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Openwell and Borewell
Recharge Technology

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All India Co-ordinated Research Project
for
Dryland Agriculture

Vasantrao Naik Marathwada Krishi Vidyapeeth
Parbhani - 431 402 (MS)

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Foreword

Water is a prime natural resource and is considered as a precious national asset. Agriculture is the largest user of water. Government of India has accorded the highest priority to the sustainable development of rainfed area with a strategy of conservation of rainwater and its management. Assured crop production in rainfed area can only be achieved if supplemental irrigation can be provided. For that, groundwater is the major source. India is the world's largest groundwater user. Over three fourths of food grains production coming from the irrigated lands is contributed by lands irrigated by groundwater. With every passing day, our dependence on ground water is increasing and is likely to remain dominant. It is clear that India's real water lifeline is groundwater.

Groundwater is clearly the preferred source for farmers. The depletion of groundwater resource is a matter of great concern for human society. Large-scale pumping out of groundwater and negligible recharging has created `water havoc' in these borewell-fed areas. The groundwater levels in the region had reached alarming levels early this year itself. In as many as 247 villages, groundwater draft has exceeded recharge to such an extent that the aquifer has gone completely dry. According to wells monitored by GSDA, in all districts of Marathwada, the groundwater level trend is steeply falling. Hence, there is an urgent need to enhance the ground water potential through artificial recharging techniques

The scientists from AICRP for Dryland Agriculture took sincere efforts in the design and development of the recharging technology for both open well and borewell. I congratulate the authors for brining out this important publication and it will definitely be useful to research and extension workers to popularize this technology among the farming community to build up the groundwater potential in the region.

Date : January, 2017
Place : Parbhani

B.Venkateswarlu
Vice - Chancellor

Preface

Water is a very scarce and crucial natural resource. In recent years, the state and the region is facing a acute shortage of water not only due to uneven and erratic rainfall but also due to improper management of rainwater. Drought is a common feature. Rainwater harvesting and its reutilization for providing protective irrigation proved effective in assured crop production. Groundwater is clearly the preferred source for farmers . This is one of the reasons why the region has experienced explosive growth in groundwater demand during recent decades and this is also one of the reasons why groundwater demand will further expand with changing climate. However, groundwater lifeline is in precarious situation and is likely to remain for many coming years.

The water table is depleting at an alarming rate. Large number of wells, hand pumps and tube wells become dry in many areas causing acute shortage of irrigation and drinking water supply in the state. Sustainable crop production in rainfed areas can be achieved if supplemental irrigation can be provided. Groundwater is the major source for providing supplemental irrigation particularly during dryspell in *kharif* and in *rabi* seasons. Looking to the enhancement of groundwater potential, the AICRP for Dryland Agriculture has designed and developed a adoptable and economically feasible technology for recharging of open well and bore well.

Openwell Recharge Technology was recommended in the Joint AGRESCO held at VNMKV, Parbhani in 2013 and the borewell recharge technology was recommended in the Joint AGRESCO held at Dr.PDKV, Akola in 2016.

The authors are thankful to Dr.B.Venkateswarlu, Hon.Vice Chancellor, VNMKV Parbhani for proving necessary support, guidance and encouragement in development of this technology. The authors also expressed the special thanks to Dr. Ch. Srinivasa Rao, Director, CRIDA and Dr.G.Ravindra Chary, Project coordinator, AICRPDA, CRIDA, ICAR, Hyderabad for their inspiration to undertake this research and development work.

We hope that this book will be useful as a guideline to every one for increasing the groundwater availability for sustainable crop production under dryland condition.

Authors

Openwell and Borewell Recharging Technology

Preamble

In Maharashtra, Out of the total area under irrigation, 28.75 lakh hectares (71%) of the agricultural land is irrigated by groundwater while 11.83 lakh hectares (29%) by flow or canal irrigation. Out of the total groundwater consumed, 83 per cent is for irrigation, 10 per cent for industries and only 5 per cent is for domestic consumption.

Marathwada region is one of the four regions of Maharashtra state, comprising eight districts and 85 per cent of cultivated land is rain dependent. Groundwater is the most important natural resource of our planet. Over three fourth of foodgrains production coming from the irrigated lands is contributed by lands irrigated by groundwater. Over 85% of rural and 55% of urban and industrial water supply comes from groundwater sources. With every passing day, our dependence on ground water is increasing and is likely to remain dominant. It is clear that India's real water lifeline is groundwater.

Groundwater is clearly the preferred source for farmers. This is one of the reasons why India has experienced explosive growth in groundwater demand during recent decades. However, India's groundwater position is in precarious situation.

Groundwater is a renewable resource. Therefore, its appropriate management has assumed great significance. The groundwater recharge depends on both quantum of precipitation and pattern of precipitation. During the last decade, the rainfall is found to be variable and rain scares situation was observed in many districts. Large-scale pumping out of groundwater and negligible recharging has created 'water havoc' in these borewell-fed areas. The groundwater levels in the region had reached alarming levels early this year itself. The entire region covers impermeable basaltic strata and there are limitations to groundwater extraction. In as many as 247 villages, groundwater draft has exceeded than recharge to such an extent that the aquifer has gone completely dry. According to wells monitored by GSDA, in all districts of Marathwada, the trend is steeply falling.

In Marathwada region of Maharashtra state, rainfed agriculture is prominent. However, there is a vast scope for rainwater harvesting & recycling and its utilization for increasing the productivity of rainfed crops. Rain water is pure but when it flows over the land surface or ground, the sediment mix with water. The runoff water needs to be filtered before its further use. Artificial recharging is becoming necessary to ensure sustainable ground water supplies to satisfy the needs of growing populations.

To tackle the problems of declining ground water table, artificial ground water recharge is one of the effective measures. In the prospect of prevailing ground water crisis, an attempt has been made to develop a adoptive and feasible open well and borewell recharge technology suitable for Marathwada region.

Design Criteria for Well Recharge Technology

Specific Gravity of Soil Solids

As the specific gravity of soil is basic property and primary requisite for determination of velocities of silt contained water, it has been determined by the pycnometer test.

Table 1 : Specific gravity computation

OBSERVATIONS	
$M_{1(g)}$	370g
$M_{2(g)}$	636g
$M_{3(g)}$	1388g
$M_{4(g)}$	1228g

Specific gravity calculated as follows,

$$G = \frac{266}{266 - (1388-1228)} = \mathbf{2.51}$$

The specific gravity was determined and found to be 2.51 for collected soil samples.

Velocity of Suspended Soil Solids

The soil samples collected from field through which runoff is flowing were collected and analyzed for determination of particle size using particle size distribution curve. Accordingly, the particle size is found to be in the tune of 0.01 to 0.1mm. The velocity at which muddy water flowing through the filtration process was computed by using stokes law.

$$v = \frac{1}{18} D^2 (G-1)\ \gamma w/\eta$$

Considering determined specific gravity and standard values of viscosity and specific weight,

$$G = 2.51,\ \eta = 0.01 \text{ poise} = 10^{-6} \text{ kN-s/m}^2$$

$$v = \frac{D^2}{1.835} \times (2.51-1)/10^6 \times 10^{-6}$$

$$V = 1.51\ D^2 / 1.835 \qquad V = 0.8228\ D^2$$

1) For coarsest particle D=0.1mm

$V_{max} = 0.8228 \times (0.1)^2$ $\qquad$ $V_{max} = 0.8228 \times 10^{-2}$ m/s

2) For finest particle D=0.01mm

$V_{min} = 0.8228 \times (0.01)^2$ $\qquad$ $V_{min} = 0.8228 \times 10^{-4}$ m/s

The minimum and maximum values of velocity were determine as 8.228×10^{-3} m/s and 8.228×10^{-5} m/s with an average velocity value 411.40×10^{-5} m/s.

Open well recharging system-Model setup

Procedure :

The filter unit should be constructed near the open well at a distance of 5 to 10 m. The filter unit consists of three blocks. First one is called primary filter (0.6 x 0.6m) which is combined with layers of stones, sand and gravels. The filter collects major sediments from runoff water fro the catchment area. Primary filter is joined by 4" dia. pipe to silt trapping unit / energy dissipation unit (1.5 x 1 x 1 m) having a rectangular notch opening in main filter unit. Third block act as a main filtration tank with dimensions as 2 x 2 x 2 m.

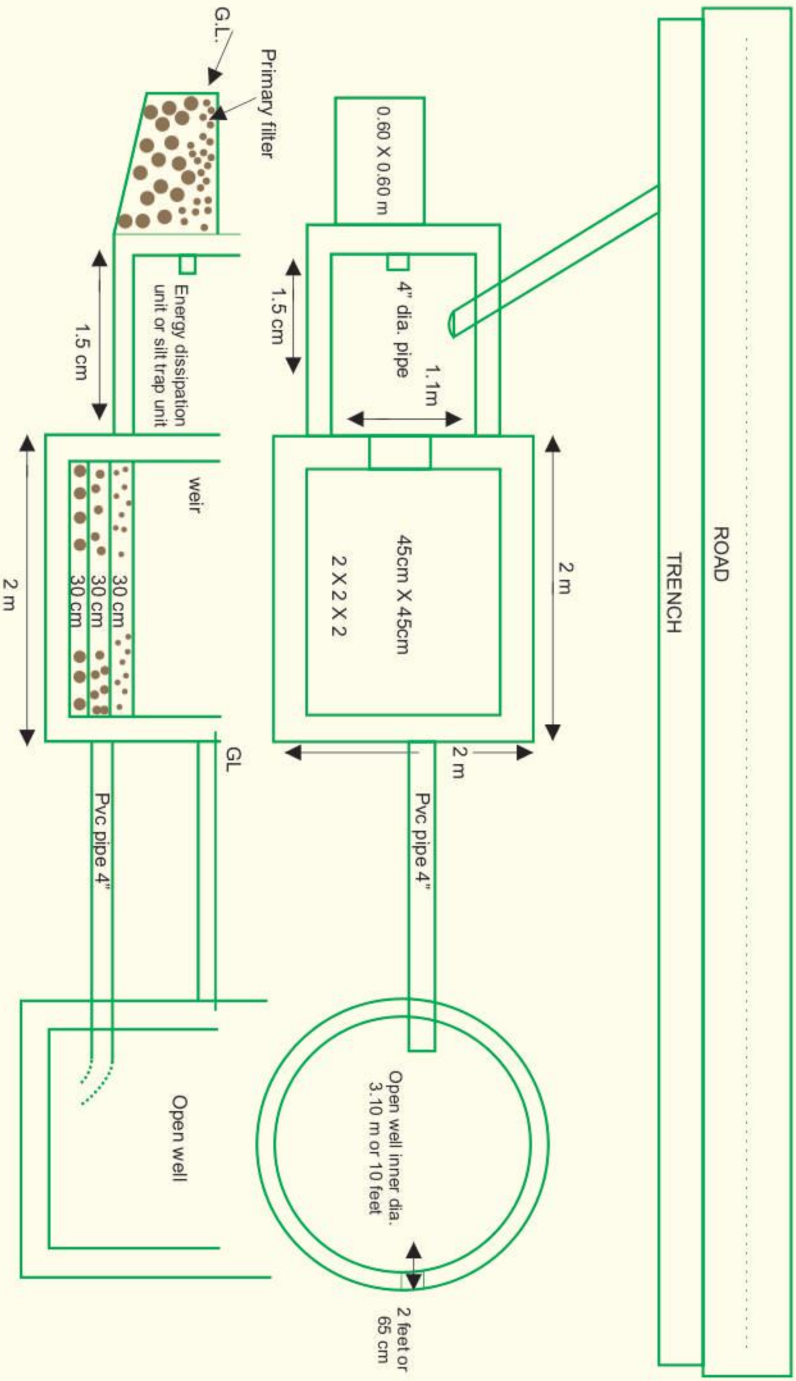


Fig.1 : Artificial Well Recharging System

Runoff Water in Filtration Tank

Filtered Water in Well

Open Well Recharge Technology

Standardization for Filtration Material

The time required to flow water from inlet to outlet was noted as 263 seconds and accordingly considering the average velocity value,

The head through which water passes was determined as h=v/t

$h = 411.40 \times 10^{-5} / 293 \quad h = 1.4\ m = 140\ cm.$

The head comes out to be 140 cm.

Based on these calculations, the depth of filtration material was worked out as 90cm with 50cm as a head of standing water which is essentially required for easy flow of water through filtration unit.

Main filtration unit comprises three layers of different filter material such as 30 cm sand over laid by 30 cm gravels and 30 cm stones one above other and acts as filter material. The main filter unit is joined to open well by the 4" dia. PVC pipe. The filter unit is constructed with brick walls and cement concrete (2 x 2 x 2 m).

Table 2 : Specification of Filter material

Sr. No.	Filter material	Size	Thickness of layer
1.	Sand	0.4"	30 cm
2.	Metal	1.5"	30 cm
3.	Stones	3 to 4"	30 cm

Working principle of Open well recharging system

Open well recharging system consist of primary, secondary and main filtration unit. Runoff water from the cultivated area/ catchment area is diverted towards well recharge unit through field trenches. It allows to enter in primary filter unit wherein the major sediments will be arrested and water flows to the secondary filter unit. In secondary unit, the velocity of water will be reduced and heavy silt will be deposited at the bottom. This unit is also called as energy dissipation unit. The muddy water containing suspended and dissolved silt will passed to main filtration unit through a notch. The filtered water will pass to open well through connected PVC pipe.

Filtration Efficiency

The filtration efficiency was found out by using formula suggested by Gideon, (1982).

$$F.E. = 100 \times 1 - \left\{ \frac{So}{Si} \right\}$$

Where,

F.E. = Filtration efficiency (%)

So = Component concentration at the filter outlet (mg/lit)

Si = Component concentration at the filter inlet (mg/lit)

For determination of filtration efficiency of the filter system, the water samples at inlet and outlet should be collected at various time interval. These sample are allowed to settle for 24 hours and then placed in hot air oven for 24 hours at 105^{0}C. After 24 hours the weight of dry silt was weighted for determination of silt content. The filtration efficiency should be determined using above equation.

Table 3 : Filtration Efficiency of Primary Filter

Sample No.	Inlet silt composition, gm	Outlet silt composition, gm	Efficiency (%)
1	2.6	0.90	66.00
2	2.5	0.75	70.00
3	2.9	0.95	68.00
4	2.8	1.00	65.00
5	3.0	1.10	64.00
	2.76	0.94	67.00

The filtration efficiency of primary filter is found to be in the range of 64 to 70 percent which proves that it is necessary to arrest the major silt component of the runoff water. The filtration efficiency of main filter is found to be in the range 93 to 96 percent.

Table 4 : Filtration efficiency of main filter

Test Sample No	Inlet silt composition (g)	Outlet silt composition (g)	Efficiency (%)
1	2.9	0.2	93.10
2	3.1	0.2	93.54
3	3.4	0.12	96.47
4	3.3	0.15	95.45
5	2.2	0.15	93.18
6	2.3	0.12	94.78
7	3.1	0.21	93.22
8	3.5	0.12	96.57
9	3.7	0.16	95.67
10	2.5	0.13	94.08
Average	2.27	0.17	94.61

Runoff availability for well recharging

Table 5 : Rainfall runoff events - 2011

Date	Rainfall mm	Runoff mm	Runoff from 1.8 ha field (m^3)
July 7	27.0	8.0	144
July 14	45.5	37.0	666
July 15	16.0	10.0	180
July 26	37.0	12.0	216
July 27	44.2	37.0	666
August 2	45.0	37.0	666
August 26	21.8	5.0	90
August 27	19.7	13.0	234
September 16	47.0	18.0	324
September 17	34.5	26.0	468
Total	**337.7**	**203**	**3654**

Table 6 : Rainfall runoff events - 2012

Date	Rainfall mm	Runoff mm	Runoff from 1.8 ha field (m3)
July 17	34.2	26.0	468
July 18	64.0	56.0	1008
September 3	64.0	56.0	1008
September 5	21.0	14.0	252
Total	**183.2**	**152.0**	**2736**

Runoff studies also indicate that sufficient runoff could be available for well recharging to build up ground water potential in assured rainfall region.

Table 7 : Rainfall runoff events - 2013

Date	Rainfall mm	Runoff (mm)	Runoff from 1.8 ha field (m^3)
June 7	51.4	43.0	774
July 9	45.0	27.0	486
July 12	30.4	22.0	396
July 17	50.4	32.0	576
July 18	47.3	29.0	522
July 19	18.7	12.0	216
July 24	34.5	26.0	468
August 1	31.3	23.0	414
August 7	37.0	12.0	216
September 16	55.5	43.0	774
September 17	36.5	27.0	486
September 18	46.0	38.0	684
September 19	21.5	14.0	252
September 20	39.0	31.0	558
October 12	37.4	28.0	504
Total	**581.9**	**407**	**7326**

Table 8 : Rainfall runoff events - 2014

Date	Rainfall mm	Runoff (mm)	Runoff from 1.8 ha field (m^3)
July 9, 2014	60.00	46	828
Aug 31, 2014	38.20	17	306
Total	**98.20**	**63**	**1134**

Table 9 : Rainfall runoff events - 2015

Date	Rainfall mm	Runoff (mm)	Runoff from 1.8 ha field (m^3)
Sept 09	50.5	24.0	432
Sept 18	57.4	25.0	450
Total	**107.9**	**49.0**	**882**

Effect of Well Recharging on Ground Water Level

The reduced levels of ground water in well were recorded since 2011. Data revealed that during the year 2011, the water table starts rising since the month of June after onset of monsoon . The increase in water table was observed upto the month of November and later on gradually reduction in water table was observed. The total runoff water from 1.8 ha field was diverted to well through well recharging model. During the year 2012, same trend was observed in spite of 29 per cent less rainfall received.

During the year 2013, due to early onset of monsoon, the water table in well starts rising since May. Due to sufficient rainfall in the month of June, sudden rise in water table was observed. A well distributed rainfall was observed during the monsoon 2013 reflected in continuous higher water table in well up to the month of November 2013.

Table 10 : Water Level from Ground Surface

Month	2011	2012	2013	Rise in Water Level
January	404.8	405.0	405.6	0.8
February	404.6	404.5	405.2	0.6
March	404.6	404.1	404.8	0.2
April	404.0	403.9	404.4	0.4
May	403.9	403.3	404.2	0.3
June	404.0	404.6	407.4	3.4
July	405.0	405.5	407.7	2.7
August	405.2	406.1	407.7	2.5
September	406.7	406.2	407.7	1.0
October	406.3	406.2	407.6	1.3
November	406.8	406.9	407.7	0.9
December	406.7	406.5	407.5	0.8

The 25 to 35 % of rainfall could be available as surface runoff for well recharging to build up ground water potential. Comparison of water levels of 2011 to 2013 indicated that there is an increase in water level in the tune of 0.3 m to 3.4 m. Thus artificial well recharging resulted in increase in ground water potential which will help to provide supplemental irrigation to *kharif and rabi* rainfed crops.

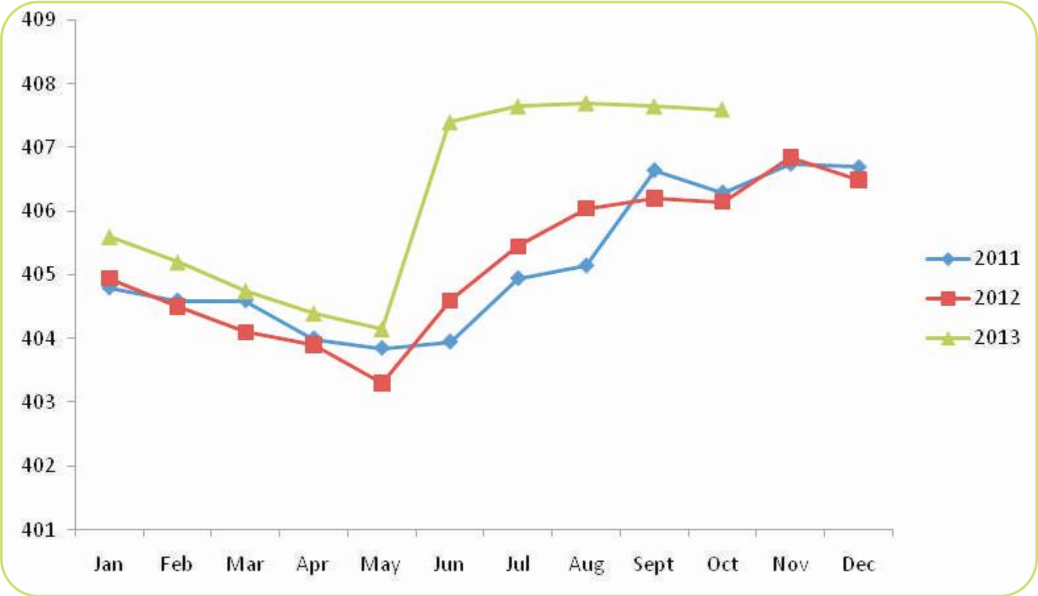


Fig. 2 : Comparison of water table fluctuation in well during 2011-13

An Experience in NICRA Village

A National Innovations on Climate Resilient Agriculture (NICRA) project in being implemented on farmers field at village Babhulgaon Tq.Dist.Parbhani.

Location: Located at 19.166514N Latitude, 76.42159' East Longitude and 357 m above Sea Level Altitude and at a distance of about 20 kilometer from Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani campus.

Table 11 : Land use details (NICRA village):

Land use	Area in ha
Total area	1133.94
Cultivated area	1097.38
Rainfed	1015.00
Waste land area	19.19
Road	3.45
Grass land	7.74
Village land	6.18

A developed open well recharge technology was demonstrated on 10 farmers field through participatory mode.

Table 12 : List of Farmers with Location Details

Recharged Openwell	Diameter of well, m	Depth of well, m	Longitude	Latitude
1. Shri. Daulatrao Maske	6.0	15.0	76^{0}40.004′	19^{0}13.205′
2. Shri. Dnyanoba Avhad	6.1	15.4	76^{0}39.896′	19^{0}13.234′
3. Shri. Ganpat Pardhe	7.0	16.9	76^{0}39.266′	19^{0}13.808′
4. Shri. Girish Pardhe	5.9	13.8	76^{0}39.022′	19^{0}13.760′
5. Shri. Vitthal Pardhe	4.9	21.5	76^{0}40.366′	19^{0}13.539′
6. Shri. Dnyanoba Pardhe	5.5	20.0	76^{0}39.713′	19^{0}12.747′
7. Shri. Shamrao Pardhe	4.9	18.4	76^{0}39.770′	19^{0}13.439′
8. Shri. Kailash Dhumal	5.5	21.5	76^{0}39.564′	19^{0}11.793′
9. Shri. Vitthal Dalve	5.2	16.5	76^{0}39.335′	19^{0}13.698′
10. Shri. Munja Pardhe	4.9	15.5	76^{0}39.204′	19^{0}13.378′
Unrecharged open wells				
1. Shri. Sundar Pardhe	5.5	14.9	76^{0}39.625′	19^{0}12.605′
2. Shri. Rama Nemane	4.9	15.7	76^{0}39.565′	19^{0}12.139′

Visit of NICRA Scientists on Farmers Field

Outcome

The pre & post monsoon water levels in the wells were monitored. Also the aquifer characteristic viz. transmissivity and specific yield were determined. Accordingly the ground water recharge was determined. The Recharge wells recorded higher ground water potential as compared to unrecharged wells.

Table 13 : Water Level Fluctuation and Ground Water Recharge (2015).

Recharged Openwell	Pre-monsoon level (meter)	Post-monsoon level (meter)	Water level fluctuation (meter)	Ground water recharge cm	Ground water recharge %
1. Sh. Daulatrao Maske	15.00	06.21	8.79	20.92	51.27
2. Sh. Dnyanoba Avhad	14.38	07.45	6.93	16.49	4.42
3. Sh. Ganpat Pardhe	11.71	06.31	5.40	12.85	31.49
4. Sh. Girish Pardhe	13.51	09.15	4.36	9.42	23.08
5. Sh. Vitthal Pardhe	21.34	15.24	5.10	12.14	29.75
6. Sh. Dnyanoba Pardhe	18.90	12.24	6.66	15.85	38.84
7. Sh. Shamrao Pardhe	16.29	11.19	5.10	12.14	29.75
8. Sh. Kailash Dhumal	17.62	09.14	8.48	20.18	49.46
9. Sh. Vitthal Dalve	17.65	12.56	5.09	12.11	29.68
10. Sh. Munja Pardhe	18.61	11.71	6.90	16.42	40.24
			Average		**36.39**
Unrecharged open wells					
1. Sh. Sundar Pardhe	18.31	16.27	2.04	4.85	11.88
2. Sh. Rama Nemane	19.15	16.10	3.05	7.26	17.79
			Average		**14.83**

Bore well recharge Technology -Model setup

Bore well recharging system consist of primary and secondary filter. The primary filter consist of excavation of pit of 1 x 0.60 x 0.60 m dimensions filled with stones, gravel and sand. This unit filters the runoff water receiving through field trenches a. This filter unit is connected by 3" dia PVC pipe to main filtration unit. Secondary filter unit consist of excavation of soil around the bore well casing pipe with dimensions as 2.5 m depth and 1.5 dia. From the bottom, upto 50 cm height, small wholes should be made with pointer at a spacing of 5 cm and this casing pipe is wrapped with nylon mesh in double layer. Then the pit is filled with 3 layers of big stone (50 cm), metals(50cm), Gravel (30 cm) and fine sand(20 cm) one above each. After second layer of metel, horizontal covering of nylon mesh should be provided and than gravel and sand layers should be placed. The top of the unit is covered with cement ring for not allowing the sediment from the flowing water.

Standardization of filtration unit

The head through which water passes was determined as

$h = v \times t$

$h = 456 \times 10^{-5} \times 395$

$h = 1.8\ m = 180\ cm.$

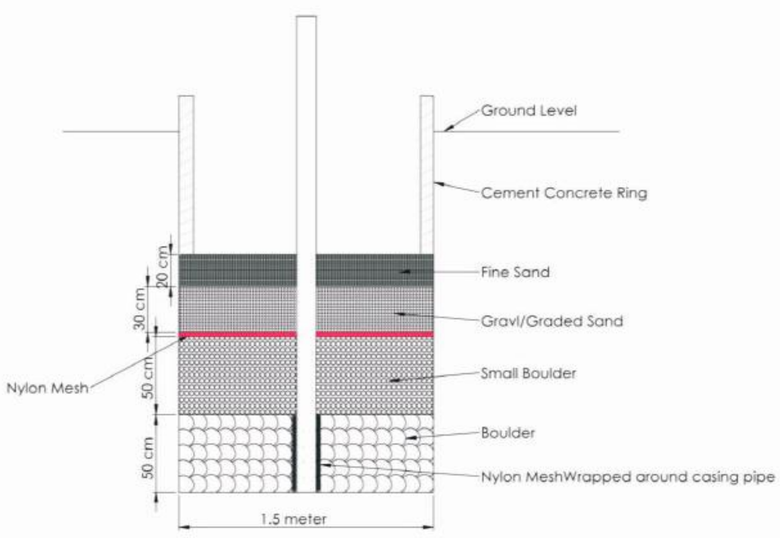


Fig. 3 : Schematic View of Borewell Recharge Technology

Excavation of pit

Drilling holes to casing pipe

Wrapping with nylon mesh

Filling with filter material

Laying of cement rings

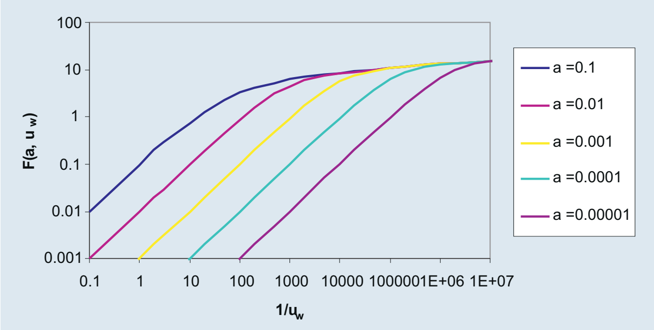
BRT - Work Execution Procedure

Determination of Aquifer Parameters by Pumping Test

Evaluation of aquifer characteristics is the prime task for harnessing an aquifer for optimum results yielding information about how much groundwater is available for development and what will be the consequences of withdrawing a certain quantity of groundwater. Aquifer parameters, i.e. transmissivity (T) and specific yield (Sy) were determined by means Scientifically planned pumping tests . It also provide information about the yield and drawdown of the well which in turn is essential for selecting the type of pump, estimating cost of pumping, well efficiency etc.

Aquifer parameters are also essential for computing groundwater recharge. In a pumping test or an aquifer test, a well is pumped at constant/variable rate for a certain period of time. The effect of pumping on the water level was measured in the pumped well and in one or more observation wells, penetrating the aquifer in the vicinity of the pumped well with the help of water level indicator. Type of an aquifer is identified by plotting time-drawdown curve on double-logarithmic scale and comparing with standard drawdown curve on double-logarithmic scale. Aquifer parameters (T and Sy) are then found by substituting the measured drawdown, discharge and the well function by use of a graphical technique called 'curve matching'.

Papadopulos and Cooper (1967) curve-matching technique was adopted for determining aquifer properties in this study. The Papadopulos and Cooper solution accounts for wellbore storage effects in a large-diameter (finite-diameter) pumping well. Aquifer parameters, i.e. transmissivity (T) and specific yield (Sy) were determined by conducting Scientifically planned pumping tests .



A long duration pumping test was conducted on representative bore well. The well characteristics like specific yield and transmissivity were determined as 0.0134 and 572.37 m^2/day, respectively.

Table 14 : Demonstrations of BRT

Sr.No.	Name of the Research Station/ Centre	No. of BRTs
1	Sorghum Research Station	02
2	Vegetable Research Scheme	02
3	Sericulture Research Unit	01
4	Cotton Research Station	01
5	Soybean Research Scheme	02
6	Wheat Research Scheme	02
7	Safflower Research Scheme	01
8	Cattle Cross Breeding Project	01
9	Central Farm	02
10	Cotton Research Station, Mahboob baugh	01
11	Breeder Seed Project, Khanapur Block	01
12	College of Agril. Engineering & Technology	02
13	Tissue Culture Project	03
14	Long Term Fertilizer Scheme	02
15	Dryland Research Centre	02
16	Integrated Farming Scheme	01
17	Badnapur sub campus	08
18	Cotton Research Station, Nanded	02
19	College of Agriculture, Ambejogai	04
20	NICRA Village Babhulgaon, Tq. & Dist. Parbhani	07
21	House hold	04
	Total	**51**

Working principle of Bore well recharging system

Runoff water from the cultivated area is diverted towards bore well recharge unit through field trenches. It allows to enter in primary filter unit wherein the major sediments will be arrested and water flows to the secondary filter unit. Through secondary filter unit, muddy water will pass through 4 layers of filtration material and percolate in subsoil strata as well as some part enter directly in casing pipe of borewell. The filtration efficiency of this unit comes out to be more than 90 per cent.

Table 15 : Filtration efficiency

Sample No.	Inlet silt composition, gm	Outlet silt composition, gm	Efficiency (%)
1	3.4	0.12	96.47
2	3.3	0.15	95.45
3	2.2	0.15	93.18
4	2.3	0.12	94.78
5	3.1	0.21	93.22
Mean			**94.62**

Runoff availability for well recharging

The daily runoff events during the year 2015 were recorded and the data is presented in table 16. During the year 2015, 407.30 mm of rainfall occurred which was 55 % less than the average annual rainfall of the region. During this year, 18 mm of runoff produced in the monsoon season. This runoff volume was utilized for bore well recharging for enhancing the ground water levels in the well.

Table 16 : Runoff events during 2015

Date	Rainfall (mm)	Runoff (mm)
September 09, 2015	50	08
September 18,2015	57.4	10
Total	**107.4**	**18**

Effect of well recharging on groundwater level fluctuation:

The ground water levels in different wells were recorded before and after monsoon season of 2015 and the data is presented in table 17. Data revealed that during the year 2015, Only 407.6 mm of rainfall occurred which was 55 % deficit than the normal annual rainfall. Although only two runoff events occurred during 2015, the complete runoff water from 1 ha catchment area diverted to bore well recharge model and allow to percolate through the developed filtration unit of bore well recharge technology. The water table starts rising since September. The increase in water table was observed up to the month of November and later on gradual reduction in water table was observed.

Table 17 : Water levels and ground water recharge in Bore wells

Location	Water level from GL in May 2015 (Pre-monsoon)	Water level from GL in November 2015 (Post Monsoon)	Water level fluctuation, m	Ground water recharge, cm	Ground water recharge %
TREATED BORE WELLS					
Dryland Res. Centre	31.45	23.20	8.25	11.05	27.16
Cotton Res. Centre	17.27	10.05	7.22	09.675	23.77
Safflower Res. Centre	18.55	12.23	6.32	08.468	20.80
Wheat & Maize Res.	32.69	23.85	8.84	11.845	29.10
Centre	33.12	24.51	8.61	11.537	28.34
CCBP	14.34	8.33	6.01	8.053	19.78
Sericulture	21.72	15.09	6.63	8.884	21.82
Central farm	15.85	9.72	6.13	8.214	20.18
	19.20	12.35	6.85	9.179	22.55
Sorghum Res. Centre	72.25	66.23	6.02	8.06	19.81
	40.60	34.70	5.90	7.906	22.26
Demonstration Farm	26.85	19.60	7.25	9.715	23.86
			Average		**23.28**
UNTREATED BORE WELLS					
Sorghum Res. Centre	74.50	71.18	3.32	4.44	05.94
Demonstration Farm	29.50	26.61	2.89	3.87	05.18
			Average		**05.56**

The specific yield value was used for estimation of ground water recharge from the bore well based on water table fluctuations in the bore wells. It was observed that in recharged bore wells, the water table fluctuation was in the range of 5.90 to 8.84 m. It was also revealed that the ground water recharge in treated bore well was in the tune of 19.78 % to 29.10 % with an average of 23.28 % as against average recharge of 5.56 % in untreated bore wells.

The water levels in recharged and un-recharged bore wells were recorded in May 2015 and May 2016 i.e. in pre monsoon season. the rise / fall in water level is presented in Table 18.

Table 18 : Comparison of water levels in May 2015 and May 2016

Location	Water level from GL in May 2015	Water level from GL in May 2016	Rise in Water level, m
Recharged bore wells			
Dryland Res. Centre	31.45	29.05	**2.40**
Cotton Res. Centre	17.27	15.22	**2.05**
Safflower Res. Centre	18.55	16.30	**2.25**
Wheat & Maize Res. Centre	32.69	30.15	**2.54**
	33.12	30.55	**2.57**
Cattle Cross Breeding Project	14.34	12.43	**1.91**
Sericulture Research Unit	21.72	19.85	**1.87**
Central Farm	15.85	13.75	**2.10**
	19.20	16.50	**2.70**
Sorghum Res. Station	72.25	70.10	**2.15**
	40.60	37.30	**3.30**
Demonstration Farm	26.85	24.25	**2.60**
	Average		**2.37**
Un-recharged bore well			
Sorghum Res. Station	74.50	75.90	**-0.40**
Demonstration Farm	29.50	30.34	**-0.84**
	Average		**-0.62**

It is found that the water level is increased in the tune of 1.87 to 3.30 m with an average of 2.37 m in the zone. However, in un-recharged bore wells, the water levels was decreased by 0.62 m in 2016 as compared to 2015

Measurement of ground water levels in bore well using water level indicator in May, 2015 at Dryland Research Station, VNMKV Parbhani

Measurement of ground water levels in bore well using water level indicator in May, 2016 at Sorghum Research Station, VNMKV Parbhani

Visit of Dignitaries

Dr.V.M.Mayande,
Former Vice Chancellor,
Dr.PDKV Akola

Officers from
Ministry of Defense,
Govt. of India, Aurangabad

Dr. D.P. Waskar, Director of Research,
Dr.A.S.Dhawan, DI & Dean,
Dr.D.L.Jadhav, Former Registrar,
University scientists and farmers

Visit of Dignitaries

Dr. B. Venkateswarlu
Hon. Vice-Chancellor,
Dr. D.P. Waskar,
Director of Research
VNMKV, Parbhani

Accreditation team ICAR
to
bore well recharge model

Dr. M.A. Shankar,
Former Director of Research,
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