount of rain fall available for deep percolation.

Subtracting actual evapotranspiration, runoff and percolation and infiltration losses from the annual rainfall recharge to ground water has been calculated and presented in Table 5.2.

\[ RGW = R.F - (ET + Run-off) + Seepage losses \]

Recharge to ground water = Rainfall - Evapotranspiration + Runoff + Percolation, infiltration, including ground water seepage losses.

The percentage of the net recharge to ground water is arrived at by dividing the net recharge by annual rainfall and it works out to 12 per cent. This is in agreement with figures arrived at during investigations in analogous terrains (GEC 1982 and Briz-Kishore, 1983). However, in view of the inadequacy of seepage data and to be more cautious and judicious in arriving at safe limits only 10 per cent infiltration factor is taken into consideration as suggested by GEC (1982) and the estimation arrived at on this basis are presented in Tables 5.1 and 5.4.

The Table No. 5.1 consists of recharge due to rainfall, recharge due to surface water bodies, recharge due to return flow from applied irrigation (surface water) and return circulation from applied irrigation (ground water). The Table No. 5.2 consists of the recharge estimates based on water balance method and on water table fluctuation methods.
<table>
<thead>
<tr>
<th>RECHARGE DUE TO RAINFALL (WATER BALANCE METHOD)</th>
<th>RECHARGE ESTIMATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS PER ADHOC NORMS OF GEC (1982)</td>
<td>BASED ON WATER TABLE</td>
</tr>
<tr>
<td></td>
<td>FLUCTUATION METHOD</td>
</tr>
<tr>
<td>1. Recharge due to Rainfall</td>
<td>121.000 MCM</td>
</tr>
<tr>
<td>2. Recharge seepage from surface</td>
<td>0.816 MCM</td>
</tr>
<tr>
<td>water applied Irrigation</td>
<td></td>
</tr>
<tr>
<td>3. Seepage from tanks/ponds</td>
<td>12.500 MCM</td>
</tr>
<tr>
<td>4. Return circulation from</td>
<td>0.450 MCM</td>
</tr>
<tr>
<td>applied irrigation (ground water)</td>
<td>128.00 MCM</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total recharge to ground water per year</td>
<td>124.766 MCM</td>
</tr>
<tr>
<td>or say</td>
<td>125.000 MCM/Year</td>
</tr>
</tbody>
</table>

The total recoverable ground +
water potential +
considered as 85% of the +
total recharge to ground water +

= 128 x 0.85
= 106.80

or say 109 MCM is the recharge potential available for development

= 109 - 1.5
= 107.5 MCM

or say 107 MCM

TABLE NO. -- 5.2 RECHARGE ESTIMATES
5.2. Water Table Fluctuation Method:

As mentioned earlier, the recharge to ground water is also estimated by water table fluctuation method. This method is popular for estimation of net ground water recharge where in the net ground water recharge is obtained by multiplying the average water level fluctuation with the specific yield of the formation and areal extent. Water levels are monitored at monthly intervals (Briz-Kishore, 1981), over fifty observation wells in the area and the data pertaining to typical wells in Yellandulapadu, Bethampudi and Motlagudem. Minimum water level is observed during October - November i.e., in the post monsoon period, whereas the maximum water level is observed in May - June, i.e., in pre-monsoon season. Taking these wells as controlled points the average fluctuation of three years was worked out to be 5.20 metres.

5.2.1 Specific Yield:

It is well known that the specific yield in percentage is the ratio of the recharge to the ground water in millimeters to average fluctuation of the area in millimeters. The average specific yield of 4% is indirectly arrived by water table fluctuation method and this percentage is also considered as per norms suggested by the earlier workers and GEC (1982) for the investigated area.

Recharge to the ground water system is arrived at taking into account the components of rainfall, runoff, evapotranspiration, infiltration and seepage losses, which were arrived at by water balance method. Hence, the specific yield over the entire area worked out to be 4% (worksheet is enclosed in page No. 151-153).

To have a cross check on the estimates arrived at on the net ground water recharge, a third method is also adopted taking advantage of satellite imagery.
and by classifying the area into different morphological map units as described in Chapter II and the estimates of recharge are presented in Table No. 5.3.

Depending on the nature and depth of weathering in each of the formations, Ground Water Estimation Committee (1982) has suggested percentage of specific yields, which is presented in Table 5.3. against each of the geomorphic unit. The fluctuation in each of the units is arrived at taking into consideration the wells existing in that unit and the average fluctuation is presented in of Table 5.3. The total recharge was worked out to be 137 MCM.

5.3. Normalisation Factor:

Since long term average annual rainfall is considered in arriving at resource estimations to normalise these values for any particular year normalisation method is adopted using the ratio of long term average rainfall to the rainfall of the year under consideration which is expressed by

\[
\text{Normalisation Factor (NF)} = \frac{\text{Normal monsoon rainfall (1901-1950)}}{\text{Monsoon rainfall of the year (1989)}}
\]

\[
= \frac{1027 \text{ mm}}{1087 \text{ mm}} = 0.94
\]

In the present investigations, the Normalisation Factor, therefore, worked out to be 0.94. After normalisation, the monsoon recharge due to water table fluctuation method worked out to be 128 MCM as presented in Table 5.2.
<table>
<thead>
<tr>
<th>GEOLOGICAL FORMATION WITH GEOMORPHIC UNITS</th>
<th>AREA IN SQ.KM.</th>
<th>DEPTH OF WEATHERED MATERIAL</th>
<th>NATURE OF WEATHERED MATERIAL</th>
<th>SPECIFIC FLUCTUATION YIELD IN %</th>
<th>AVERAGE RECHARGE IN MCM</th>
<th>RECHARGE IN M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gondwana sandstones MP1, MP2, MP3</td>
<td>206</td>
<td>5 – 15</td>
<td>Medium to coarse grained sand, clay and boulders</td>
<td>3 &amp; 4</td>
<td>6</td>
<td>26.64</td>
</tr>
<tr>
<td>2. Lakhanavaram shales P15</td>
<td>16</td>
<td>0 – 5</td>
<td>Fine grained material with clay</td>
<td>2</td>
<td>5</td>
<td>1.60</td>
</tr>
<tr>
<td>3. Pandikunta shales with limestone bands and Gunjeda formation P19 and P110</td>
<td>262</td>
<td>5 – 10</td>
<td>Fine to medium grained material</td>
<td>2</td>
<td>5</td>
<td>24.00</td>
</tr>
<tr>
<td>4. Bolapalli formations P11</td>
<td>4</td>
<td>0 – 5</td>
<td>Fine grained clay loam</td>
<td>2</td>
<td>4.5</td>
<td>0.27</td>
</tr>
<tr>
<td>5. Basic plutonics P112 and SP12</td>
<td>184</td>
<td>0 – 5</td>
<td>Coarse grained sandy materials</td>
<td>1 &amp; 2</td>
<td>5</td>
<td>14.75</td>
</tr>
<tr>
<td>6. Peninsular gneisses (MP13) (P113)</td>
<td>230</td>
<td>5 – 15</td>
<td>Coarse to finegrained sandy material</td>
<td>4</td>
<td>4</td>
<td>25.80</td>
</tr>
<tr>
<td>7. Older schists (P114) (SP14)</td>
<td>231</td>
<td>0 – 5</td>
<td>Fine grained sand with clay and medium grained sand with clay</td>
<td>2 &amp; 3</td>
<td>5</td>
<td>31.00</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**TABLE NO. – 5.3 ESTIMATION OF RECHARGE BY WATER TABLE FLUCTUATION METHOD USING SATELLITE IMAGERY DATA**
5.4.1 Check Percentage:

The recharge estimate arrived in the previous paragraphs by rainfall infiltration factor is 125 MCM and water table fluctuation method is 128 MCM. The check percentage is the variation between these two methods. If the percentage variation in resource estimated between these two methods is more than 20% only, rainfall infiltration estimated values are to be considered (as per GEC norms 1982). In the present investigation, the percentage variation between rainfall infiltration and water table fluctuation method is less than 3% as the estimated resource by rainfall infiltration is 125 MCM and water table fluctuation is 128 MCM. Hence, the recharge estimate is considered as 128 MCM.

5.4.2 Estimation of Ground Water Draft:

The draft in the area is mainly due to the ground water extraction through ground water structures, namely, dugwells with Mhothes, wells fitted with pumpsets and borewells. The systematic well inventory was taken up during the present investigations and it is found that a total number of 110 wells are existing in the area. Out of these 110 wells, 58 wells are open dugwells with Mhothes, 25 are dugwells fitted with pumpsets and 26 are borewells.

The open dugwells are mostly circular in shape with 5 to 6 m. diameters having depth range of 6 to 8 metres and are fitted with 3 and 5 HP motors. The average pumping time of wells is in the range of 2.5 to 3 hours/day with a discharge of about 5000 gph. Where the power supply is either not existing or is away from the road side, the draft is executed through the conventional method of Mhothes. Borewells are fitted with 5 HP submersible pumps and centrifugal pumps where the pumping water levels are within 6.00 metres below ground level.
The second component of draft includes human and livestock consumption for industrial purposes. It is calculated based on the population figures and the rate of consumption/head per day and details of the same are presented in Table No. 5.4.

5.5 Ground Water Development:

In view of the occurrence of vast tracts of ground water availability, the author has made detailed studies to improve the quality of life of tribal tracts by suggesting various methods of ground water development through construction of open wells, borewells, tubewells and sub-surface reservoirs based on the hydrogeological studies. It is already mentioned that out of 1380 sq.kms. of the investigated area, the hills occupy an area of 247 sq.kms., forest 645 sq.kms. and coalmines 50 sq.kms. The remaining 450 sq.kms. area can be brought under agriculture. The potential areas for ground water development are delineated based on geology and geomorphic features, including hydrogeological conditions as presented in figure No.5.1 and the utility of the water and the nature of structures feasible for construction are described in the following paragraphs:

5.5.1 Dug Wells:

It is mentioned in the earlier sections that about 450 sq.kms. area is suitable for construction of various types of wells. Out of the 450 sq.kms. area, 380 sq.kms. area is feasible for construction of dug wells and dug-cum-borewells. These areas are mainly occupied by pediment inselberg complexes and shallow weathered pediplains in granites, gneisses, schists and phyllites. The weathered zone in these geomorphic units is considered to be shallow
<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>NAME OF THE STRUCTURE</th>
<th>NO. OF STRUCTURES</th>
<th>UNIT DRAFT IN MCM</th>
<th>TOTAL DRAFT IN MCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dugwells with Mhotes</td>
<td>58</td>
<td>0.0031</td>
<td>0.1798</td>
</tr>
<tr>
<td>2</td>
<td>Dugwells with pumps</td>
<td>25</td>
<td>0.0093</td>
<td>0.2325</td>
</tr>
<tr>
<td>3</td>
<td>Borewells</td>
<td>26</td>
<td>0.0247</td>
<td>0.6422</td>
</tr>
<tr>
<td>4</td>
<td>Human population</td>
<td>44000</td>
<td>100</td>
<td>0.1600</td>
</tr>
<tr>
<td>5</td>
<td>Livestock 50% of Human consumption</td>
<td>–</td>
<td>0.0800</td>
<td>0.0800</td>
</tr>
<tr>
<td>6</td>
<td>Industrial and other purposes</td>
<td>–</td>
<td>0.2000</td>
<td>0.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.4945</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>or say 1.50 MCM</td>
</tr>
</tbody>
</table>

**TABLE NO. – 5.4 DRAFT ESTIMATES OF THE INVESTIGATED AREA**
FIG. 5.1: DELINEATION OF POTENTIAL AREAS SUITABLE FOR GROUNDWATER DEVELOPMENT.

INDEX

- Area feasible for dug wells.
  in the depth range of 8 to 10 metres.

- Area feasible for construction of bore wells.
  in the depth range of 45 to 60 metres.

- Area feasible for construction of tube wells.
  in the depth range from 100 - 300 metres.

- Area not feasible
and limited to a thickness of 10 to 15 metres. The source of supply of water in this type of terrain can only be through dug wells made in shallow water table aquifers. The recharge in the above terrain is estimated to be about 60 MCM as shown in Table 5.3. It is well known that normal draft of a dug well fitted with 3 to 5 HP pumpsets operated 200 days at the rate of 4 hours/day is worked out to be 1.2 ha.m. But as per the availability, discharge rate, hours of pumping and area irrigated under each well, this rate has been arrived at as 0.93 ha.m. of draft/year, in the present area. The dug wells for domestic as well as irrigation purposes feasible in this zone can be arrived at by dividing ground water potential with draft. But in the present case, by limiting 10 wells/sq.km. of potential area feasible for development, it is estimated that 3800 wells are feasible for construction. On an average, each well will capable of irrigating 1 hectare of wet crop and the total area that can be brought under assured irrigation works out to 3800 hectares. The cost (description) particulars are given in Table 5.5.

5.5.2 Borewells:

From exploratory borewell results, it is clear that all the dolomitic limestones which occupy about 60 sq.kms. area are potential and feasible for construction of borewells. The total resources worked out in the area is about 12 MCM. The other geological formations in the area along the fault and fracture zones are also suitable for construction of borewells. The unit draft for borewells fitted with 5 HP motor working for 8 hours, for 200 days works out to 2.47 ha.m. Hence, about 420 borewells can be constructed. In view of forest, undulating terrains and occupancy 1/3 of the area is accessible for the
<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>ITEM</th>
<th>NOS</th>
<th>UNIT</th>
<th>TOTAL COST (Rs. in lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavation of dugwells with pumpssets with an average depth of 10 m. and 6 m. dia</td>
<td>3800</td>
<td>25000</td>
<td>950.00</td>
</tr>
<tr>
<td>2</td>
<td>Construction of borewells with 15 cm. dia. to average depth of 45 to 50 mtrs. with 5 HP submersible pumps</td>
<td>120</td>
<td>30000</td>
<td>36.00</td>
</tr>
<tr>
<td>3</td>
<td>For the development of ground water in under ground reservoir area for construction of 20 borewells</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) 20 bore-wells</td>
<td>600000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Laying of pipeline</td>
<td>600000</td>
<td>15.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Land development</td>
<td>300000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1001.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE NO. – 5.5 ESTIMATION OF CONSTRUCTION OF DIFFERENT STRUCTURES FOR GROUND WATER DEVELOPMENT
immediate development of 120 borewells. Each borewell will be able to irrigate 2 hectares of wet crop or 4 hectares of irrigation dry crops. The total area that can be brought under assured irrigation will be to the tune of 480 hectares.

The estimated cost for construction and energisation for irrigation wells is presented in Table 5.5. As can be seen from the table, the total cost of the borewells works out to Rs.36,00,000. It is well known that these borewells can irrigate an area of 2 Ha. of wet crop or 4 Ha. of ID crop. Hence, the total area that can be brought under Kharif and Rabbi is 480 hectares for which the above expenditure is to be incurred. Therefore, the average cost per hector under ground water service works out to Rs.7500/ha.

5.5.3 Tubewells:

Though the Gondwana formation occupies 225 sq.km. most of the area is covered by forest and coal mines. Hence, few patches can only be developed by constructing 10 - 20 tubewells in the area.

5.6 Under Ground Storage Reservoir:

During the field investigations, it was observed that the aquifer at Kotiling-gala which is about 4 kms. southwest of Yellandulapadu town, has limited areal extent. However, the wells have high yields, but it is likely that heavy pumping in future may result in several depletion of water levels. Therefore, it is necessary that a suitable artificial recharge method must be adopted to sustain well yields.

The above area is covered by dolomitic limestones which have undergone intensive folding and faulting forming a synclinal bowl. Percolating waters
along these zones of weakness have created large underground cavities and interconnected caverns resulting in very high permeability.

A number of natural springs discharge heavy volumes of water, these springs seem to be located along fault zones and the sink holes are observed in-depth sections along stream. It is also observed that the discharge through stream and spring are getting mixed instantaneously.

To know precisely the aquifer and confirm subsurface geological features, five exploratory borewells were drilled. Each of these wells has yielded more than 800 LPM. It is interesting to note that one of the wells has recorded an yield of 1700 LPM at a shallow depth of 30 metres, which is the highest yield in these rock types in the whole State.

The lithology of borewells and the well yields conform to the presence of solution cavities and other openings in the investigated area.

In such hydrogeological setting under ground storage, reservoirs are the best means of artificially recharging the aquifers, especially where surface flood water is available for such a recharge facility.

Hence, it is proposed to seal the contact between phyllites and dolomitic limestones at the existing anicut 1/2 kms. southwest of Kotilingala with a leak proof concrete to control the seepage from the underground storage reservoir. Reservoir model is shown in figure No.5.2 and hydrogeological map of the proposed site is shown in figure No.5.3.

An area of about 500 hectares in contiguous patch on the main road side is available around the proposed reservoir area. It's strategic location, natural resources like replenishable ground water potential, excellent quality of water, fertile land, electricity, communication and nearby industrial township add
Fig. 5.2. Model of proposed site for underground storage reservoir at Kotilingala.
INDEX FOR FIG. 5.2.

- Drainage
- Anicut
- Proposed village
- Existing forest
- Proposed social forestry
- Orchard
- Proposed ayacut area for wet crops
- Area proposed for irrigation dry crops
- Existing borewells
- Proposed borewells
- Proposed borewells for artificial recharge
- Dolomitic limestones
FIG.5.3: HYDROGEOLOGICAL MAP OF PROPOSED UNDERGROUND STORAGE RESERVOIR SITE.
significance to this area for the development of a model and demonstrable agricultural farm as there is every possibility for around development. For this purpose, following developmental activities are proposed for ground water development by taking up 20 more borewells in the area (as shown in model map) in addition to the existing wells.

i) Energisation of all the wells with suitable pumps.

ii) The borewells in the western side of Bugganadi to be connected to a single pumping main and laying a pipeline to the higher level in eastern side of Bugganadi to enable gravity flow from that point as more cultivable area is in the eastern and northern sides of the Kotilingala.

iii) Rehabilitation of existing Tribal population living in isolated hutments around Kotillingala, Polampalli, Repallewa, Kommugudem, Nizampeta and other hamlets by bringing all of them together to this area by providing elevated land around the well No. 17 by allotting house sites and housing scheme with an ideal layout.

The developmental activities, including housing, different corps to be grown, borewells to be taken up for recharge and development and the anicut to be made leak proof are shown in model figure No. 5.2. For providing additional irrigation potential for an area of 300 hectares, of which 100 hectares are for fodder, the cost works out to be Rs. 5000/ha.

On implementation of the programmes proposed by the author in the investigated area, it is possible to create an additional irrigation potential of 4580 hectares, of which 3800 hectares will be under open dugwells, 480 hectares under borewells and 300 hectares under the special scheme at Kotilingala.
The hamlets mostly inhabited by tribal population do not have drinking water. Hence, all the problematic villages where no other surface water source is available in the area can be provided, drinking water in addition to irrigation.

The creation of additional irrigation potential will not only improve their livelihood, but also improve the socio-economic conditions and their annual income will be almost increased two to three times, i.e., to the tune of Rs.6,000/head. In addition to agriculture, there is possibility for development of dairy and poultry and growing vegetables which will provide additional income.

CALCULATION OF SPECIFIC YIELD

The specific yield of the area has been calculated from estimation of rainfall recharge and fluctuation of water level data of observation wells.

1. Normal Monsoon Rainfall of Yellandulapadu considered for recharge estimation 1027 mm. for the period 1901 to 1950

2. Actual evapotranspiration of calculated form tables for Khammam station which is the nearest IMD station for the investigated area 363 mm.
3. Percolation, infiltration.
   including unaccounted
   seepage losses considered as 10% of
   Monsoon rainfall
   
   \[
   \frac{1027 \times 10}{100} = 102.7 \text{ mm.}
   \]
   
   = or say 103 mm.

4. Runoff estimation as per Ingli’s
   and De souza’s Formula
   
   \[
   R = \frac{(P - 17.8)^{P}}{254}
   \]
   
   Where,

   \[
   R = \text{Runoff in centimeters}
   \]

   \[
   P = \text{Precipitation in centimeters}
   \]

   \[
   R = \frac{(102.7 - 17.8)^{102.70}}{254} = \frac{34.32}{254} = 0.135 \text{ cm.}
   \]

   = or say 343 mm.
5. Deep percolation of Recharge to ground water = Precipitation - Runoff + percolation, infiltration, including seepage losses + Evapotranspiration

= 1027 mm. - (363 + 103 + 343)

= 809 mm.

= 1027 - 809 = 218 mm.

6. Average water table fluctuation = 5.20 metres.

(The ground water fluctuation of the observation wells established at Yellandulapadu, Bethampudi and Motlagudem villages in the investigated area are considered and the average fluctuation observed is 5.20 metres).
Rainfall available for deep percolation, i.e., recharge to ground water in mm.

7. Specific yield in percentage = \[
\frac{\text{Average water table fluctuation of the area in mm. (Total rise).}}{5200}
\]

\[
= \frac{218 \times 100}{5200} = 4.19
\]

= or say 4%