Case History of Selected Artificial Recharge Projects Implemented in India

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Artificial Recharge is being implemented for augmentation of ground water reservoir and to provide sustainability to ground water development. The CGWB has constructed about 1000 demonstrative recharge structures in different parts of the country during VIII-IXth Plan period to develop area specific designs of artificial recharge structures suited to different hydrogeological terrains. The case histories of a few schemes for artificial recharge implemented in different hydrogeological situations in Indian context are given here under:

1 Artificial Recharge for Ground Water Sustainability in Basaltic Terrain - Maharashtra:

The Central Ground Water Board has conducted specific studies in an over exploited watershed WR-2, Amravati district, Maharashtra. where excessive development of ground water to meet the crop requirements for orange cultivation has depleted the ground water resources. The receding ground water levels in this watershed have resulted in increased lifting costs for ground water withdrawal, deepening of wells, construction of deep bore wells and in many cases reduction in areas as well as production of orange crops.

The multidisciplinary approach adopted by Central Ground Water Board to augment sub-surface storage included topographical studies to assess and understand various physiographic parameters important to locate the appropriate recharge structures, Hydrometeorological studies to assess the rainfall pattern for working out design of recharge structures, hydrological studies to assess non committed surplus monsoon run off available for recharge and hydrogeological studies to assess the capability of basaltic aquifers to accommodate the additional recharge for utilisation in lean period. The studies have brought out that the watershed covering 488 sq.km. area has surplus monsoon runoff of about 98.9 Million Cubic Metres (MCM) which can be conserved through simple artificial recharge structures like percolation tanks and check dams (cement plugs). The efficiency of these structures constructed at suitable locations with appropriate design in case of percolation tanks is 91% and for cement plugs 94%.

The total capacity utilization of percolation tank has been found to be up to 150% due to repetitive fittings and up to 400% in case of cement plugs. The benefitted area in case of percolation tanks with gross storage capacity varying from 71 to 220 Thousand Cubic Metres (TCM) varied from 60 to 120 hectares (ha) during 1997-98 and benefits extended up to 1.5 km. down stream of percolation tanks. In case of cement plugs with

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storage capacity varying from 2.10 TCM to 7.42 TCM varied from 3 to 15 ha during 1997-98. The existing dug wells in the command areas of these structures were benefited not only in terms of rise in ground water levels compared to pre-project period but the sustainability of ground water pumpage increased during summer period. The Figures 1 and 2 indicate the improvement in ground water levels in the command areas of percolation tank and Check dam. Additional areas were brought under cultivation and areas of orange orchards have increased. The project implemented by CGWB has proved the techno-economic feasibility of the artificial recharge techniques in basaltic terrain with no adverse environmental impact.

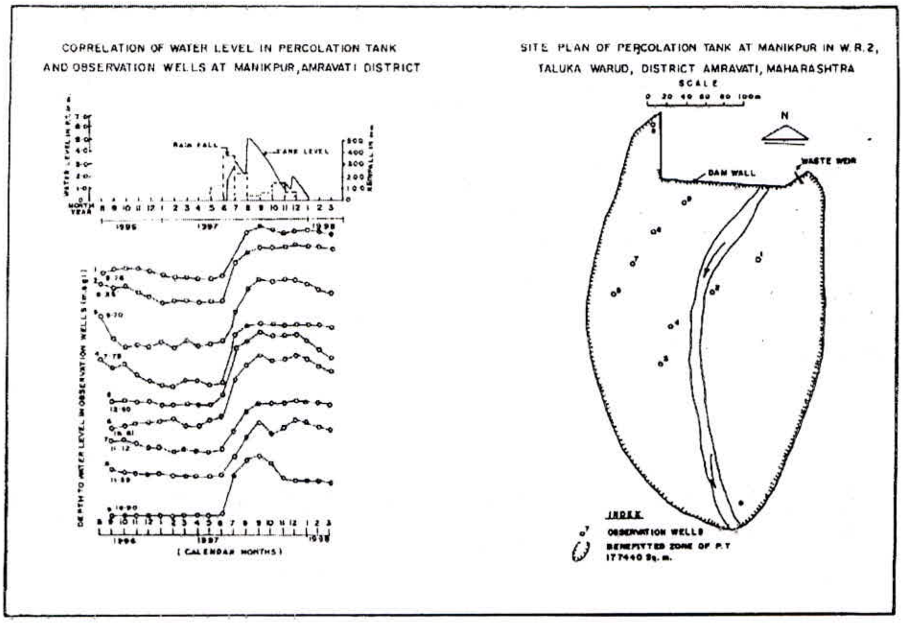


Fig. 1

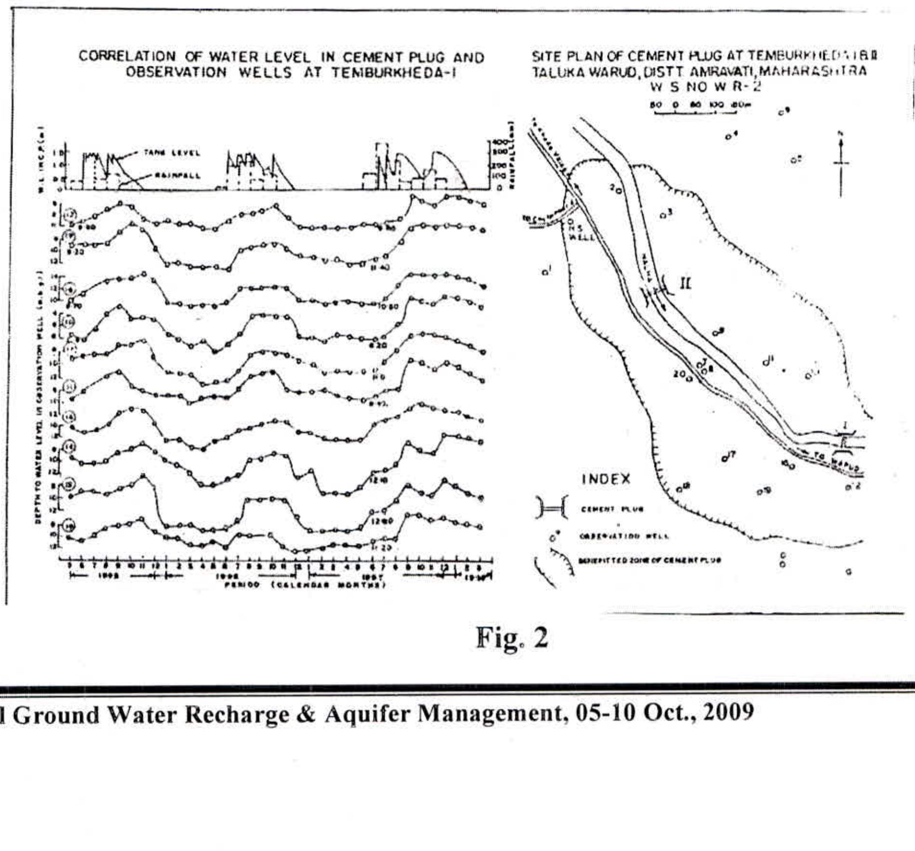


Fig. 2

2. Mountain Front Recharge Augmentation for Alluvial Aquifers - Maharashtra:

The prominent regional aquifer system for Tapi Alluvial basin parallel to Satpura Mountain front is being extensively developed to meet the water requirement of cash crops like Banana and Sugarcane. This has led to decline of water levels of more than 8-10 metres during last 10-15 years. Large number of wells has either gone dry or their yields have declined. There is thus an urgent need to augment the ground water resources of the Tapi alluvial basin.

The Satpura Mountain front offers favourable locale to augment ground water reservoir due to the high infiltration capacity of alluvial fans occurring in this zone. The Central Ground Water Board has undertaken artificial recharge studies in one of the watersheds TE-17 in Jalgaon district wherein extensive ground water irrigation for Banana crop has resulted in depletion of ground water resource. The studies undertaken included assessment of surplus monsoon runoff available in the watershed and delineation of potential talus and scree zone locally known as Bazada which offers favourable location for construction of artificial recharge structures. The studies included assessment of the total thickness of unsaturated granular zone above water table to determine the potential of recharge in this zone. The subsurface storage potential of watershed 5 metres below ground level was assessed as 85 Million Cubic Metres (MCM) compared to surplus monsoon runoff of 29.7 MCM.

Artificial recharge techniques like recharge through percolation tanks, recharge through existing dug wells, recharge shafts and through injection tubewells were experimented. Some of the existing artificial recharge structures like village tanks were renovated to convert these into percolation tanks and storage capacity of existing percolation tanks was augmented by stream diversion from adjacent watershed.

The percolation tanks in Bazada formation of Satpura foothills were found to be highly efficient with efficiency as high as 97% and capacity utilization going up to 400%. The zone of benefit extended to 5 km with benefited area up to 400 ha. The recharge through existing disused dug wells utilizing surplus water from existing canal irrigation system provided encouraging results and after observing this experiment, the local farmers have resorted to dug well recharge through their own efforts providing sustainability to ground water development. Recharge through injection tube well though feasible is not very effective and efficient compared to other artificial recharge techniques.

The studies undertaken by Central Ground Water Board have clearly indicated that the Satpura Mountain front is quite favourable for implementation of a mega artificial recharge project which can utilize the techniques experimented in watershed TE-17 for augmenting the depleting ground water resources of Tapi Alluvial Tract (Fig. 3).

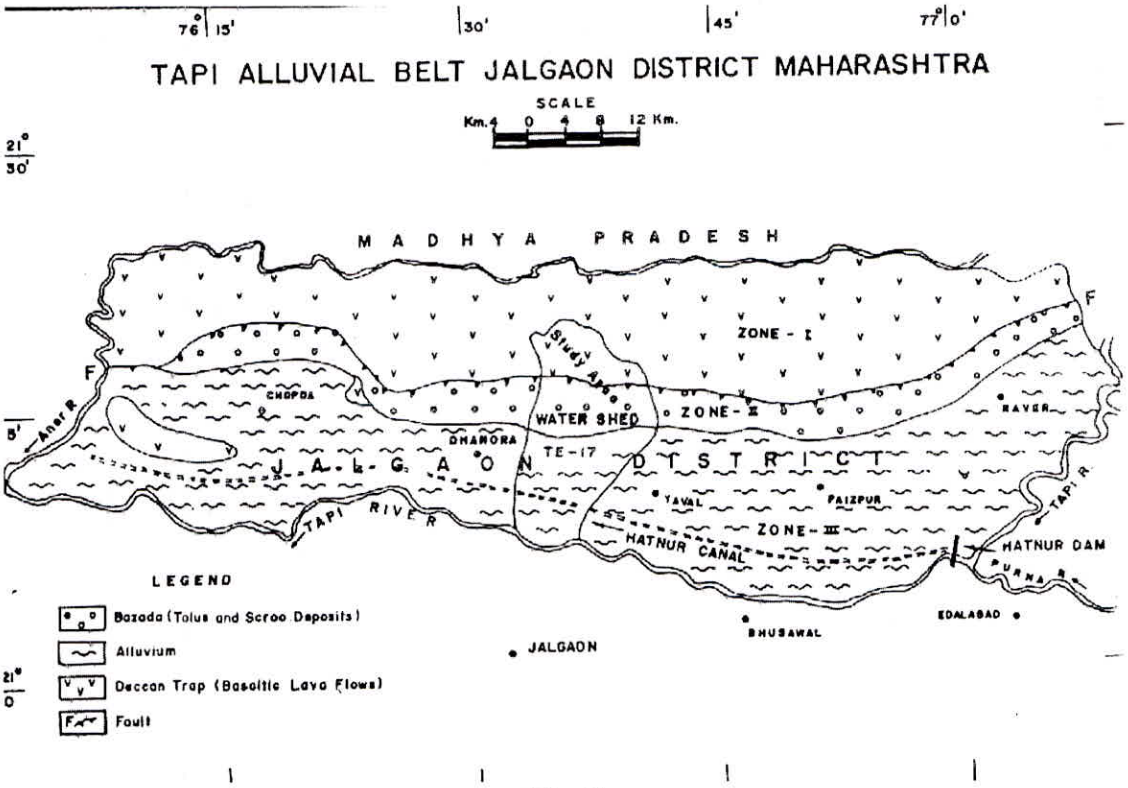


Fig. 3

3 Artificial Recharge Experiment for Injection Well Technique in Ahmedabad-Gujarat.

The Physical Research Laboratory, Ahmedabad and Gujarat Water Resources Development Corporation Limited have jointly conducted an experiment on recharging the deeper confined aquifers around Hansol, near Ahmedabad during 1977. The experiment involved transferring of water from shallow aquifer to the deeper confined aquifer using siphon principle. In this experiment, a shallow tube well (dia : 350 mm) of 21.34 m depth was drilled in west bank of Sabarmati river bed and tapping the shallow phreatic aquifer between 6.04 and 21.34 m below river bed level. An injection well (diameter of 600 mm up to 75 m from ground level and followed by 400 mm to the depth of 240 m) to a depth of 238 m was drilled and developed at a distance of 61.3 m from the source well on the same bank of the river. An observation well to the same depth of 238m was drilled near the injection well to monitor the response of the aquifer during artificial recharge. These deep wells tap the confined aquifers below 74 m depth which are under heavy exploitation for agricultural activities. A schematic diagram showing the arrangement of source well, injection well, connecting siphon pipe and the observation well is shown in Fig. 4.

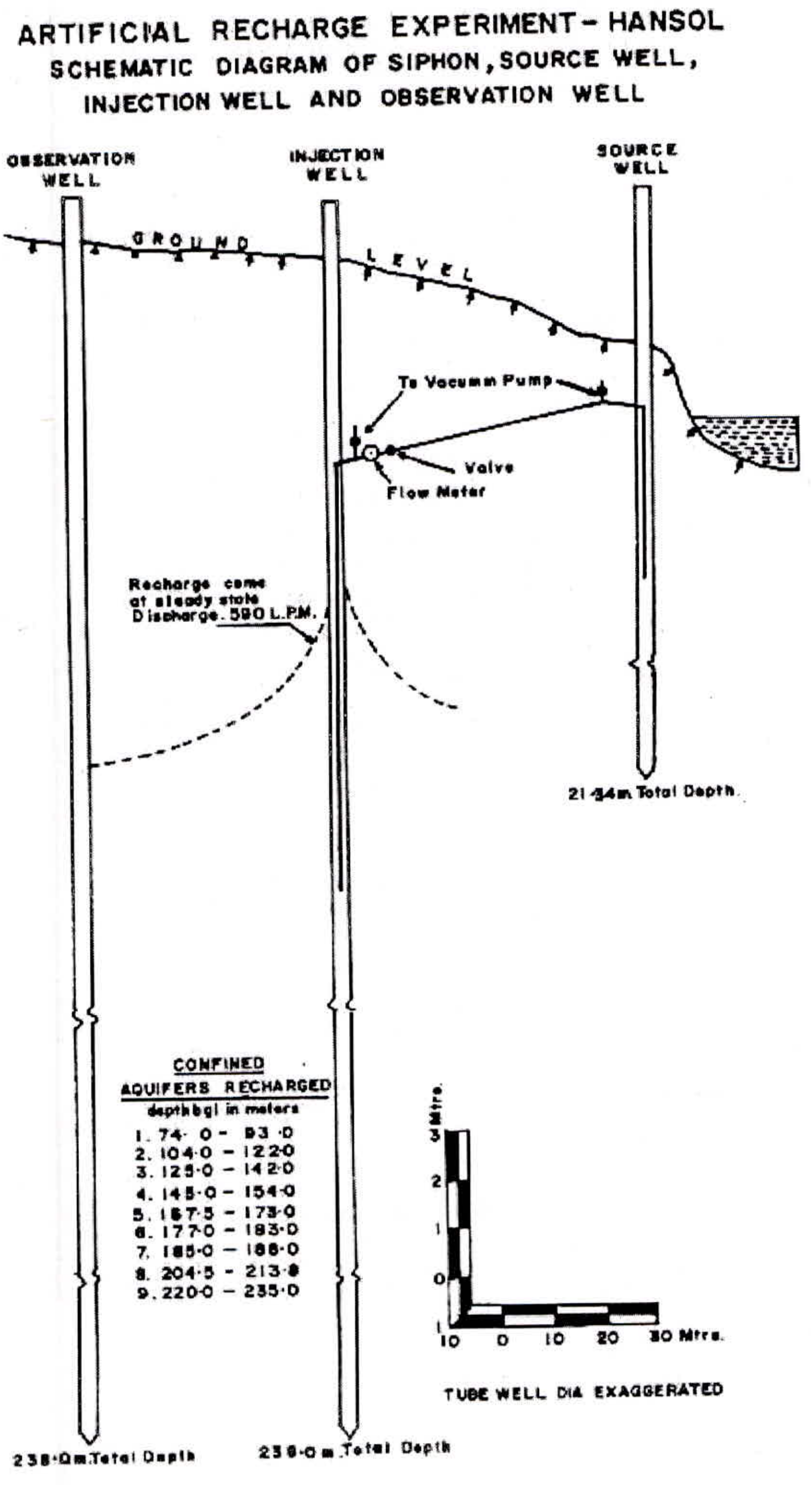

ARTIFICIAL RECHARGE EXPERIMENT – HANSOL
SCHEMATIC DIAGRAM OF SIPHON, SOURCE WELL, INJECTION WELL AND OBSERVATION WELL
OBSERVATION WELL
INJECTION WELL
SOURCE WELL
GROUND LEVEL
To Vacumm Pump
Valve
Flow Meter
Recharge come at steady state Discharge. 590 L.P.M.
21·34m Total Depth
CONFINED AQUIFERS RECHARGED
depth bgl in meters
1. 74·0 – 93·0
2. 104·0 – 122·0
3. 125·0 – 142·0
4. 145·0 – 154·0
5. 167·5 – 173·0
6. 177·0 – 183·0
7. 185·0 – 188·0
8. 204·5 – 213·8
9. 220·0 – 235·0
Mtrs.
3
2
1
0
1
10
0
10
20
30 Mtrs.
TUBE WELL DIA EXAGGERATED
238·0m Total Depth
238·0m Total Depth

Fig. 4

A trial recharge experiment was conducted for 92 days for understanding the response of the aquifer during the recharge in terms of development of recharge cone and dissipation of recharge mound. A stabilized recharge rate of 590 litres per minute (LPM) was observed from 200th minute of the recharge experiment till the end. During the recharge phase, nearly 7.5 million litres of water was recharged into the confined aquifer.

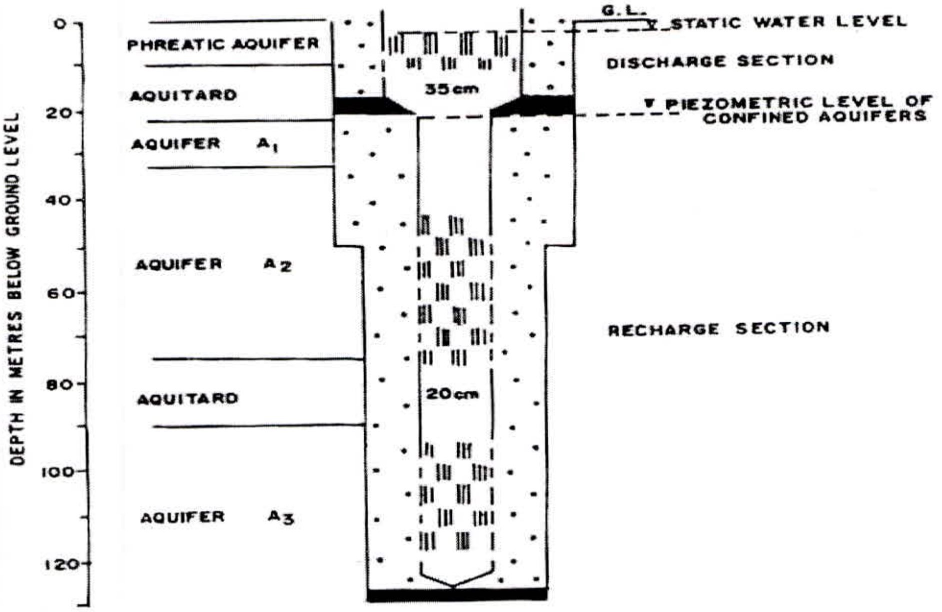
A short period pressure injection was conducted by the Gujarat Water Resources Development Corporation in 1974 near Ahmedabad city. Processed water from the city water works was injected for 72 hours in a deep tube well and a pressure varying between 80-100 PSI with a rate of 45 litres per second.

4 Artificial Recharge In Mehsana Area And Coastal Saurashtra - Gujarat

The Pilot Project on evaluating the technical feasibility of artificial recharge in augmenting the depleted aquifers in the Mehsana area and for controlling the saline ingression in coastal belt of Gujarat was successfully conducted by the Central Ground Water Board in collaboration with UNDP and State Ground Water Agencies.

After detailed hydrogeological surveys and ground water draft estimation, the alluvial area around Kamliwara in the Central Mehsana was selected for pilot experiments on artificial recharge through pressure injection and surface spreading methods during 1983. The source of water drawn for the artificial recharge through pressure injection test was from the phreatic aquifer below the Sarswati river bed. Since ground water was used for artificial recharge, the injection water was devoid of silts and other impurities and chemically compatible with the water in aquifer getting recharged. The experimental results did not show any adverse effect of clogging. The pressure injection experiment was conducted continuously for about 250 days with an average injection quantity of 225 cubic meters per day. During the recharge cycle, a rise in water level of 5 meters in the injection well (apparent built up of 11 m) and 0.6 to 1.0 m in wells 150 meters away from the injection well were observed. The higher rate of injection continuously for about 250 days was probably sustained because of contemporaneous withdrawal from the aquifer through nearby irrigation wells. (Fig. 5)

In Mehsana area, artificial recharge experiments through spreading method were also conducted using canal water. A spreading channel of 3.3 meters width, 400 m length with 1 in 1 side slope was constructed and in which the canal water was fed for 46 days. The recorded build up in water level of 1.4 to 2 m. was observed up to 15 m from the recharge channel and about 20 cm at distance of 200 m. The recharge rate of 260 cubic meters per day was estimated using an infiltration rate of 17 cm/day. Dissipation in recharge mound (1.42 m) was observed in 15 days.



CONNECTOR WELL AT KAMLIWALA, GUJRAT

Fig. 5

Another experiment using a recharge pit (1.7 m x 1.7 m x 0.75 m) to study the feasibility of recharging the shallow aquifers was conducted at Dabhu in Central Mehsana area. Canal water was used for the experiment and the pit was covered to prevent dust deposition and evaporation losses. During the recharge phase of 60 days, the recharge was affected at the rate of 17.3 cubic meters per day with an infiltration of 0.5 m/day. A rise of 4.13 m in water level was observed at a distance of 5 meters from the recharge pit.

Artificial recharge through pressure injection technique was tried on a pilot scale using ground water from phreatic aquifer for a short period in the Mehsana alluvial aquifers. The source well was located in the Saraswati River and the water was carried to injection well at distance of 130 meters by 10 cm pipeline. On-line flow meter and pressure gauge were fitted to monitor the flow rate and cumulative quantity and to record the pressure developed during injection experiment. The injection recharge experiment was conducted with 8 litres per second (LPS) rate for about an hour. The injection rate was increased to 12 LPS and the test was continued for 90 minutes. A drastic reduction in recharge rate (3 LPS) was reported and the cause of reduction was attributed to backpressure due to clogging of injection well. Due to well clogging, the water level could not reach to its initial static level even after 8 days. Though, in this case, the silt free shallow ground water was used for recharge, the observational results clearly indicate the necessity of understanding probable clogging problems which may arise due many other factors apart from silt entry.

Studies on control of salinity in the coastal Saurashtra using spreading and injection method have indicated that the recharge pit and the injection shaft can affect recharge at the rate of 192 and 2600 cubic meters per day respectively. Canal water was used for recharge studies. Problems in land acquisition in this highly developed area make it difficult to select suitable sites for spreading structures.

5. Artificial Recharge Studies In The Ghaggar River Basin - Haryana:

Central Ground Water Board, with the assistance of UNDP, has undertaken artificial recharge studies involving induced recharge and recharge through injection wells at two sites located in the districts Ambala and Kurukshetra along with Ghaggar river in Haryana. The Dabkheri site in the Narwana Branch area, Kurukshetra district was selected for the artificial recharge studies by the injection well method after detailed hydrogeological surveys. An injection well tapping aquifer at different depth levels was developed with cement sealing from ground level to a depth of 15 m. The injection experiment was carried out using canal water with an injection rate of 43.3 LPS under pressure.

It was observed that the injection pressure of 1.6 atmosphere raised to 1.96 atmosphere within 30 minutes of injection and remained constant for about 4 hours. Sudden and violent vibrations in the injection line were reported to have been witnessed and the injection pressure shot up to 2.5 atmosphere and it was reported that it was due to clogging of foot valve with grass etc.

After construction and development of another injection well with improved design, second injection recharge experiment was conducted with a recharge rate of 40 LPS for 389 hours and with 22 LPS for another 24 hours. The experiment demonstrated that the hydrogeological conditions of the area are favourable for artificial recharge through injection method. The canal water quality was found to be suitable for injection.

6 .Artificial Recharge In Moti Rayan And Bhujpur Area, Mandvi Kutch District

In order to augment the ground water reservoir in Moti Rayan area, 18 Check dams, three percolation ponds, two recharge wells and one sub surface dam with four recharge wells were constructed. During the year 1994, there were 34 rainy days from June 30th to September 15th. The daily rainfall varied from 1 mm to 175 mm. The number of rainy days in June, July, August and September were 1, 8, 6 and 9 days respectively. The water harvesting structures received around 2 fillings and total quantity infiltrated amounted to 344.664 m3. This indicates that even during low rainfall years, ground water can be recharged through water harvesting structures. The Fig. 6 gives the details of ground water harvesting structures in Moti Rayan Area.

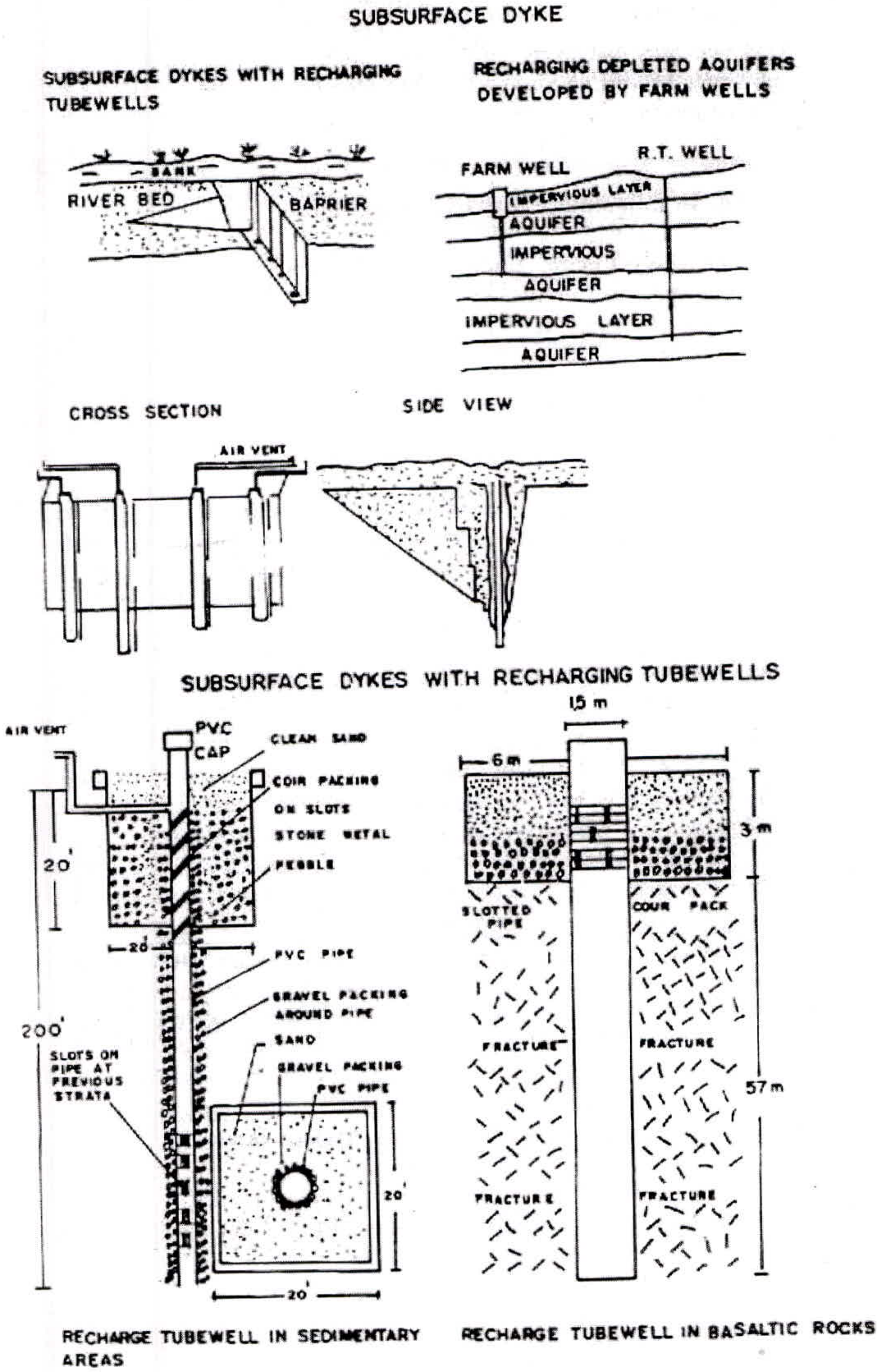

SUBSURFACE DYKE
SUBSURFACE DYKES WITH RECHARGING TUBEWELLS
RECHARGING DEPLETED AQUIFERS DEVELOPED BY FARM WELLS
BANK
RIVER BED
BARRIER
FARM WELL
R.T. WELL
IMPERVIOUS LAYER
AQUIFER
IMPERVIOUS
AQUIFER
IMPERVIOUS LAYER
AQUIFER
CROSS SECTION
SIDE VIEW
AIR VENT
SUBSURFACE DYKES WITH RECHARGING TUBEWELLS
AIR VENT
PVC CAP
CLEAN SAND
COIR PACKING
ON SLOTS
STONE METAL
PEBBLE
20'
20'
PVC PIPE
GRAVEL PACKING AROUND PIPE
200'
SLOTS ON PIPE AT PREVIOUS STRATA
SAND
GRAVEL PACKING
PVC PIPE
20'
20'
1.5 m
6 m
3 m
SLOTTED PIPE
COIR PACK
FRACTURE
FRACTURE
57 m
FRACTURE
FRACTURE
RECHARGE TUBEWELL IN SEDIMENTARY AREAS
RECHARGE TUBEWELL IN BASALTIC ROCKS

Fig. 6

7 . Percolation Ponds In Coimbatore District, Tamil Nadu

The water Technology Centre, Tamil Nadu Agricultural University has studied existing 10 percolation tanks in Coimbatore district of Tamil Nadu State for economic evaluation. Eight percolation tanks in Coimbatore taluk and two in Avinashi taluk of Coimbatore district were selected and studied. The study indicates that the total number of wells benefitting from percolation ponds during 1988-89 was 36 out of the 258 wells (14%). The total area benefitted due to these 36 wells was only about 14.4 ha. The direct benefits due to percolation ponds during 1988-89 is as follows :

Pond. No.	Total No. of Wells	No. of wells benefitted	Zone of influence (km)	Additional area benefitted(ham)	Average net income (Rs/ham)
1	14	4	0.7	2.5	2542
2	36	6	0.3	2.4	2736
3	25	3	0.4	1.0	2251
4	32	3	0.4	2.1	2087
5	18	2	0.5	0.6	1865
6	24	4	0.7	1.2	1956
7	31	3	0.3	0.7	2134
8	27	5	0.7	1.5	1543
9	24	2	0.3	0.4	1323
10	27	4	0.2	1.3	1569

The poor performance of these percolation tanks during the study period was attributed to inadequate rainfall and poor location of the percolation ponds. The district-wise distribution of the benefitted wells had indicated that 39 per cent of the wells as an important parameter in determining the benefits due to percolation ponds.

8. Artificial Recharge To Ground Water Through Roof Top Rain Water in CSIO, Chandigarh

In order to augment the ground water recharge and also to reduce runoff in urban areas like Chandigarh, roof top rain water harvesting can be adopted to recharge the ground water at very nominal cost which will reduce storm water runoff and increase the life of roads and other structures.

PLAN OF ROOF TOP AND RAINFALL COLLECTING SYSTEM CSIO CHANDIGARH

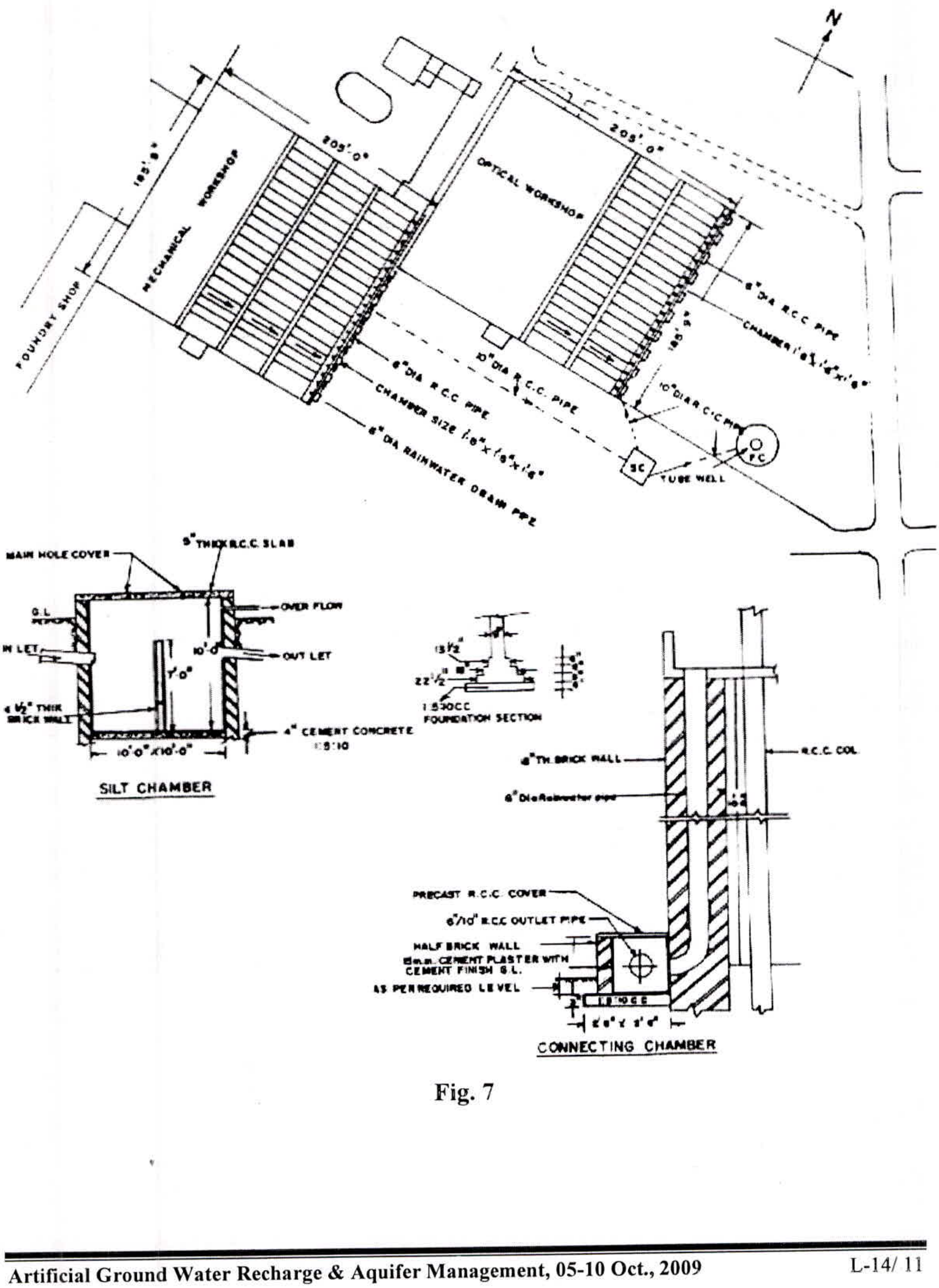


Fig. 7

In Chandigarh such experiment is being done at one of the CSIO buildings having roof area of 3550 sq.m. 19,98,2427 Cubic Metres of rainwater was harvested and recharged to ground water through propose built injection tubewells (Fig. 7). The additional recharge to ground water has resulted in sustainable yield of tubewells already being operated. It is estimated that for effective impact roof area of about 1000 sq.m. is required to harvest rain water. However, this should be done by individual house/flat owner and if done collectively the impact will be very significant. The studies have shown that the ground water quality has improved.

9. Artificial Recharge to Ground Water in N.C.T. Delhi

In urban areas, dependence on ground water is high, resulting in depletion of ground water resource. This necessitates replenishment of ground water reservoirs through artificial recharge by rainwater harvesting which involves inducing, collecting, storing and conserving local surface runoff.

The CGWB has initiated pilot projects in Jawahar Lal Nehru University (J.N.U.), Sanjay Van for artificial recharge experiments. In J.N.U. and I.I.T. comprising of 5 micro watersheds, 0.46 Million Cubic Meters (MCM) storm water was going waste which could be stored in purpose-built structures and ultimately recharge the depleted aquifers. Four check dams were constructed on rivulets and sixteen piezometers were established to monitor the impact of artificial recharge on ground water regime. The storage capacity of 49,000 Cubic Meters was created in these dams and 1,25,000 Cubic Meters water had already been recharged to the aquifer. Rise of water level maximum up to 4 m has been observed. Apart from sustainable yield of tubewells and more vegetation cover around the check dams. The efficiency of check dams is around 98% (Fig. 8 and 9).

10. Rain Water Harvesting in Chennai City, Tamil Nadu

Chennai being a coastal city, is always under threat of seawater intrusion along the coast, if more fresh water is extracted. Indiscriminate extraction in Minjur - a coastal area along the North Sea coast of Chennai, has been spoiled because of over exploitation. The Metrowater is now taking up serious efforts to disseminate Rain Water Harvesting techniques to the citizens of Chennai. In the process, it has issued notifications to the builders who are constructing complexes with 1+3 floors to implement the Rain Water Harvesting measures. Chennai City receives rainfall ranging from 1100 to 1200 per annum. As per statistics, a house on one ground plot (223 sq.m.) gets about 700 litres of water a day by rainfall. Even in the case of multi-storied flats, where the effective space of per resident may be as small as 50 sq.m. , the rainfall corresponds to an amount of about 100 to 150 litres per day. The examples of the step taken in Chennai city are given in Fig. 10 & 11.

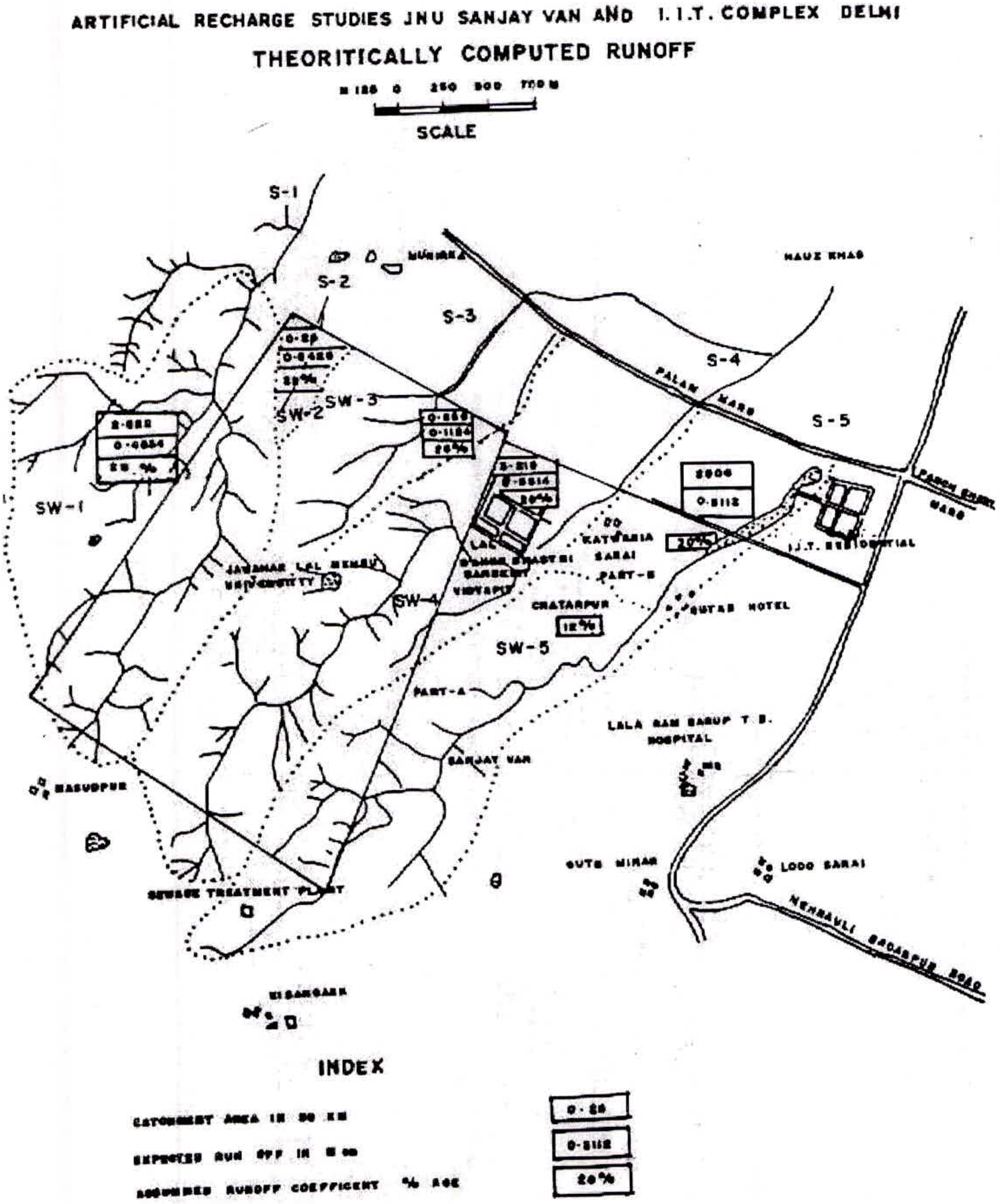

ARTIFICIAL RECHARGE STUDIES JNU SANJAY VAN AND I.I.T. COMPLEX DELHI
THEORITICALLY COMPUTED RUNOFF
SCALE
S-1
S-2
S-3
S-4
S-5
SW-1
SW-2
SW-3
SW-4
SW-5
HAUZ KHAS
PALAM MARG
KATWARIA SARAI
PART-B
CHATARPUR
12%
20%
PART-A
SANJAY VAN
LALA RAM SARUP T.B. HOSPITAL
QUTB MINAR
LODO SARAI
SEWAGE TREATMENT PLANT
INDEX
0·25
0·5112
20%

Fig. 8

DESIGN OF STONE MASONRY DAM AT SITE - I, ON STREAM - I

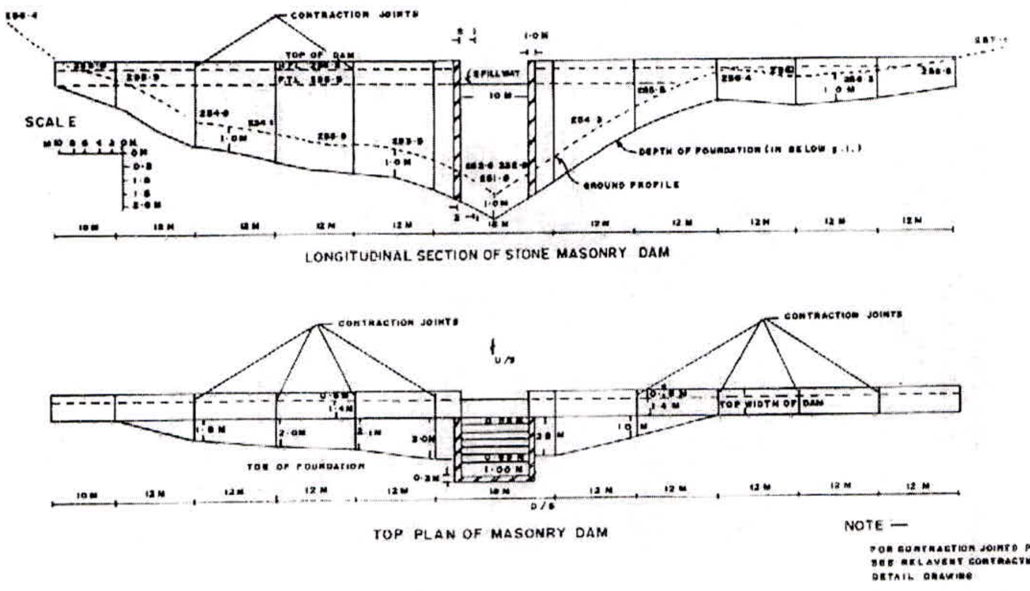
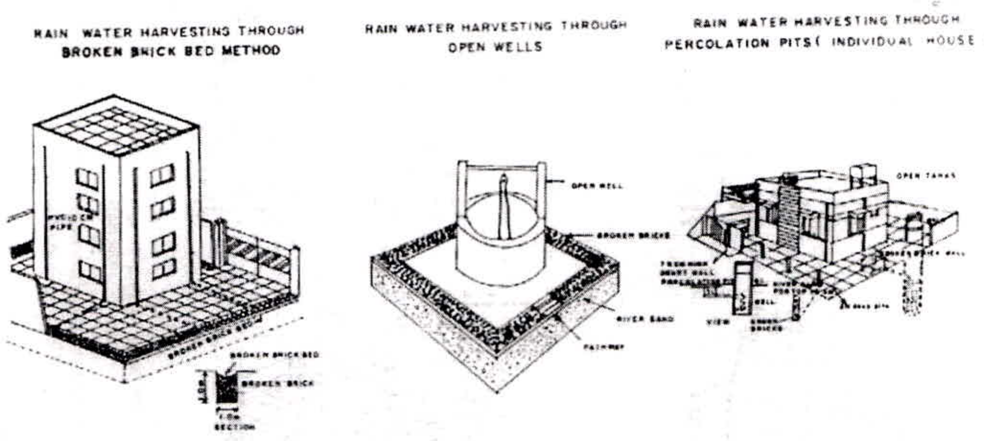


Fig. 9



On the three sides along the inner periphery adjoining The compound wall, dig 1 m wide pit to a depth of 1.5m and fill it with 5 to 7.5 cm. Sized broken bricks. Let the rain water falling on the terrace flow into this broken brick bed.

Cementing of the platform around the open well will reduce the rain water recharge. Therefore, to harvest rain water from the surrounding open space of the well, dig a percolation bed for a depth and width of 0.3 m as shown in the figure. Fill the percolation bed with sand and broken bricks. Leave a pathway of 0.6m X 0.6m to reach the well for drawing water. The platform cementing has to be done with gentle slope towards the percolation bed.

Dig a number of 3.0 m deep and 30 cm. Dia. Percolation pits at 3.0m intervals around the plinth. Fill them up with broken bricks and pack the top 15 cm. With river sand. Erect 7.5 cm. High dwarf walls at entrance to facilitate recharge.

Lead the rain water falling on the terrace into the house well through a drain pipe making it pass through a 60 cm X 60 cm X 60 cm broken brick filter under the ground level before reaching the well

Fig. 10

DESIGN OF STONE MASONRY DAM AT SITE - I, ON STREAM - I

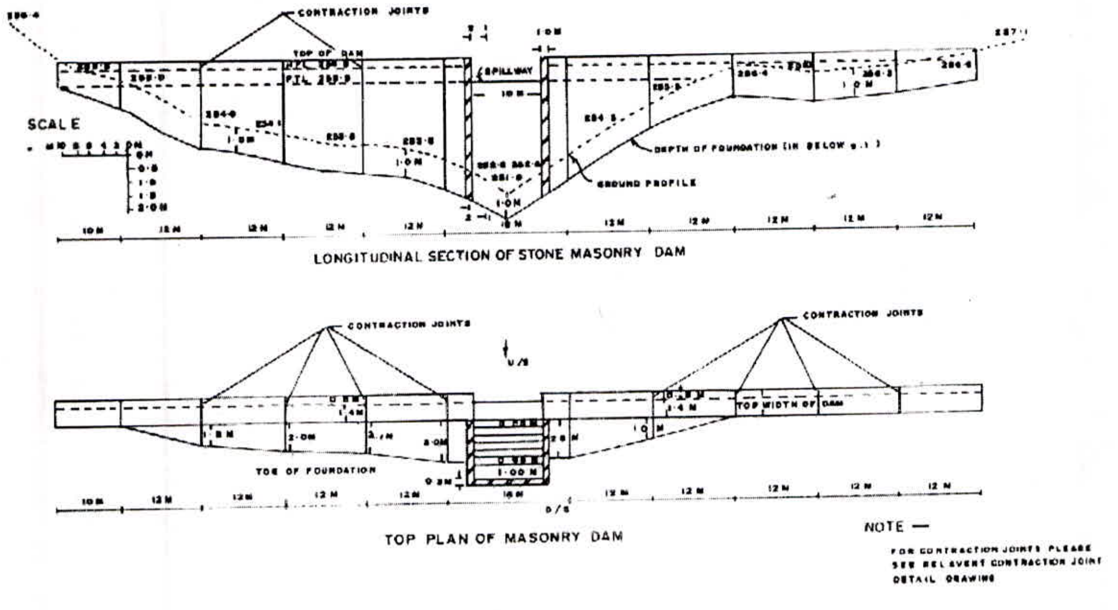


Fig. 11

11. Rain Water Harvesting in the President's Estate, New Delhi

President's Estate having 1.20 sq.km. is located on the Northern flank of Delhi ridge. Excessive ground water development has resulted in ground water decline in the range of 6-13 m. Four metre thick aquifer has become desaturated over an area of 0.7 sq.km. The artificial recharge in the Estate is being done through two dried dug wells, one injection well, one vertical recharge shaft, two recharge trenches with injection wells. Annually 28,170 cum water collected due to rainfall run off will be recharged to ground water.

12. Artificial recharge to ground water from Brahm Sarovar, Kurukshetra, Haryana

The Brahm Sarovar is filled by the canal water and sarovar water is being drained out on regular basis. In Kurukshetra town and adjoining areas ground water levels are declining at the rate of 30cm per year due to over development of ground water resource. Presently the stage of ground water development is 186.2%. For recharging the ground water, two injection wells, and two lateral recharge shafts with inverted filter have been constructed (Fig.- 12). The rate of recharge in injection well is upto 10 lps while that of recharge shaft is upto 15 lps.

DESIGN OF RECHARGE TRENCH CUM INJECTION WELLS AT SHRAM SHAKTI BHAWAN, NEW DELHI

NOT TO SCALE

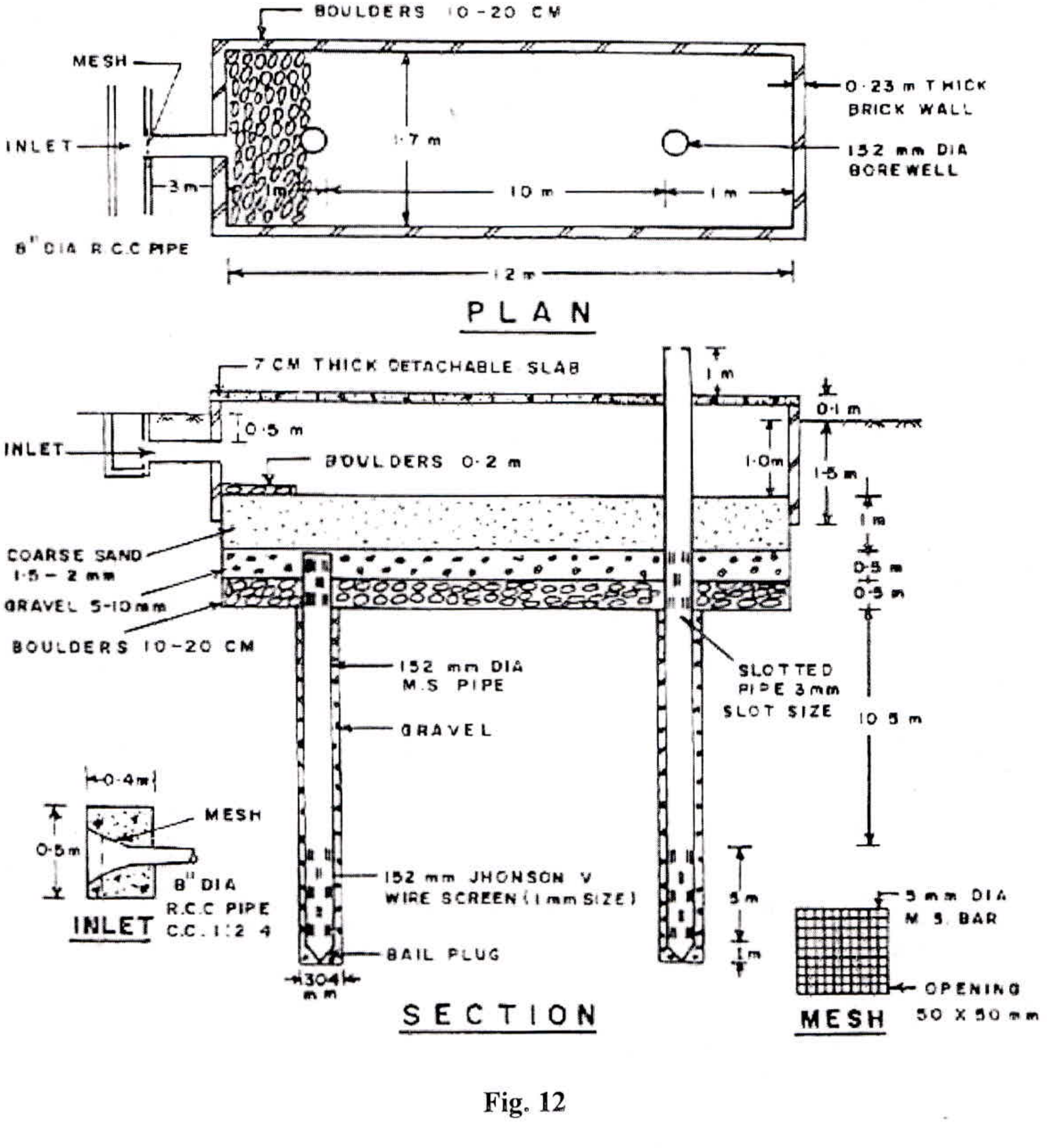


Fig. 12

13. Artificial recharge to ground water Golden Temple, Amritsar City, Punjab

The Golden Temple Sarovar is filled with canal water and water is pumped out regularly in the sewage drain. In the town water levels are declining at the rate of 0.50

m/yr. due to heavy pumping of ground water. Sarovar water which is being discharged into sewage drain will be used to recharge ground water (Fig.-13). It is estimated that water available for recharge is 0.45 mcm/year. Expected rise in water level in 500 ha will be 0.45m/year.

ARTIFICIAL RECHARGE TO GROUND WATER FROM SURPLUS WATER OF SAROVAR AND PARIKARMA, GOLDEN TAMPLE AREA AMRITSAR CITY, PUNJAB

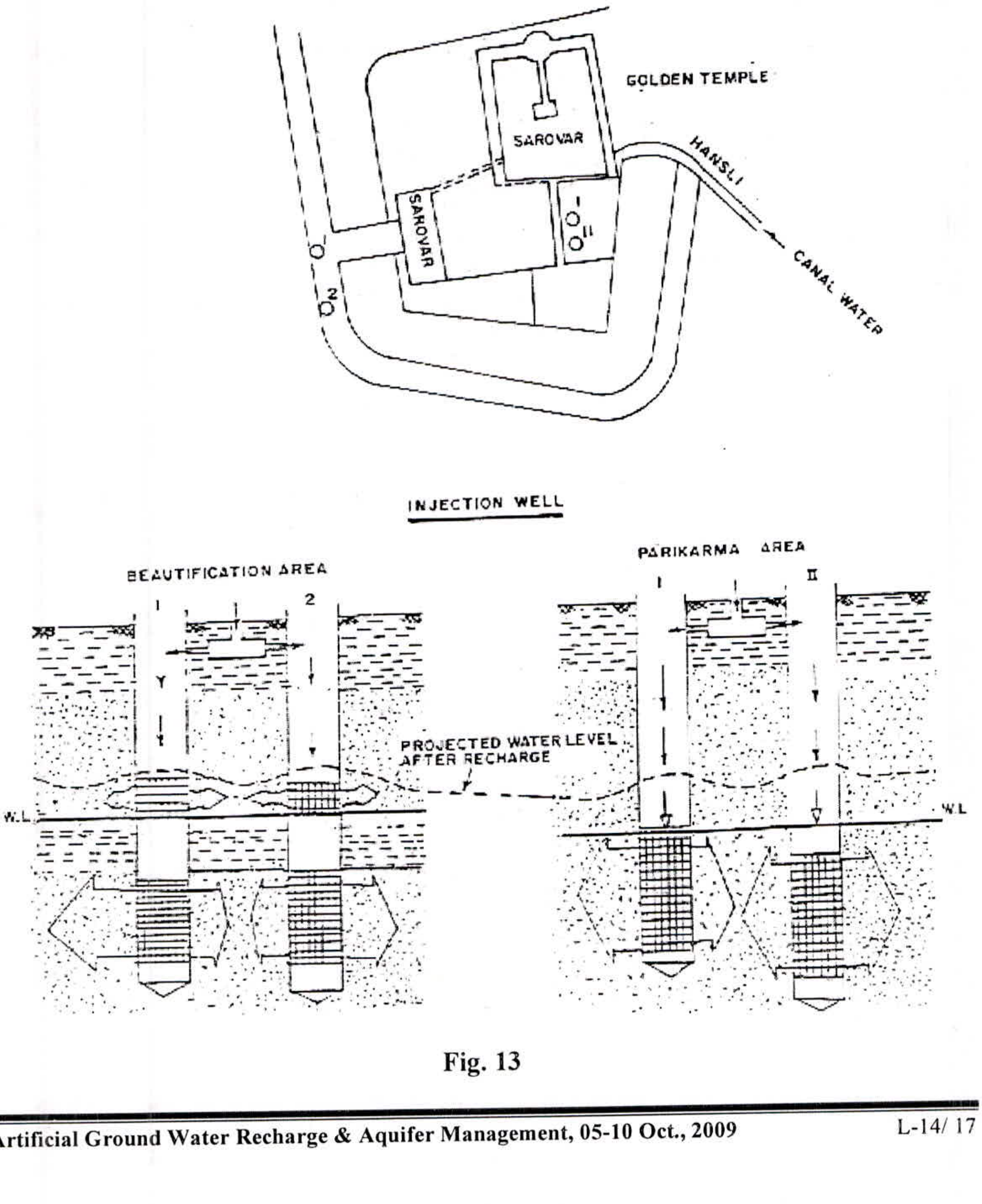


Fig. 13

14. Artificial recharge to ground water using canal water from Dhuri Link Drain, Dhuri Block, Sangrur District, Punjab

Dhuri link drain passes through Dhuri block where water levels are continuously declining at a rate of 0.40 m/year. In order to meet the ever increasing demand of ground water for agriculture it is proposed to recharge the ground water in the area by constructing 28 vertical shafts and 250m long lateral shaft. The shafts are filled with inverted filter to arrest the silt. Annually around 2.5 mcm water shall be recharged and it is estimated that around 1.15 m/year rise of water level will take place in 1000 ha.

15. Artificial recharge to ground water from Bist Doab Canal, Nurmahal Block, District Jalandhar, Punjab

In Nurmahal block water level has declined between 5 to 6 m in last 17 years. The spare water of Phillaur and Sarih distributary during monsoon period will be diverted to two storage tanks and same will be recharged to the ground through 6 vertical shafts. Annual water available for recharge is around 1.62 mcm. Rise in water level in 1000 ha is around every year 0.80 m/year.

16. Artificial recharge to ground water using canal water from Dhuri Drain, Dhuri Block, Sangrur District, Punjab

Copious volume of water is available in drain and it is proposed to use the same for ground water recharge through 298m long lateral shaft, 30 vertical shafts with injection wells as recharge structures (Fig.-14). In order to arrest silt inverted filter is provided. Annual water available for recharge is 4.79 mcm. Rise in water level in 3100 ha is about 0.70 m/year.

17. Roof top Rain Water Harvesting in Palampur Town, District Kangra, Himachal Pradesh

In Palampur town ground water recharge is getting reduced due to urbanization and channelization of the drainage system. A substantial rainfall runoff from the roof top is not only going waste but also damaging the roads and other structures. The run off from rooftop of IPH building will be collected and recharged to ground water by constructing a recharge well. The water will be recharged into the aquifer existing between 12-30 m depth in the area. It is estimated that 576 cu.m. run off water is available for recharge.

ARTIFICIAL RECHARGE TO GROUND WATER, DHURI DRAIN
SANGRUR DISTRICT, PUNJAB

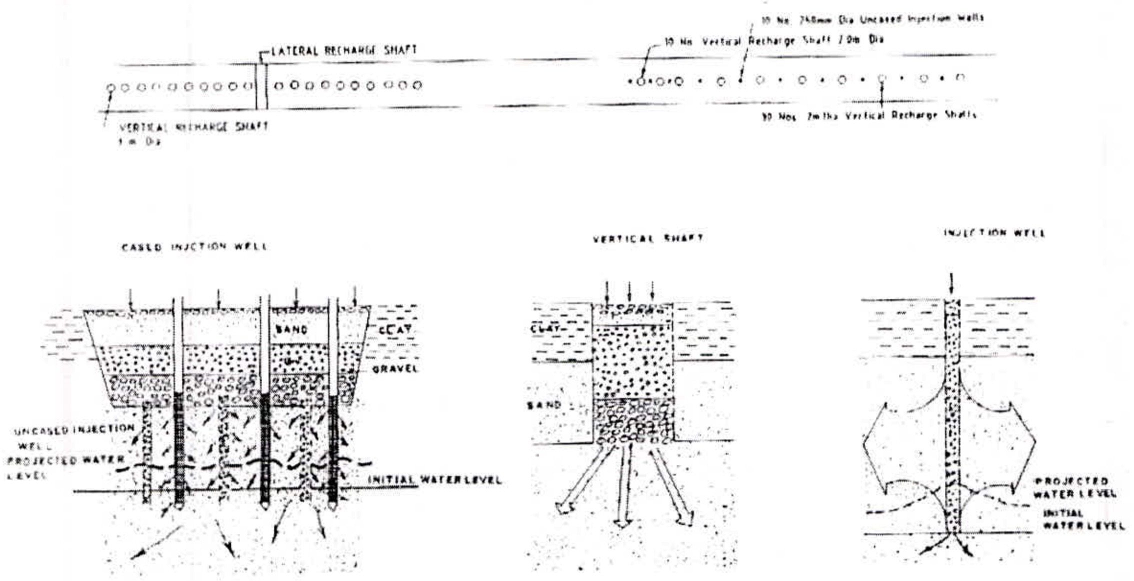


Fig. 14

18. Artificial Recharge in Naker Khad, Renta-Dhawala Village, Tehsil Dehra, District Kangra, Himachal Pradesh

The holy town of Jawalamukhi is experiencing water shortages during summer months. Presently water supply to the town is by 12 percolation wells. In order to harness the surplus runoff in the Khad artificial recharge scheme is proposed to provide sustainable yield to the existing wells during summer months. It is proposed to construct a check dam of 1.85 m height and about 16 m in length across the Khad. Total runoff available for recharge is 120 mcm.

19. Roof Top Rain Water Harvesting, PHED Colony, Narmada Water Supply Project, Musakhedi, Indore, Madhya Pradesh

Malwa region of Madhya Pradesh has been facing acute water scarcity due to excessive ground water pumpage. Rain water from roof top from PHED buildings, situated in the campus of Narmada Water Supply Project colony located at Musakhedi, Indore, Madhya Pradesh is proposed to be harnessed for artificial recharge to ground water. Six buildings having an area of 2710 sq. m. are chosen for rainwater harvesting. Rain water coming from the roof tops is proposed for recharging through a dug cum bore well of 20 m depth. Water available for recharge is 2142 cu.m.

20. Artificial recharge to Tumar Water Shed, Mandsaur Block, Mandsaur District, Madhya Pradesh

In the Tumar water shed 85% of the total irrigation is through ground water. The huge withdrawal of ground water has led to decline in the water levels. The ground water development has already reached to 118% during 1998. To augument ground water recharge to restrict further decline of water levels one cement plug at Jhawal (Afzalpur),two check dams at Roopwali and Khera villages, 19 Gabbion structures. Total water available for recharge is 10.90 mcm. Rise in water levels in existing tubewells in upstream area by 0.30 m to 2.00 m has been observed.

21.Artificial recharge to Water Shed TE-11, Jalgaon District, Maharashtra

In the TE-11 watershed water levels are steadily declining at the rate of 1 metre per year. The depth to water levels ranges between 30-40 mbgl. In order to tap the rainwater going waste as runoff two percolation tanks and five recharge shafts are being constructed (Fig-15). It is estimated that 14.51 mcm water is available as surplus run-off. Sub-surface storage potential available is 153 mcm. Average thickness of aquifer that has become desaturated is about 12.00 m. Volume of sub-surface aquifer in which recharge can take place is 3827 mcm. Benefitted area – 400-500 hectare around the scheme.

22.Artificial recharge in Chogwan Area, Baghpat District, Uttar Pradesh

The Chogwan area lies between Krishni and Hindon rivers covering parts of Binauli block, Baghpat district, Uttar Pradesh. In this area irrigation is from ground water sources.The over-dependence of ground water has caused decline of water levels in the range of 3– 5 m over last one decade. The area has number of village ponds which have enough water even during summer season. During rainy season, the water over flows through these tanks. At Garhi Kangran, this excess water is being used for Artificial recharge through lateral shafts with three injection wells (Fig.- 16). It is estimated that 4000 cum water is being recharged annually.

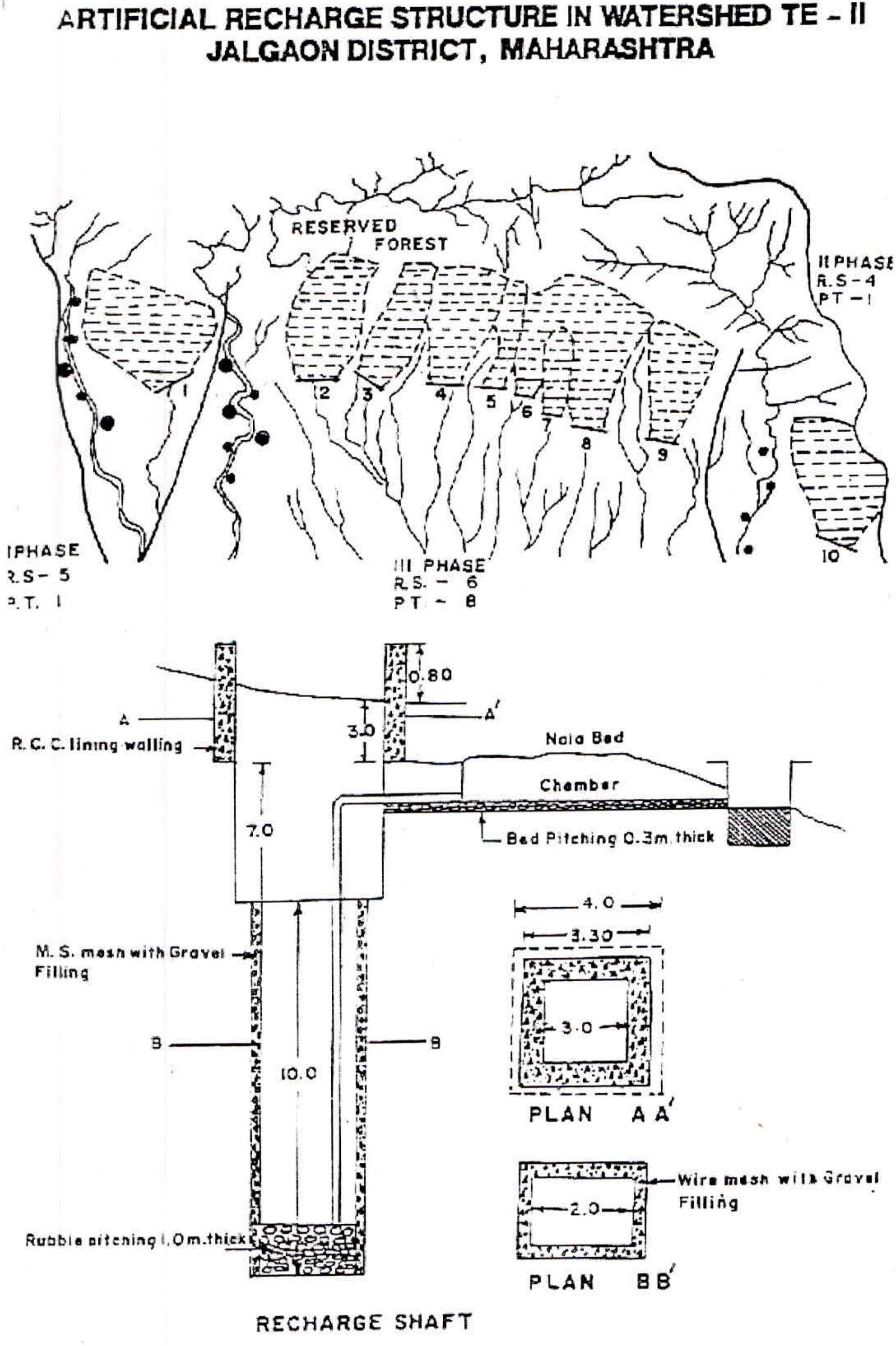

ARTIFICIAL RECHARGE STRUCTURE IN WATERSHED TE - II
JALGAON DISTRICT, MAHARASHTRA
RESERVED FOREST
II PHASE
R.S - 4
PT - 1
I PHASE
R.S - 5
P.T. 1
III PHASE
R.S. - 6
PT - 8
0.80
A
A'
3.0
R. C. C. lining walling
Nala Bed
Chamber
7.0
Bed Pitching 0.3m thick
4.0
3.30
3.0
PLAN AA'
M. S. mesh with Gravel Filling
B
B
10.0
Wire mesh with Gravel Filling
2.0
Rubble pitching 1.0m thick
PLAN BB'
RECHARGE SHAFT

Fig. 15

RECHARGE TRENCH CUM SHAFTS AT GARHI KANGRAN

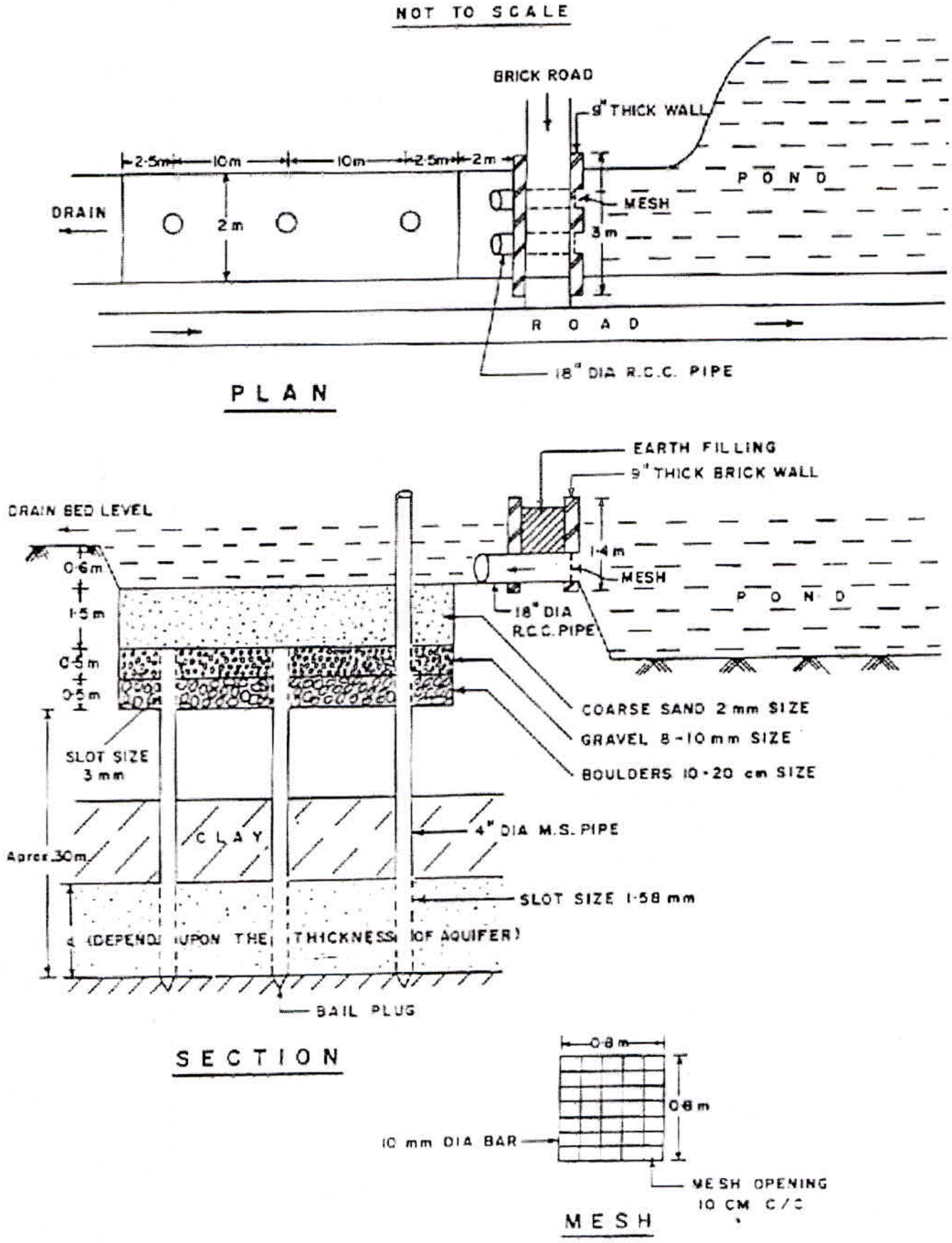


Fig. 16

23. Artificial recharge to ground water in Jammna, District Hoogli, West Bengal

The stage of ground water development (85%) in Hoogli district is very high. In Pandua block the river Dhusi is one such stream which is connected with river Gangur through a 5 km long channel. Almost entire stretch of the channel has been silted particularly there is no flow except during peak monsoon. Average depth to water level is 16 m.bgl. It is proposed to de-silt the channel to augment ground water recharge.

24. Artificial recharge to ground water in District Purulia, West Bengal

In Purulia district cropping intensity is very high (116%). The Irrigation is from surface and ground water resources. Principal rock types are Archean gneiss having 15 – 20 m weathered mantle. Depth to water level varies from 4.00 to 11.00 m bgl. The water level fluctuation vary from 1 to 5 m. The area has moderate to high slopes and bulk of rainfall is lost due to high run-off. Different types of artificial recharge structures such as sub-surface dykes, Nalla bunds, tank excavation, re-excavation of existing minor irrigation tanks and contour bunding are being constructed. The implementation of these schemes will store the excess monsoon run off on the surface which other than supplying water for irrigation will also recharge the shallow unconfined aquifer to create additional subsurface storage for further utilisation. Water level rise of 0.15 m. observed.

25. Artificial recharge to ground water in Mainpura, District Jhunjhunu, Rajasthan

Due to excessive withdrawal of ground water for industrial & irrigation purposes, the area has experienced sharp decline in water level to the tune of 7.1 m in last 13 years and average decline in ground water level is 0.54 m /year. The stage of ground water development is 118.76 % in alluvium & 180.43 % in quartzite. The catchment of Kantli river is 4667.8 Sq. Km and runoff availability is 93 MCM. For utilising the some part of the available runoff for augmentation of ground water resources, one sub surface barrier of 0.8 m. height, 2.75 m depth & 89 m long and three gravity head inverted wells of 1.2 m dia & 10 m. depth have been constructed. 11500 Cubic meter runoff water recharged in one year. Water level rise from 0.25 to 0.60 m.

26. Roof Top Rain Water Harvesting In C.G.W.B. Office Premises, Jaipur

Due to over development of ground water for domestic water supply in Jaipur the ground water levels are continuously declining. Therefore for utilising the roof top rain water for recharge to ground water, the CGWB Office building at Jhalana Dungri at Jaipur is identified for experimental study. The roof top / paved area of the building is 1250 Sq.m. The depth to ground water level is 29.0 m.bgl. The rate of decline is 1.10 m / year. The annual availability of water from roof top / paved area is 544 Cum. For recharging the available runoff an injection tubewell of 250 mm dia. and 50 m depth has been constructed (Fig- 17).

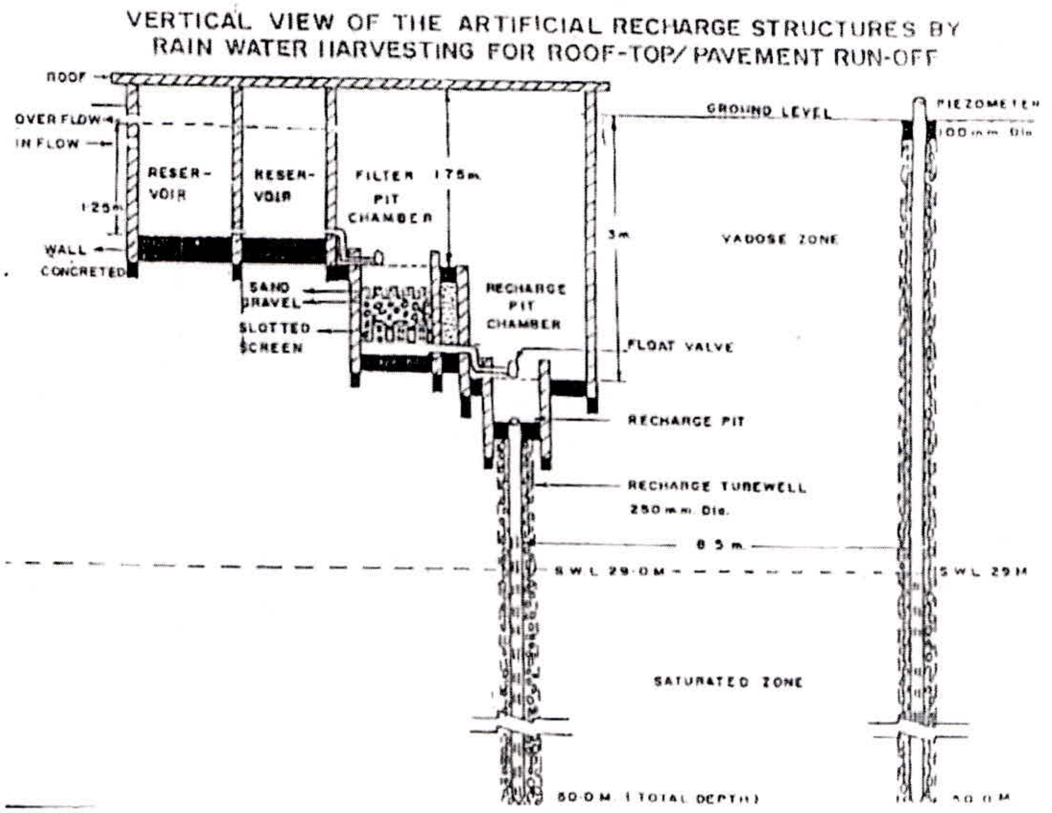


Fig. 17

27. Artificial Recharge To Ground Water Through Sub-Surface Dyke At Nallan Pillai Patral, Gingee Block, Gingee Taluk, Villupuram District, Tamil Nadu

The project is located in a backward area having concentration of landless labour. Villupuram district is severely affected by drought every year. Due to nature of the terrain and gradient of land, depletion of storage of water occurs at a very rapid rate and the entire zone becomes dry during summer. It is proposed to tap ground water by constructing subsurface dyke. The length of dyke is about 100 m whereas depth varies from 3.50 – 7.00 m. The construction of dyke has resulted in better availability of water in the dug wells in about 39 ha area for a longer period even during summer months.

28. Artificial Recharge To Ground Water Through Sub-Surface Dyke, Chirayinkil Block , Trivandrum District, Kerala

The area is located in Vamanpuram basin, which is drained by a small nala in which base flow is available upto mid-February only. Due to drying up of the Nala the area faces acute water shortages during peak summer seasons. The average rainfall is 1963 mm of which about 70% is received during south-western monsoon. In village Ayilam, 75% of rainfall goes waste as run off due to very high gradient. Sub-surface dyke is being constructed to arrest the sub-surface ground water outflow (Fig.-18). The dyke has resulted in building up of ground water levels by 2 meters that can be harnessed during lean season.

SUB-SURFACE DYKE AT MYVELIELA

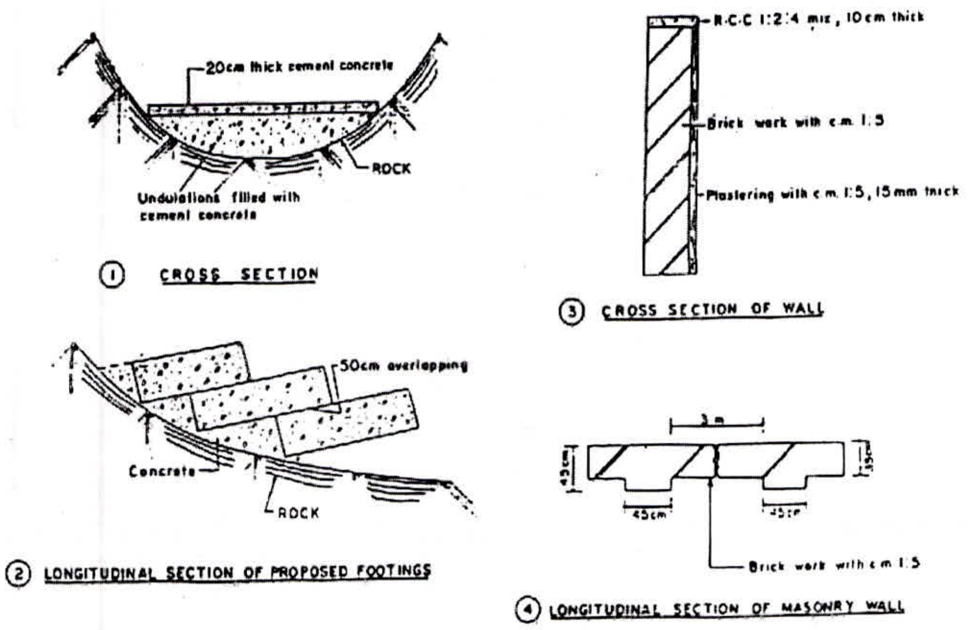


Fig. 18

Table 1: Impact Assessment of Select Artificial Recharge Projects implemented by CGWB

Sr. No.	Name of State	No. of schemes for which impact assessment done	Artificial Recharge Structures	Impact assessment
1.	Andhra Pradesh	6	Percolation Tanks	4500-5900 Cubic meter runoff water recharged in one year
		3	Check dams	1000-1250 Cubic meter runoff water recharged in one year
		1	Combination of recharge pits and lateral shafts	370 Cubic meter runoff recharged in one year
2.	Chandigarh	1	Recharge Trenches	9.50 lakh cubic meter rainwater runoff recharged in one year
3.	Haryana	1	Combination of Recharge shafts and injection wells	3.50 lakh cubic meter runoff water recharged in one year. Declining rate reduced from 1.175 m/yr to 0.25 m/yr.
4.	Himachal Pradesh	3	Check dams	1.20-21.00 lakhs cubic meter runoff water recharged in one year.
5.	Karnataka	1	Combination of Percolation Tanks, Watershed Structures, Recharge wells, Roof Top Rain Water Harvesting	2-3.5 m. rise in water levels and 9-16 ha area benefited from percolation tanks 8.60 lakh cubic meter water recharged through recharge well. 3-5 m rise in ground water levels through watershed structures. 530 cubic meter recharged from Roof Top Rain Water Harvesting.
6.	Kerala	1	Sub-surface Dyke	Augmented 5000 Cubic meter of ground water in upstream side with 2 m rise in groundwater levels.
		1	Recharge wells	2800 Cubic meter runoff water recharged in one year

		3	Percolation tanks	2000-15000 Cubic meter runoff water recharged in one year
		1	Tidal regulator	4000 Cubic meter runoff water conserved and a difference of 1.5 m was observed in upstream and downstream water level.
		1	Check Dam	30,000 Cubic meter runoff water recharged in one year
7.	Madhya Pradesh	4	Sub-surface Dykes	Rise in water level in dugwells in the range of 0.80-3.80 m and 6-12 m in hand pumps has been observed.
		1	Percolation Tank	Rise in ground water levels by 1-4 m. in command area downstream of tank has been observed.
		1	Roof Top Rain Water Harvesting (1000 houses)	More than 2 lakh cubic meter runoff water recharged in one year.
		1	Combination of sub-surface dykes and check dam	Rise in water levels in existing tubewells in upstream area by 0.30 m to 2.00 m has been observed.
8.	Maharashtra	1	Combination of Percolation Tanks and Check Dams.	Benefited area – About 60 to 120 ha. per Percolation Tank, 3 to 15 hectare per Check Dam Water level rise – Upto 1.5 m.
		1	Percolation tanks, Recharge Shaft, Dugwell Recharge.	Benefited area – 400-500 hectare around the scheme.
9.	NCT Delhi	2	Check dams	Water levels have risen upto 2.55 m in the vicinity of Check Dams and area benefited is upto 30 hectare from each check dam in JNU & IIT. 1.30-lakh cubic meter of rainwater was recharged in one year in Kushak Nala.

		7	Roof Top Rain Water Harvesting	800 – 5000 Cubic meter runoff water recharged in one year
		8	Rain water harvesting through Roof Top & Pavement catchments	8500 – 20,000 cubic meter runoff water recharged in one year
10.	Punjab	3	Recharge wells	9 – 15.50 lakhs cubic meter runoff water recharged in one year.
		1	Trenches	Average rise in water level upto 0.32-0.70 m has been observed.
			Combination of vertical shafts, injection wells & recharge trenches	Recharge of 1.70 lakh cubic meter runoff water caused average rise of 0.25 m. in ground water levels around the scheme area.
		1	Combination of recharge shafts and injection wells	14,400 Cubic meter runoff water recharged in one year.
11.	Rajasthan	1	Check dams	88,000 Cubic meter runoff water recharged in one year. Water level rise - 0.65 m.
		3	Sub-surface Barriers	2000-11500 Cubic meter runoff water recharged in one year. Water level rise from 0.25 to 0.60 m.
12.	Tamil Nadu	1	Sub-surface Dyke	39.25 ha. area benefited.
		7	Percolation Tanks	10,000-2,25,000 runoff water recharged in one year.
13..	West Bengal	1	Combination of Farm Ponds, Nala Bunds, Sub-surface Dykes	Water level rise of 0.15 m. observed.
		1	Sub-surface Dykes	Rise in water levels by 0.45 m. observed