# Success Stories of Artificial Recharge Schemes in State of Tamil Nadu

The dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells.

Central Ground Water Board had also taken up Pilot and Demonstrative Artificial Recharge studies under Central Sector Schemes to augment the groundwater resources during VIII, IX & X Plans. The schemes have been executed through the State Agencies and NGOs with technical and financial support of Central Ground Water Board.

The report describes briefly the objective of the study, the background information on the area, project formulation, execution and impact of the artificial recharge structures on the groundwater regime.

Under Central Sector Scheme, construction of sub-surface dykes on experimental/ operational basis was taken up at three locations in Tamil Nadu by the CGWB during the 8th plan period (Table-1). The details of villages where these structures have been shown in Table-1

Table: 1 Details of villages in Tamil Nadu where subsurface dykes were constructed during 8th Plan period.

| S.No | District | Taluk | Block | Village |
|---|---|---|---|---|
| 1 | Dharmapuri | Pennagaram | Pennagaram | Madam |
| 2 | Namakkal | Rasipuram | Rasipuram | Kunavelampatti |
| 3 | Dharmapuri | Harur | Harur | Ellapudayampatti |

Sub-surface dykes, also known as Ground water Dams or Underground Bandharas are basically water conservation structures and are effective in providing sustainability to ground water abstraction structures by arresting sub-surface flow. The main purpose of construction of a sub-surface dyke is to arrest the flow of ground water out of the watershed and to increase the storage within the aquifer, by which the de-saturated aquifers get replenished, resulting in rise of ground water in the upstream side of the structure.

Sub-surface dykes have the following advantages in comparison with other artificial recharge structures

i. As water is stored within the aquifer, no land is lost due to submergence and the land above the reservoir can be utilized even after construction of the structure.
ii. No water is lost due to evaporation.
iii. There is no siltation and consequent reduction in storage capacity.
iv. There is no potential disaster like collapse as in the case of surface reservoirs.

Technical possibilities of constructing the dyke and achieving large storage reservoirs with suitable recharge conditions and low seepage losses are the main criteria for siting of sub-surface dykes. Valley shapes and gradients are used for site identification. Optimally, a valley should be well defined and wide with a very narrow outlet (bottle necked). This reduces the cost of the structure and makes it possible to have a comparatively large storage volume. This indicates that the gradient of the valley floor should not be high since that would reduce the storage volumes behind a dam of given height.

The limitations on depth of underground construction stipulate that the unconfined aquifer should be within a shallow to moderate depth (down to 10 m bgl) and have a well-defined impermeable base layer. Such situations occur in hard rock areas and shallow alluvial riverine deposits.

Salient features of the sub surface dykes constructed under VIII Plan period are given below. (Table 2)

| Particulars | Madam Village, Pennagaram block, Dharmapuri District | Kunavelampatti village, Rasipuram block, Namakkal District | Ellapudayampatti village, Harur block, Dharmapuri District |
|---|---|---|---|
| Normal rainfall (mm) | 857 | 862 | 850 |
| Elevation (m. a msl) | 510 | 240 | 350 |
| Geology | Archaean Gneisses | Archaean Gneisses | Archaean Gneisses |
| Soil Type | Mixed Loams | Mixed Loams | Mixed Loams & gravelly to sandy soils |
| Crops Grown | Paddy, Jowar, Ground nut | Paddy, Ground nut, Vegetables | Paddy, Ground nut, Vegetables |
| Depth to water (m.bgl)<br>Pre-monsoon<br>Post-monsoon | <br>8 – 12<br>4 - 8 | <br>8 – 12<br>4 - 8 | <br>8 – 12<br>4 - 8 |
| Length of structure (m) | 175 | 100 | 120 |
| Maximum Depth (m.bgl) | 6.50 | 5.5 | 6.5 |
| No. of Piezometers | 4 Pairs | 2 Pairs | - |
| Cost of Construction | Rs. 4.50 Lakhs. | Rs. 4.00 Lakhs. | Rs. 6.50 Lakhs. |

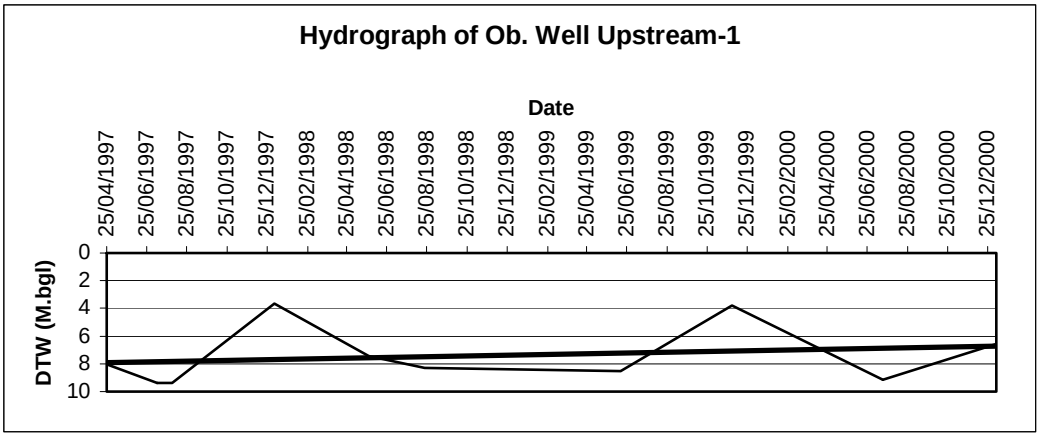
## Impact Assessment Study

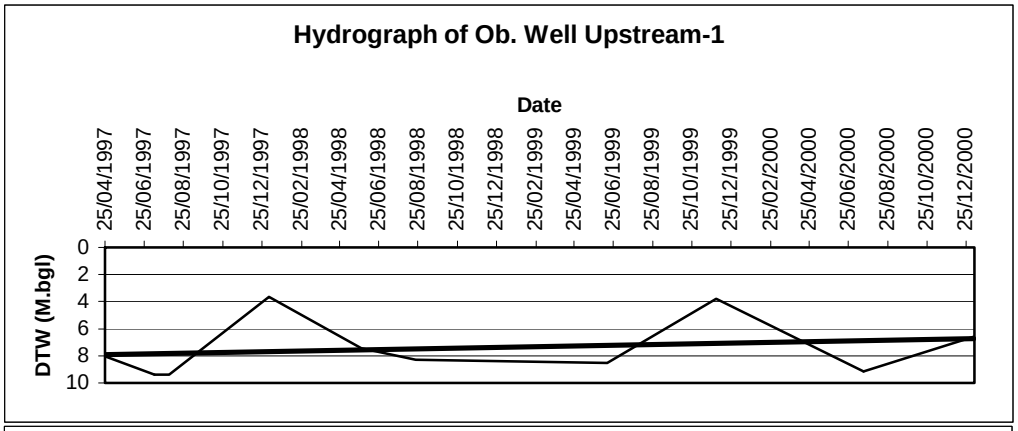
The following methodologies have been adopted for assessing the impacts of the sub-surface dyke on the ground water regime in the area.

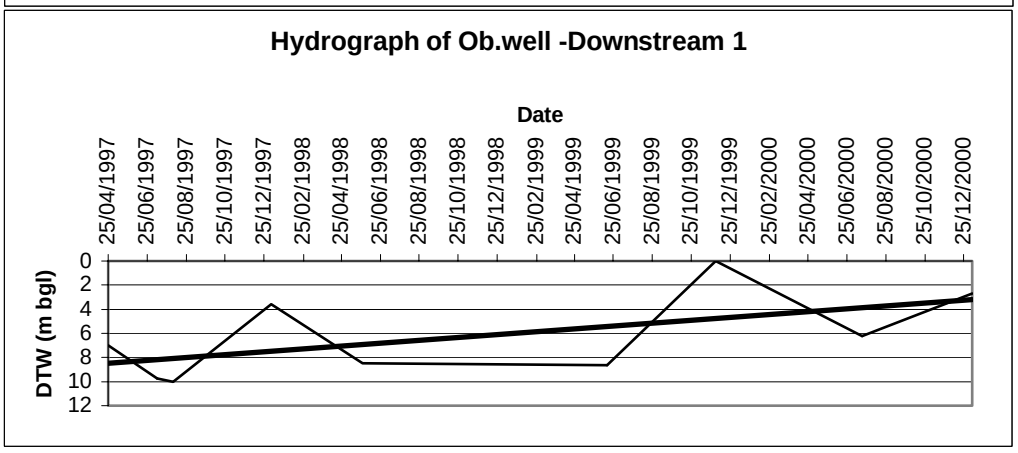
i. Observation wells established in the area were monitored on a regular basis to estimate the rise in water levels and to estimate the quantum of ground water recharge. However, as ground water extraction is taking place from the area together with its recharge, realistic assessment of the quantum of water recharged is considered difficult.
ii. Data pertaining to Increase in the availability of water in the existing wells and the increase in the area cropped were collected from the farmers and this data was used to quantify the benefits due to construction of the structure.

Impacts on water levels have been presented below for each site.

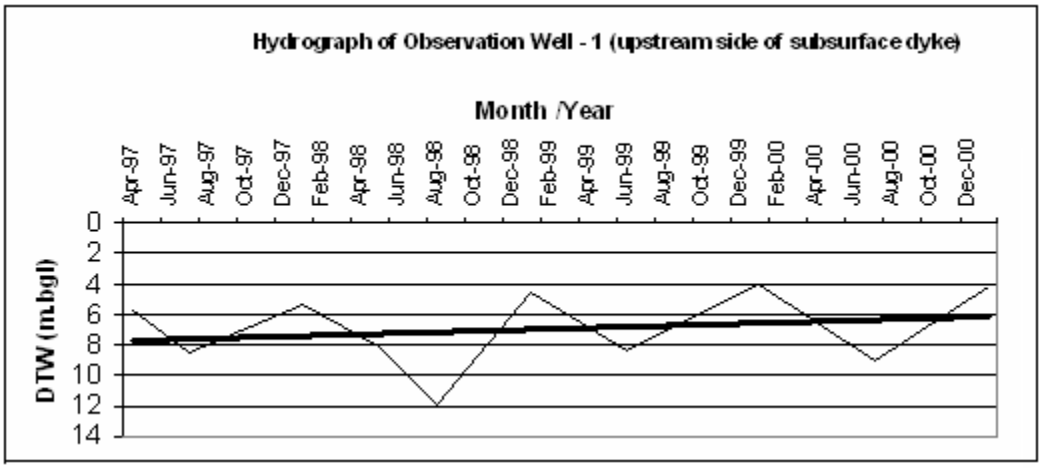
- Madam, Dharmapuri District (Fig 2)

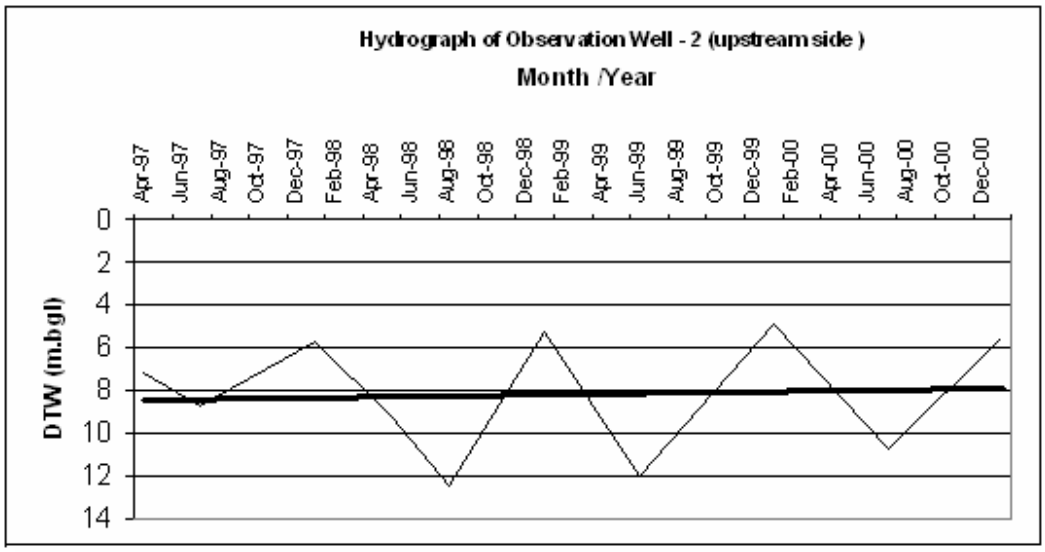





- Kunavelampatti, Namakkal District (Fig 3)






A summary of impact on the irrigation has been provided below (Table 3)

| Particulars | Madam Dharmapuri District | Ellapudayampatti Dharmapuri District | Kunavelampatti Namakkal district |
|---|---|---|---|
| No. of farmers benefited | 15 | 8 | 5 |
| Total area benefited | 10 Ha. | 12 Ha. | 7.5Ha. |
| Incremental income due to assured irrigation + additional area brought under irrigation (Rs/Yr/ha) | 2500 | 2500 | 2500 |
| Total incremental income due to increased production(Rs/Yr) | 25,000 | 30,000 | 18,750 |
| Cost of construction of the structure (Rs.) | 4,50,000 | 6,50,000 | 4,00,000 |
| Life of the structure (Years) | 25 | 25 | 25 |
| Annual investment for construction (Rs) | 18,000 | 26,000 | 16,000 |
| Interest on Annual expenditure @10% (Rs) | 1800 | 2600 | 1600 |
| Total Annual investment (Rs) | 19,800 | 28,600 | 17,600 |
| Cost-benefit ratio | 1: 1.26 | 1: 1.052 | 1: 1.1 |

The construction of sub surface dykes for water conservation purposes has revealed the following.

1. Subsurface dykes constructed in Namakkal and Dharmapuri districts have been effective in conserving ground water on their upstream sides by arresting sub-surface flow of ground water.

2. The construction of the structures has resulted in improved sustainability of irrigation wells in the command areas of the structures.

3. No significant decline in water levels/reduction in yield has been observed in wells located downstream of the structures.

4. The cost-benefit ratios computed for the schemes indicate that subsurface dykes, though economically viable, may not be the best structures suitable for conservation of groundwater for irrigation purposes, as the area

benefited is normally small. However, subsurface dykes could be ideal structures for water conservation for community water supplies, when combined with an infiltration well on its upstream side. Further, the cost on operation and maintenance is nil, thus on a longer run, the structure will be highly cost effective.

5. Realistic assessment of impacts of subsurface dyke is difficult due to the ground water extraction from the command area. The assessment of impacts, in such cases, is to be done based on reported data only. However, the actual beneficial impacts in the long run will be much higher when we consider the improvements in the socio-economic conditions of the farmers in the area.

6. Subsurface dykes could be used effectively to conserve sub-surface flow, when constructed in combination with other recharge structures like check dams and percolation ponds, for a watershed/sub-basin as a whole.

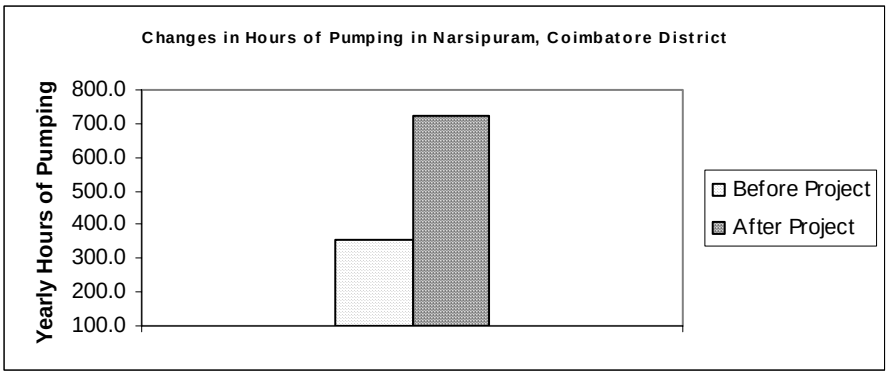
During IX and X plans 13 schemes were executed by CGWB under Central Sector Scheme in the State of Tamil Nadu and details of which are provided as Table 4. The schemes have been executed by State Government agencies, viz., Agricultural Engineering Department, Tamil Nadu Water Supply & Drainage Board, Public Works Department, Auroville Water Service, a NGO etc.

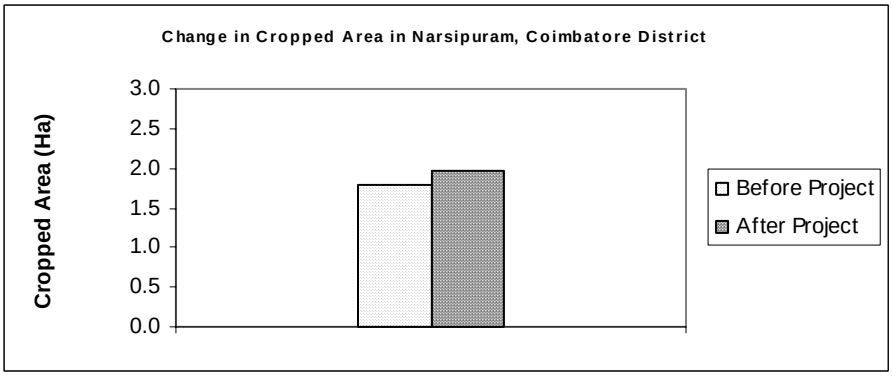
Observation wells established in the area were monitored on a regular basis to estimate the rise in water levels and to estimate the quantum of ground water recharge. However, as ground water extraction is taking place from the area together with its recharge, realistic assessment of the quantum of water recharged is considered difficult. Data pertaining to increase in the availability of water in the existing wells and the increases in the area cropped were collected from the farmers and this data was used to quantify the benefits due to construction of the structure.

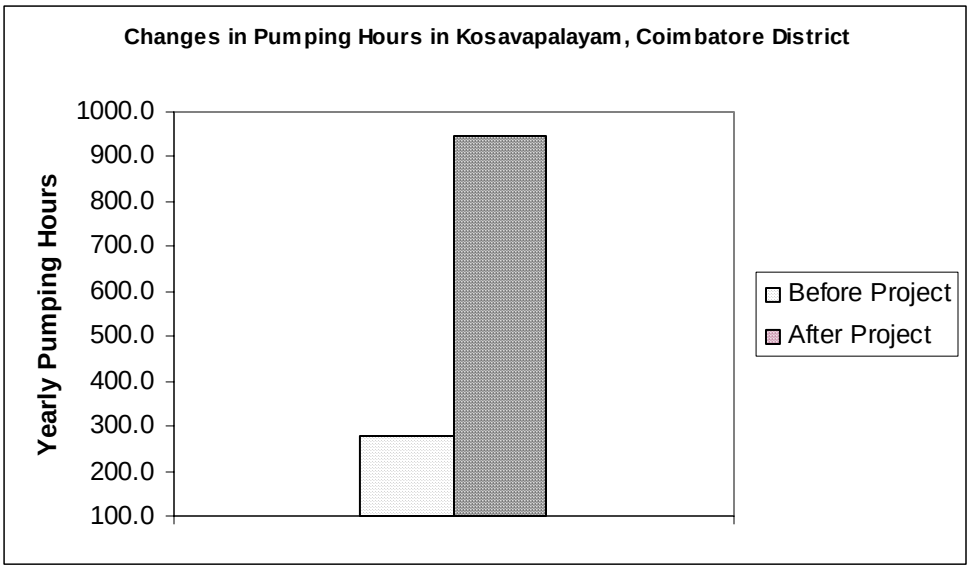
## Impact Assessment Study

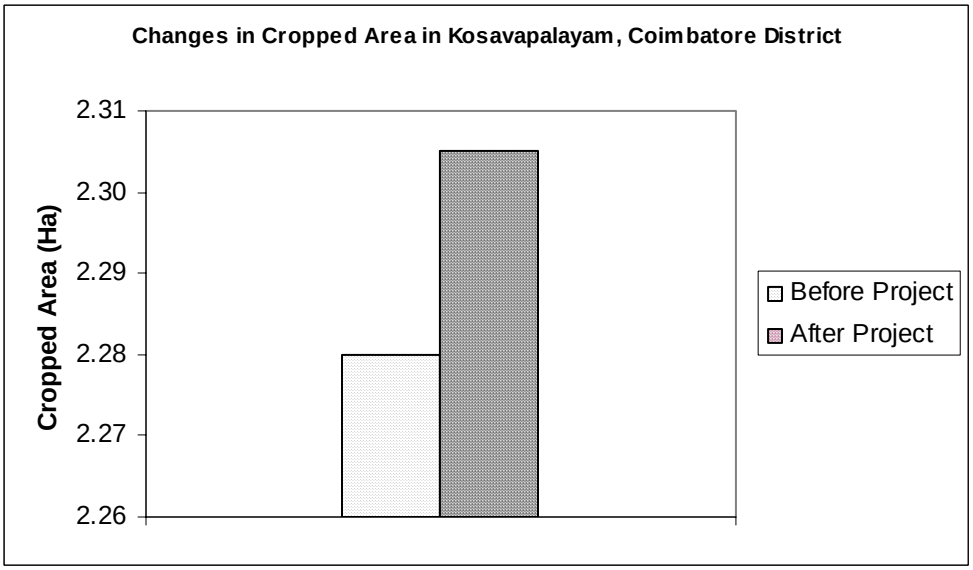
The impacts of different structures are enumerated below.

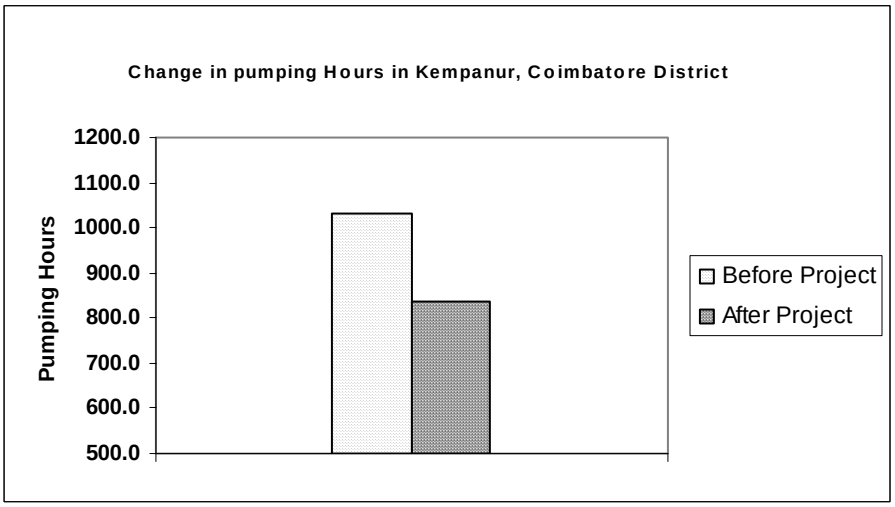
Percolation Ponds in Coimbatore District

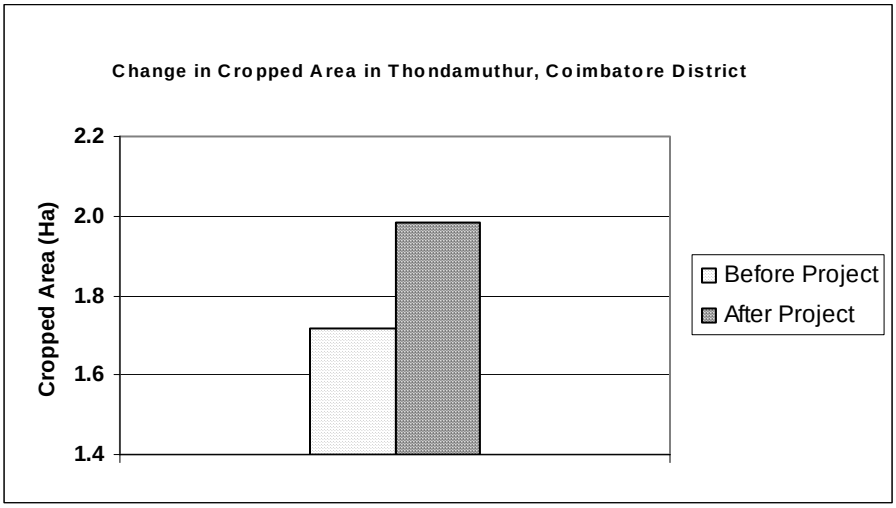


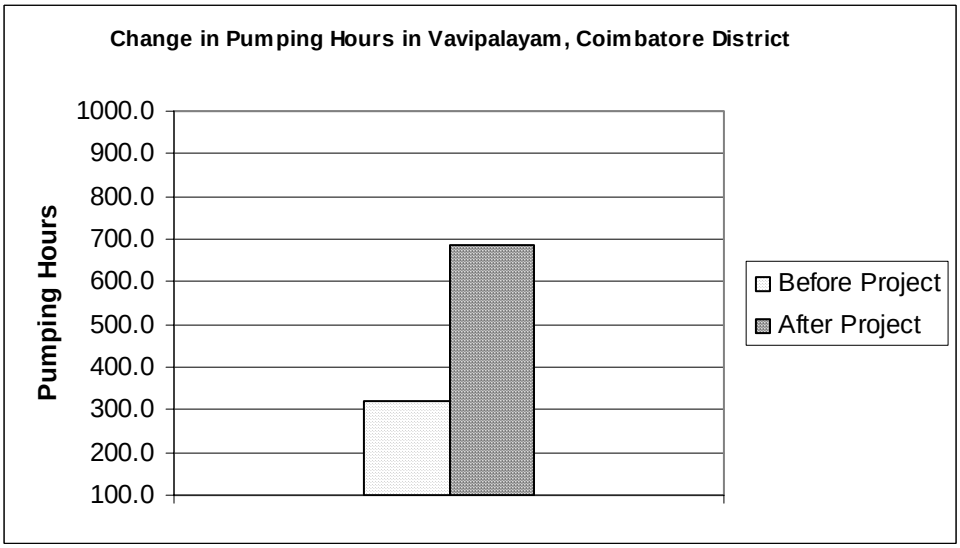




Changes in Pumping Hours in Kosavapalayam, Coimbatore District
Yearly Pumping Hours
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
Before Project
After Project

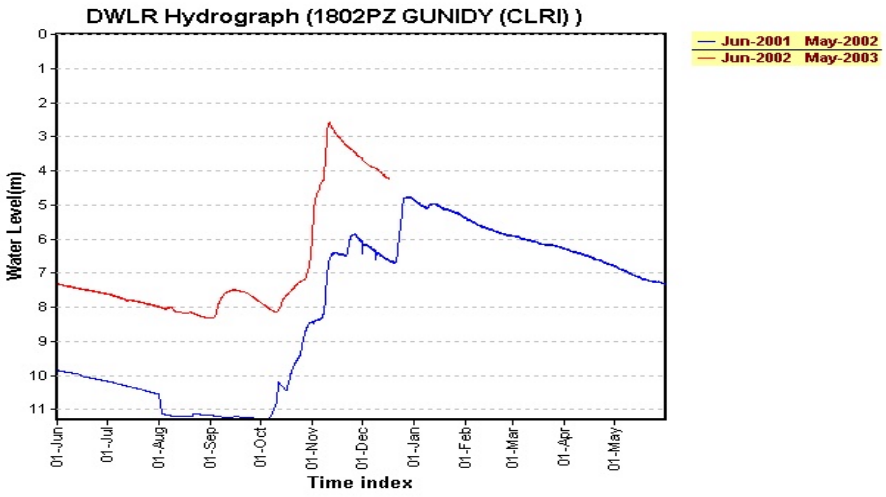

Changes in Cropped Area in Kosavapalayam, Coimbatore District
Cropped Area (Ha)
2.31
2.30
2.29
2.28
2.27
2.26
Before Project
After Project


Change in pumping Hours in Kempanur, Coimbatore District
Pumping Hours
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
Before Project
After Project

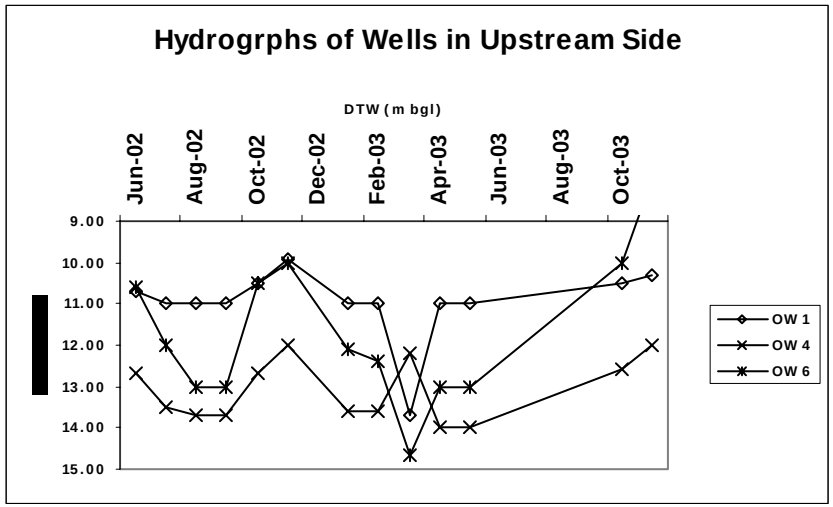


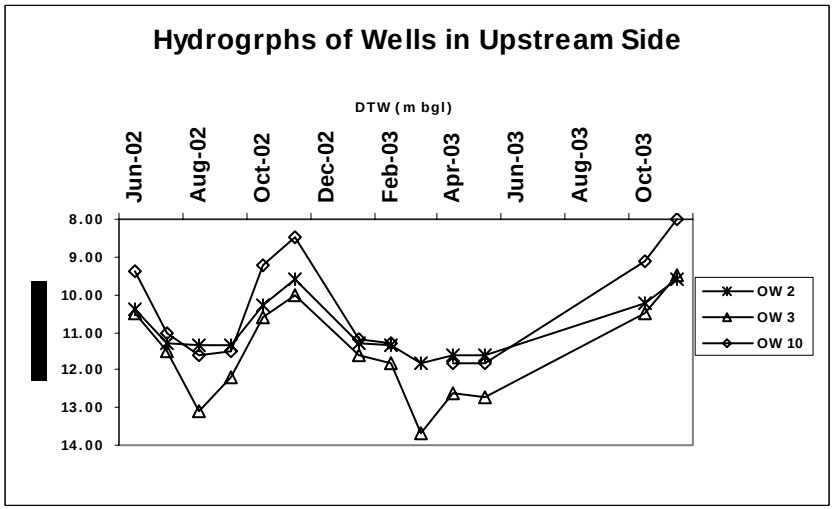



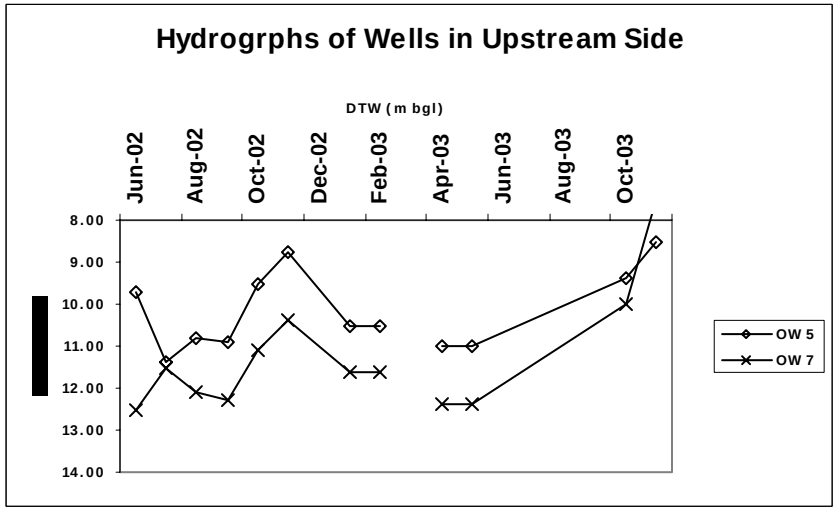

Percolation Ponds in CLRI, Chennai

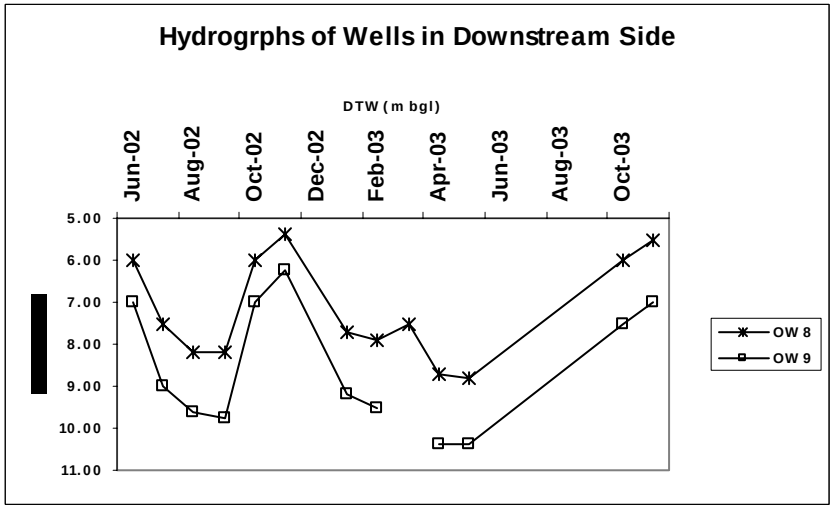


Hydrographs adjacent to Sub Surface Dyke in Avaravalli, Tiruchchirappalli District



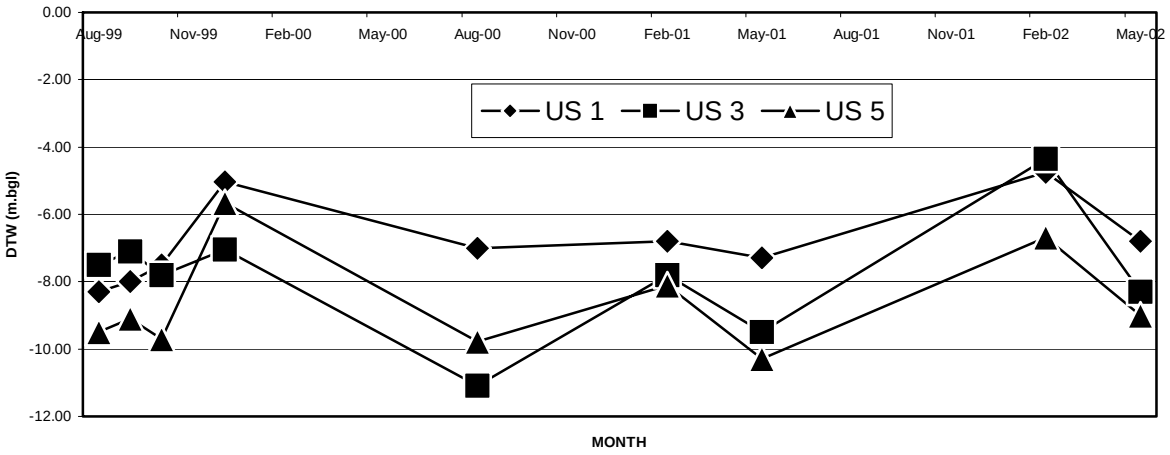



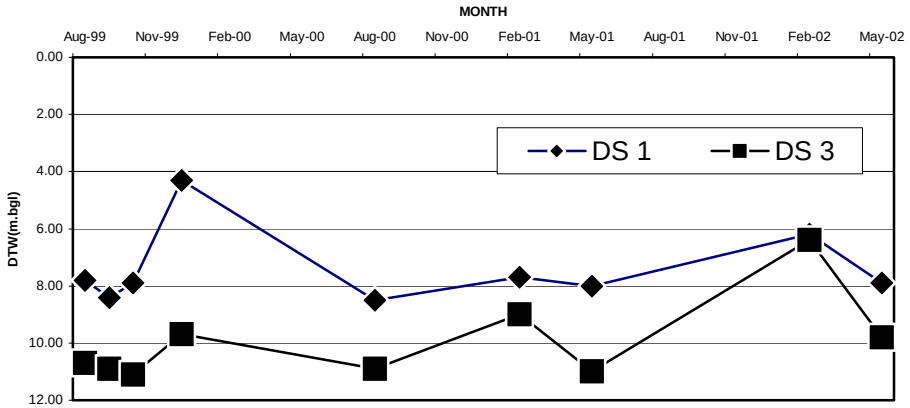
SUBSURFACE DYKE AT NALLANPILLAI PETRAL, VILLUPURAM DISTRICT, TAMIL NADU

**HYDROGRAPHS OF SELECT OBSERVATION WELLS**
**(UPSTREAM SIDE)**




SUBSURFACE DYKE AT NALLANPILLAI PETRAL, VILLUPURAM DISTRICT, TAMIL NADU

**HYDROGRAPHS OF SELECT OBSERVATION WELLS**
**DOWNSTREAM SIDE**



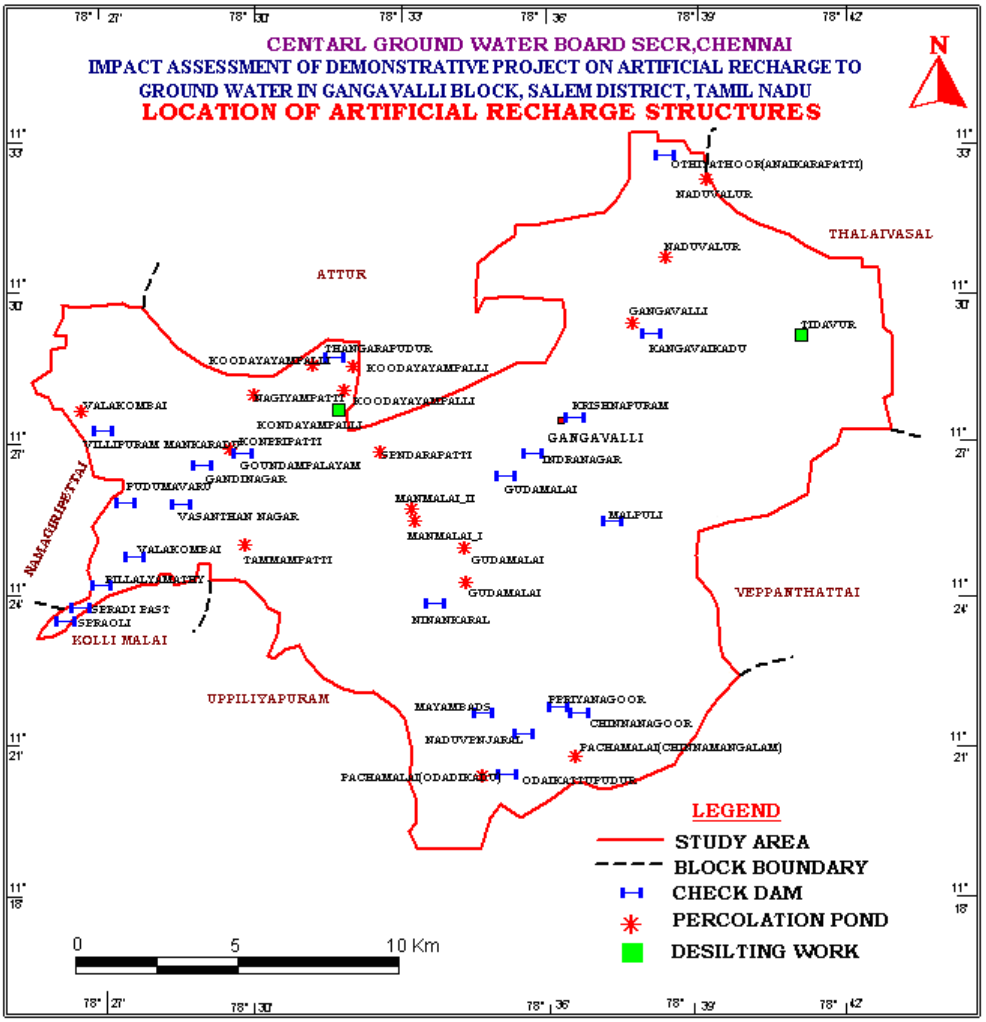
## Demonstrative Project on Artificial Recharge to Groundwater in Gangavalli Block

During X Plan, the Central Ground Water Board executed artificial recharge structures with cluster approach in Gangavalli Block, which has the highest groundwater development (221%) as per the computation of Dynamic resources of the State of Tamil Nadu as on 31.03.2004, to improve the over all groundwater situation for increased productivity of crops and sustainable rural water supply to the people.

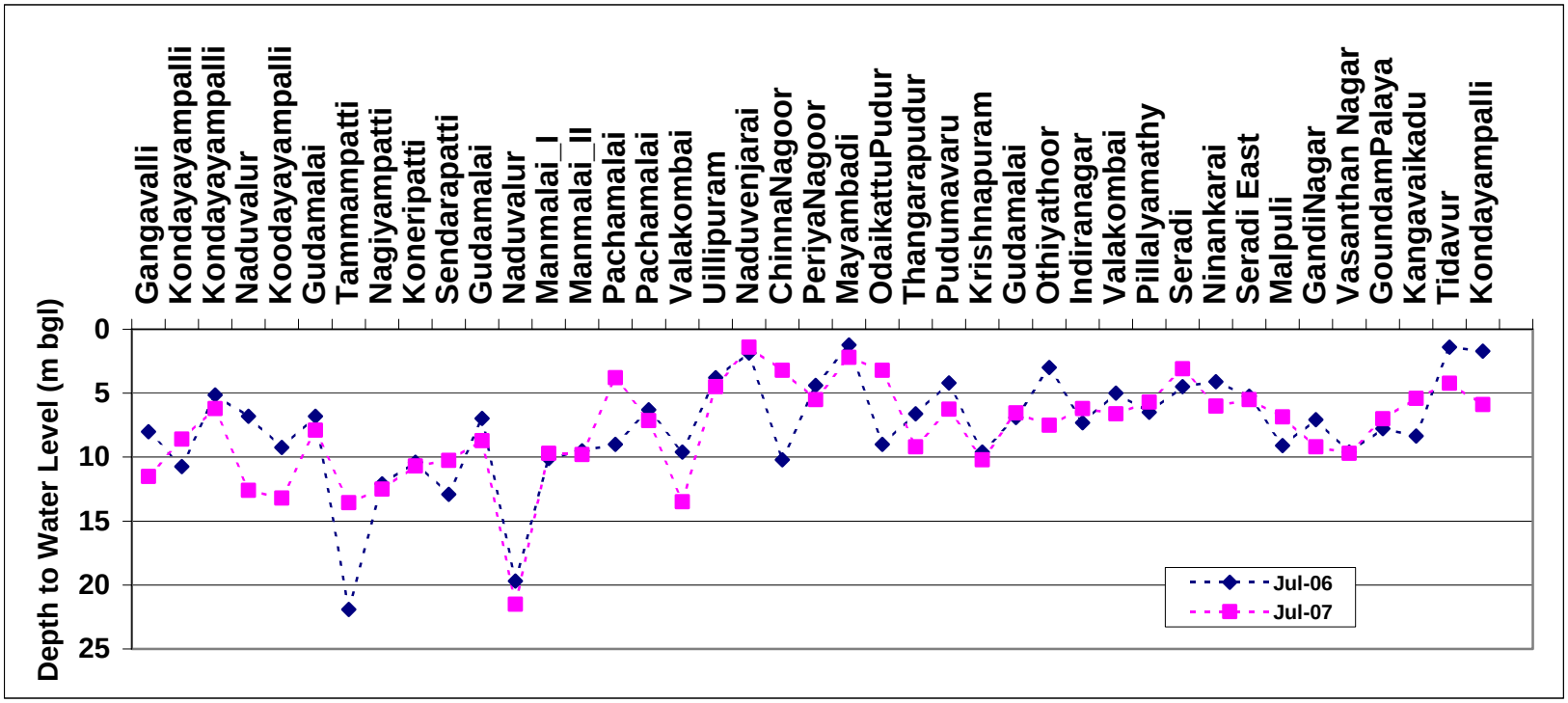
The scheme for artificial recharge was formulated with two-pronged approach, viz., augmenting the irrigation sources and drinking water sources. A reconnaissance survey was made and Tamil Nadu Water Supply and Drainage Board (TWAD Board) responsible for water supply in the State of Tamil Nadu was asked to submit a proposal for augmenting their sources in Gangavalli Block, while Agricultural Engineering Department (AED) responsible for assisting the farmers in "On Farm Development" activities and Public Works Department (PWD) responsible for irrigation were asked to submit their proposals for augmenting the irrigation sources.

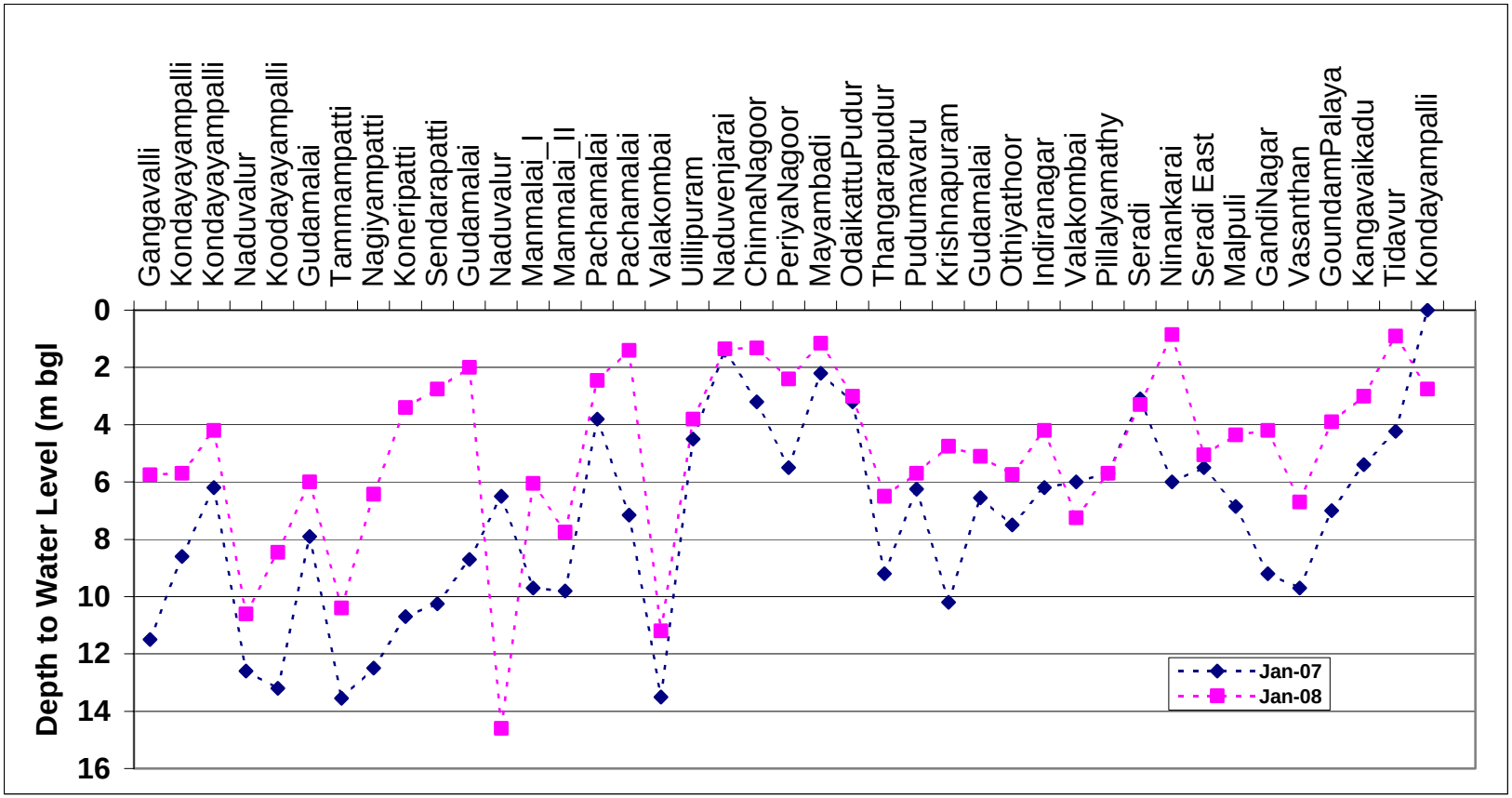
A summary of the project proposal giving details on the location, capacity, executing agency and the cost of the scheme are provided are provided as Figure 5.

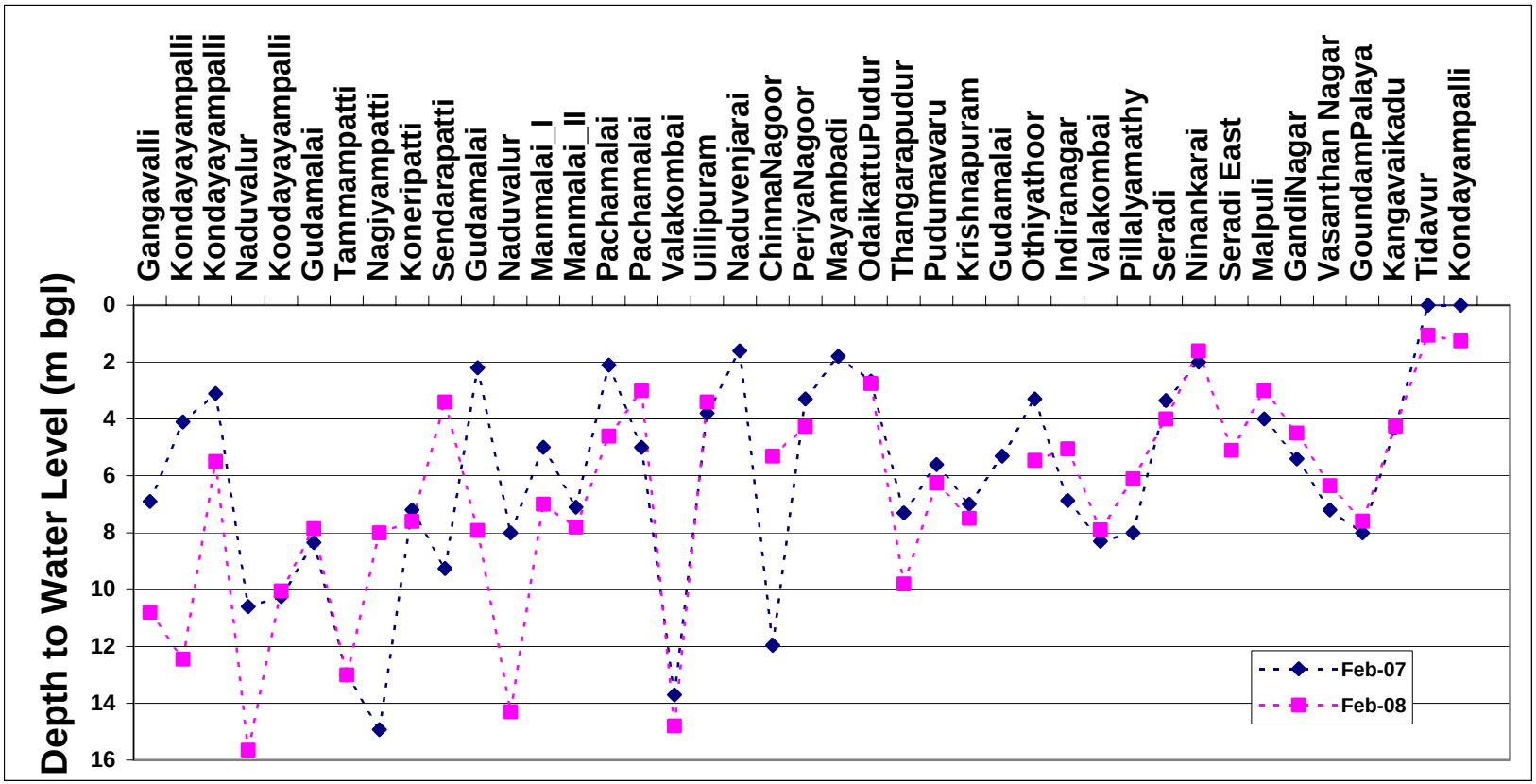
**Figure 5**

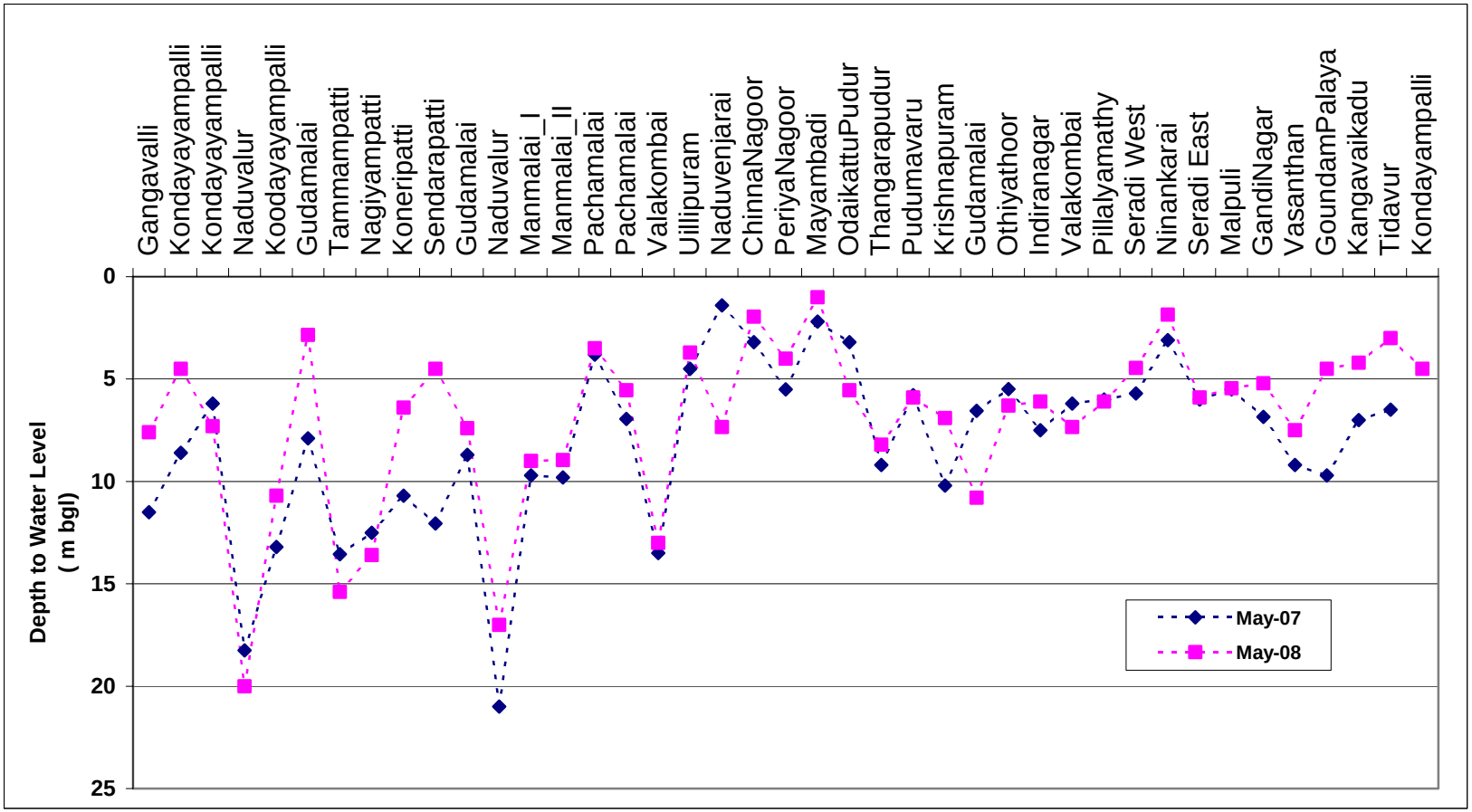


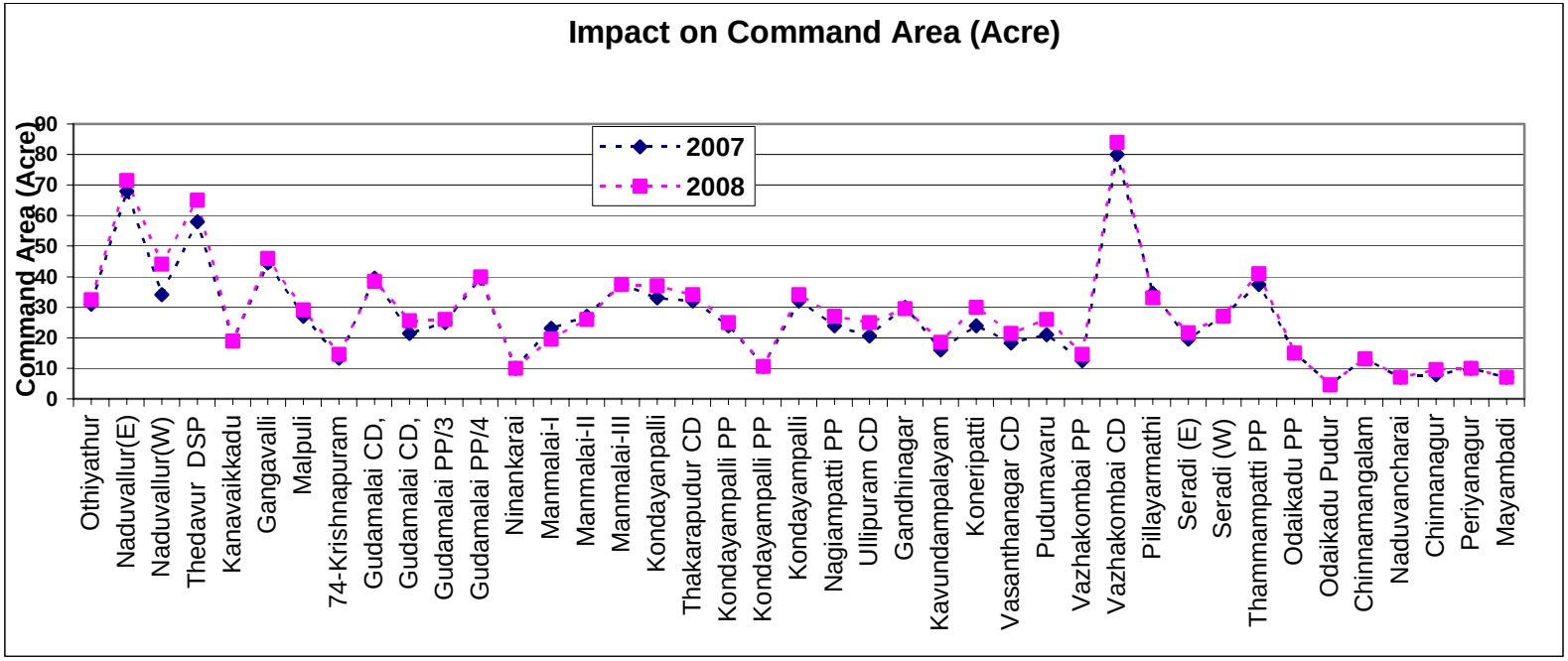
Impact on Water levels

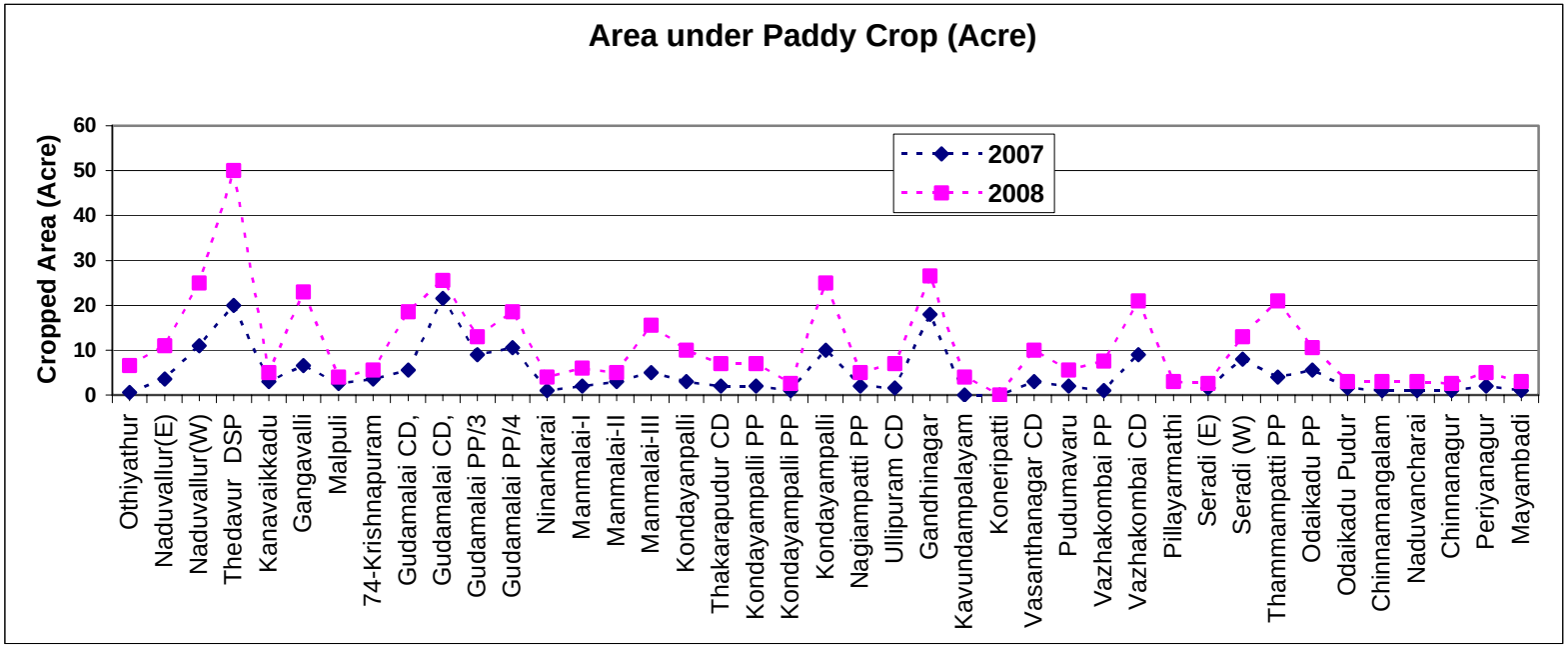


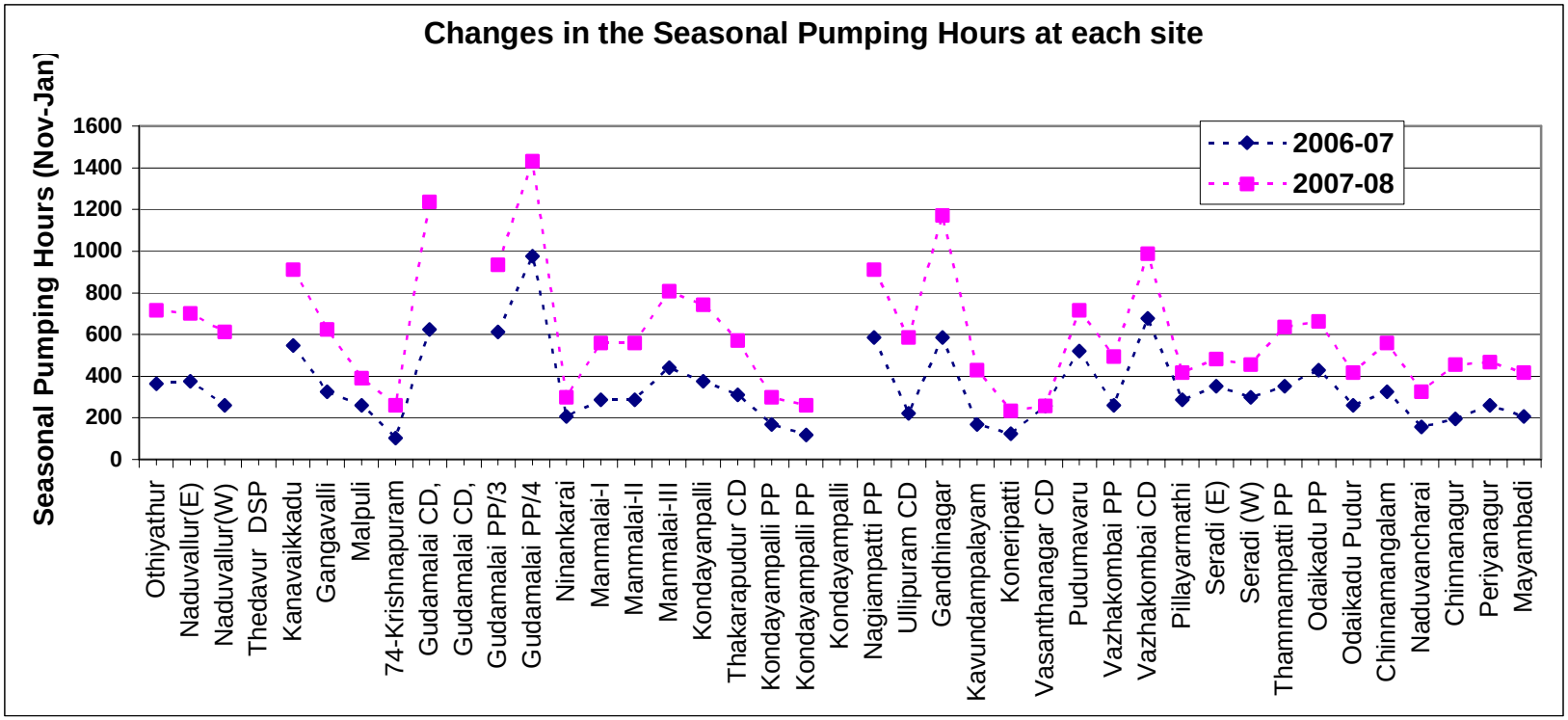

Depth to Water Level (m bgl)
0
2
4
6
8
10
12
14
16
Gangavalli
Kondayayampalli
Kondayayampalli
Naduvalur
Koodayayampalli
Gudamalai
Tammampatti
Nagiyampatti
Koneripatti
Sendarapatti
Gudamalai
Naduvalur
Manmalai_I
Manmalai_II
Pachamalai
Pachamalai
Valakombai
Uillipuram
Naduvenjarai
ChinnaNagoor
PeriyaNagoor
Mayambadi
OdaikattuPudur
Thangarapudur
Pudumavaru
Krishnapuram
Gudamalai
Othiyathoor
Indiranagar
Valakombai
Pillalyamathy
Seradi
Ninankarai
Seradi East
Malpuli
GandiNagar
Vasanthan
GoundamPalaya
Kangavaikadu
Tidavur
Kondayampalli
Jan-07
Jan-08

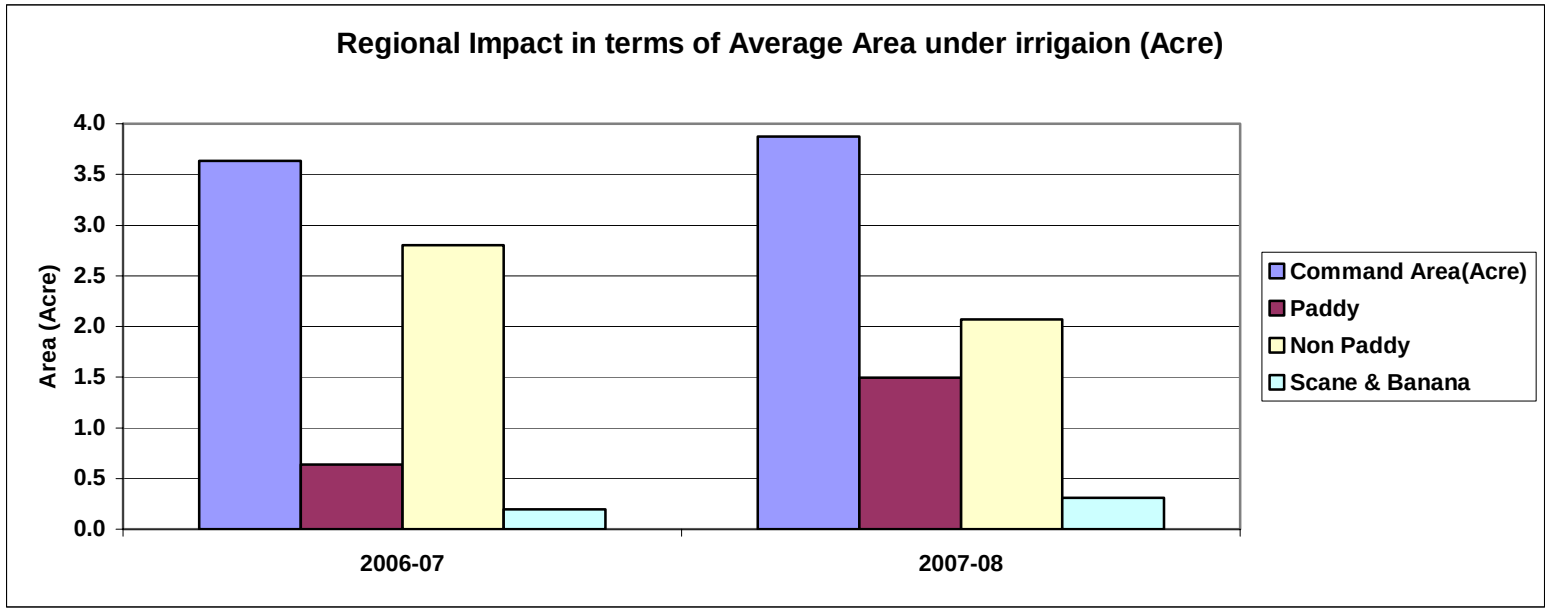

Depth to Water Level (m bgl)
0
2
4
6
8
10
12
14
16
Gangavalli
Kondayayampalli
Kondayayampalli
Naduvalur
Koodayayampalli
Gudamalai
Tammampatti
Nagiyampatti
Koneripatti
Sendarapatti
Gudamalai
Naduvalur
Manmalai_I
Manmalai_II
Pachamalai
Pachamalai
Valakombai
Uillipuram
Naduvenjarai
ChinnaNagoor
PeriyaNagoor
Mayambadi
OdaikattuPudur
Thangarapudur
Pudumavaru
Krishnapuram
Gudamalai
Othiyathoor
Indiranagar
Valakombai
Pillalyamathy
Seradi
Ninankarai
Seradi East
Malpuli
GandiNagar
Vasanthan Nagar
GoundamPalaya
Kangavaikadu
Tidavur
Kondayampalli
Feb-07
Feb-08

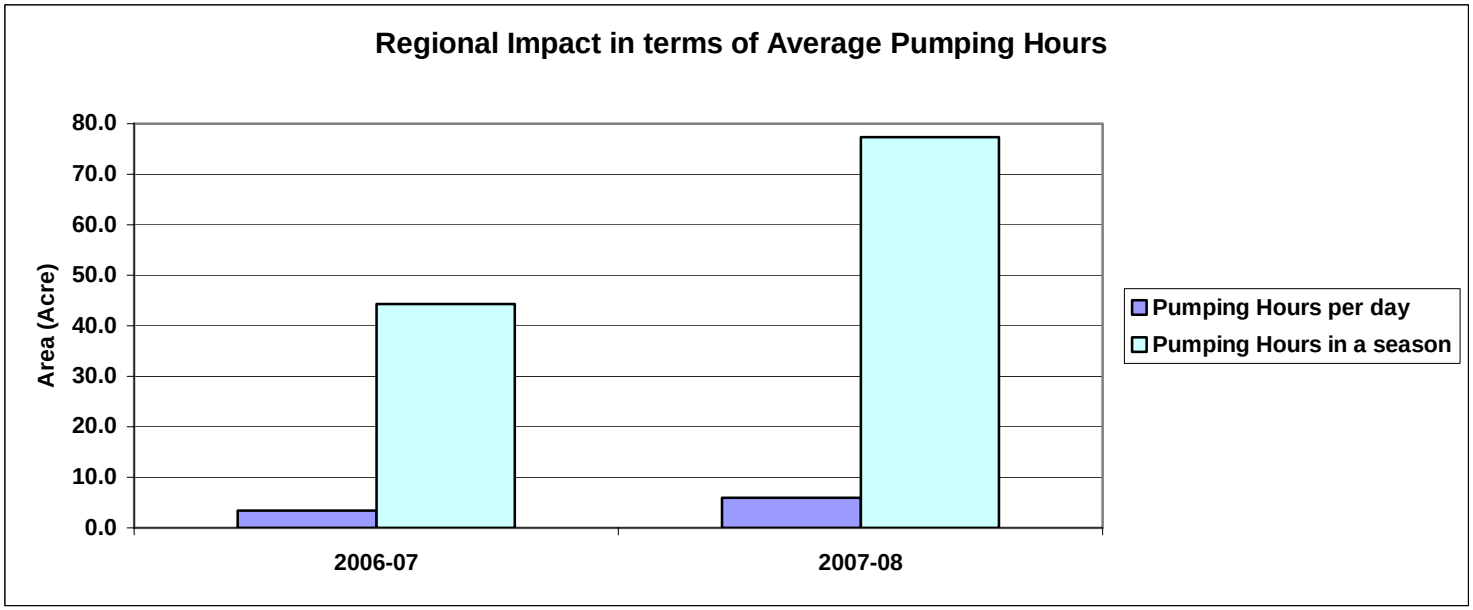

Gangavalli
Kondayayampalli
Kondayayampalli
Naduvalur
Koodayayampalli
Gudamalai
Tammampatti
Nagiyampatti
Koneripatti
Sendarapatti
Gudamalai
Naduvalur
Manmalai_I
Manmalai_II
Pachamalai
Pachamalai
Valakombai
Uillipuram
Naduvenjarai
ChinnaNagoor
PeriyaNagoor
Mayambadi
OdaikattuPudur
Thangarapudur
Pudumavaru
Krishnapuram
Gudamalai
Othiyathoor
Indiranagar
Valakombai
Pillalyamathy
Seradi West
Ninankarai
Seradi East
Malpuli
GandiNagar
Vasanthan
GoundamPalaya
Kangavaikadu
Tidavur
Kondayampalli
Depth to Water Level ( m bgl)
0
5
10
15
20
25
May-07
May-08


Impact on Command Area (Acre)
Command Area (Acre)
2007
2008
0
10
20
30
40
50
60
70
80
90
Othiyathur
Naduvallur(E)
Naduvallur(W)
Thedavur DSP
Kanavaikkadu
Gangavalli
Malpuli
74-Krishnapuram
Gudamalai CD,
Gudamalai CD,
Gudamalai PP/3
Gudamalai PP/4
Ninankarai
Manmalai-I
Manmalai-II
Manmalai-III
Kondayanpalli
Thakarapudur CD
Kondayampalli PP
Kondayampalli PP
Kondayampalli
Nagiampatti PP
Ullipuram CD
Gandhinagar
Kavundampalayam
Koneripatti
Vasanthanagar CD
Pudumavaru
Vazhakombai PP
Vazhakombai CD
Pillayarmathi
Seradi (E)
Seradi (W)
Thammampatti PP
Odaikadu PP
Odaikadu Pudur
Chinnamangalam
Naduvancharai
Chinnagur
Periyanagur
Mayambadi


Area under Paddy Crop (Acre)
Cropped Area (Acre)
60
50
40
30
20
10
0
2007
2008
Othiyathur
Naduvallur(E)
Naduvallur(W)
Thedavur DSP
Kanavaikkadu
Gangavalli
Malpuli
74-Krishnapuram
Gudamalai CD,
Gudamalai CD,
Gudamalai PP/3
Gudamalai PP/4
Ninankarai
Manmalai-I
Manmalai-II
Manmalai-III
Kondayanpalli
Thakarapudur CD
Kondayampalli PP
Kondayampalli PP
Kondayampalli
Nagiampatti PP
Ullipuram CD
Gandhinagar
Kavundampalayam
Koneripatti
Vasanthanagar CD
Pudumavaru
Vazhakombai PP
Vazhakombai CD
Pillayarmathi
Seradi (E)
Seradi (W)
Thammampatti PP
Odaikadu PP
Odaikadu Pudur
Chinnamangalam
Naduvancharai
Chinnanagur
Periyanagur
Mayambadi


Changes in the Seasonal Pumping Hours at each site
Seasonal Pumping Hours (Nov-Jan)
1600
1400
1200
1000
800
600
400
200
0
2006-07
2007-08
Othiyathur
Naduvallur(E)
Naduvallur(W)
Thedavur DSP
Kanavaikkadu
Gangavalli
Malpuli
74-Krishnapuram
Gudamalai CD,
Gudamalai CD,
Gudamalai PP/3
Gudamalai PP/4
Ninankarai
Manmalai-I
Manmalai-II
Manmalai-III
Kondayanpalli
Thakarapudur CD
Kondayampalli PP
Kondayampalli PP
Kondayampalli
Nagiampatti PP
Ullipuram CD
Gandhinagar
Kavundampalayam
Koneripatti
Vasanthanagar CD
Pudumavaru
Vazhakombai PP
Vazhakombai CD
Pillayarmathi
Seradi (E)
Seradi (W)
Thammampatti PP
Odaikadu PP
Odaikadu Pudur
Chinnamangalam
Naduvancharai
Chinnanagur
Periyanagur
Mayambadi


Regional Impact in terms of Average Area under irrigaion (Acre)
Area (Acre)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2006-07
2007-08
Command Area(Acre)
Paddy
Non Paddy
Scane & Banana


Regional Impact in terms of Average Pumping Hours
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Area (Acre)
2006-07
2007-08
Pumping Hours per day
Pumping Hours in a season