International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Analysis and Development of Watershed for Ruikhed Village, Maharashtra- A Case Study

Tejaswini Sanjay Mankar[1], Dr. Sachin Mane[2], Dr. Sandip T. Mali[3], Mahesh R Tapas[4]

[1]PG Student, Department of Civil Environmental Engineering, D.Y. Patil College of Engineering, Akurdi, Pune, Maharashtra, India.
[2]Asst.Professor, Department of Civil Engineering, D.Y. Patil College of Engineering, Akurdi, Pune, Maharashtra, India.
[3]Professor and H.O.D., Department of Civil Engineering, Pimpri Chinchwad College of Engineering, Pradhikaran Nigdi, Pune, Maharashtra, India.
[4]PG Student, Department of Civil Engineering, National Institute of Technology Warangal, Telangana, India.

Abstract - *One of the challenges tackled by human civilization across the globe is water scarcity. A limited supply of freshwater cannot meet the growing water demand. Factors similar to contamination of groundwater and surface water, irregular distribution of water resources, and recurrent drought triggered by extreme worldwide weather outlines have harshly influenced water scarcity. To respond to increasing groundwater predicament and take benefit of the higher levels of runoff non captured by natural recharge, analysis, and effective management of groundwater by introducing various approaches through non-natural recharge of aquifers has converted extensive in India for the last three to four decades. Mainly this study is carried out for Ruikhed Village in Akot Taluka, District Akola, Maharashtra, India. By studying various approaches of groundwater recharge, analysis, and development of Watershed for Ruikhed Village, Maharashtra is carried out. An action plan to focus on adequate water management is developed to address the increasing water demand. Various water conservation structures are recommended by taking average annual rainfall, hydrology, and morphology of area into consideration.*

Total water to be conserved using Farm Pond, Check Dam, Vanrai Bandhara, Rain Water Harvesting, Nala Bunding is calculated in this study. If watershed development methods are executed, it will rise the irrigation possible, which eventually upsurges production of crop, leading to an increase in the economic condition and living standard of individuals of Ruikhed, India.

Key Words: **Groundwater Recharge1, Groundwater Management2, Water Demand3, Groundwater Crises4, Watershed5, Watershed Management6, Watershed Management Structures7.**

1.INTRODUCTION

Numerous towns and agrarian zones rely over the shared usage of groundwater and water over surface. When requirement increases, groundwater is recurrently the furthermost economical basis of supply, but overexploitation may lead to the flagging of quality of water or a declining groundwater level. The easy accessibility of groundwater even by limited users, its local obtainability, and the difficulty of coordinating and leading numerous users of the similar aquifers through wide geographic spaces have regularly led to the undiscriminating withdrawal of this valuable natural reserve for Industrial, Domestic, and agrarian usages round the world. Groundwater misuse, mostly in Ruikhed, India, has increased by Bounds and Leaps over the preceding fifty years along with the growth of narrow, typically isolated wells. The amount of water pumped by farmers from India's aquifers is greatly exceeding natural recharge in many areas. The growth of groundwater abstraction structures from 1990 to 2020 portrays the growing use of groundwater use across sectors. There are numerous reasons for increased usage of Indian groundwater, generally involving technical, hydrological and policy causes. Technologically speaking, the last 50 years have contributed to wide scale groundwater usage becoming both practical and affordable in terms of production of the construction of deep tube wells, water extraction systems and pumping methods. To respond to the growing groundwater calamity and take benefit of the raised stages of runoff non taken by natural recharge, analysis, and effective management of groundwater by introducing various approaches through artificial recharge of aquifers has become extensive in India over the last three to four decades. Mainly this study is carried out for Ruikhed Village in Akot Taluka, District Akola, Maharashtra, India.

1.1 Aim

To undertake groundwater quality analysis, thereby identifying and recommending appropriate techniques for groundwater recharge and watershed management.

1.2 Objectives

- To study the concept of watershed management.
- To analyze the water quality of Ruikhed Village.

• To perform the geological investigation for the Ruikhed village in Akot district, Maharashtra.
• Design the watershed for the village and prepare estimates.

2. SALIENT FEATURES OF THE STUDY AREA

The noticeable features of the study area are given below in tabular form as a project at a glance.

Table -1: Salient Features of the Study Area

Sr. No.	Particulars	Information
1	Names of the State	Maharashtra
2	Names of the District	Akola
3	Names of the blocks	Akot
4	Name of Gram Panchayat	Ruikhed
5	Names & Census code of villages covered	Ruikhed-529761
6	Four primary reasons for selection of watershed	1) Partially Cover 2) Drinking water 3) Poverty 4)Small Marginal Farmers
7	Name, Address	Taluka Agriculture office, Akot
8	Assembly Constituency	Akot
9	Parliament Constituency	Akola
10	Population	2478
11	Total Geographical Area(ha)	298.82

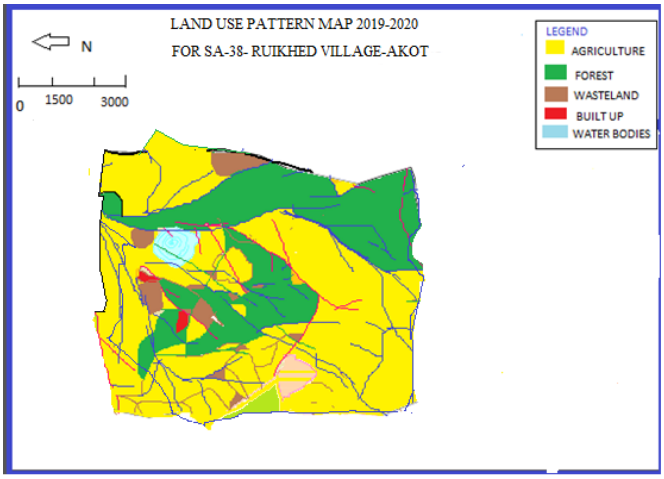

Fig -1: Land Use Pattern Map of Ruikhed Village

3. WATER QUALITY ANALYSIS

Water quality analysis is done to determine whether the water is appropriate for potable and irrigation purposes. The following charts are showing the results of samples use for drinking and irrigation purposes for its various parameters. All the results obtained are within standard limits.

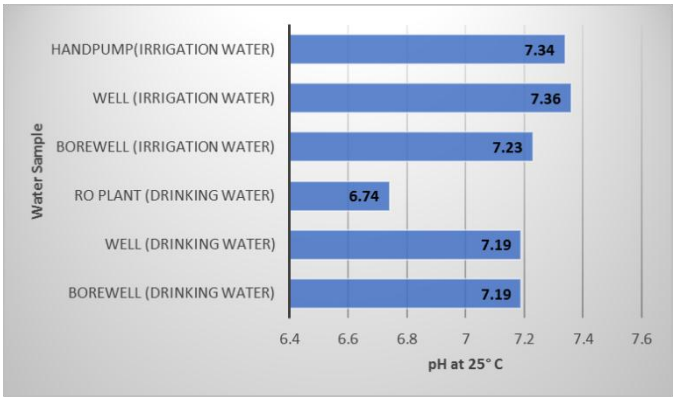

Chart -1: pH for Drinking and Irrigation Water Samples

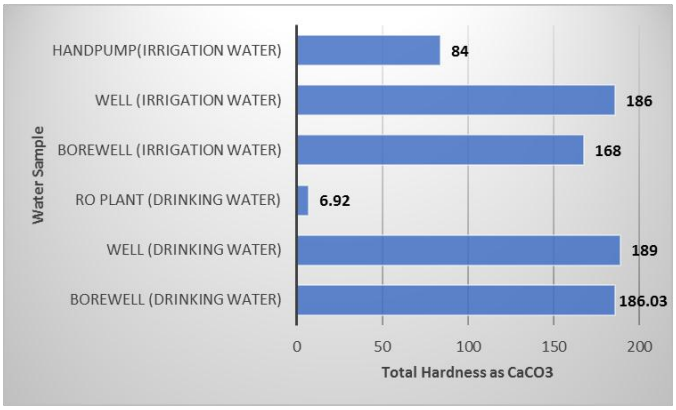

Chart -2: Total Hardness (as $CACO_3$)

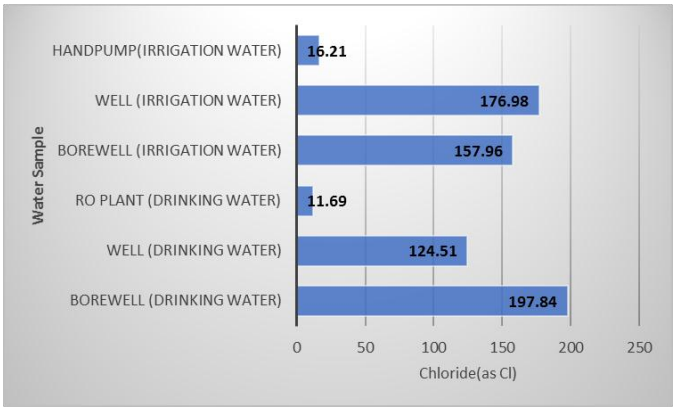

Chart -3: Chlorides (as Cl)

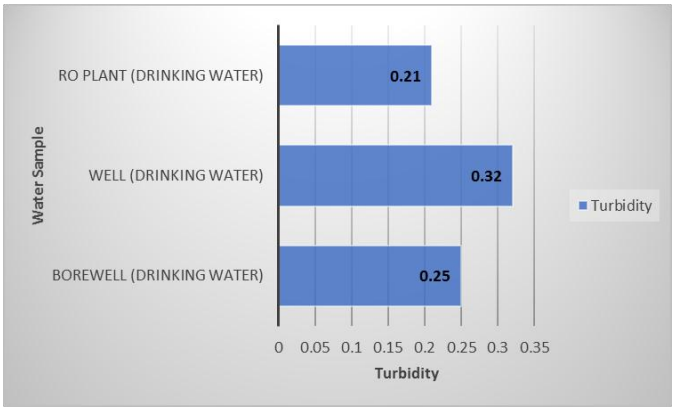

Chart -4: Turbidity

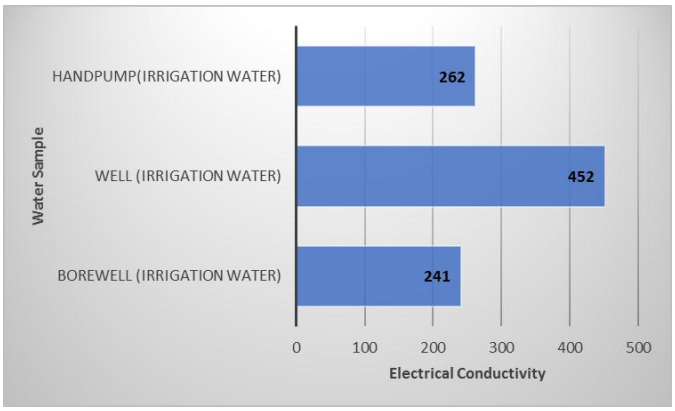

Chart -5: Electrical Conductivity

4. ESTIMATION OF RUNOFF

This is important to assess the drainage capacity of the water bottom shaft which is the primary contribution to restore the groundwater before proposing water management steps. The runoff is measured on a geomorphic basis for increasing micro-shift. Throughout a method, a weighted average value was chosen for the runoff coefficient and a full estimate was made. Suitable refill systems at appropriate points are important for the capture of runoff. The formula used for Ruikhed Inglis is as follows: C.C. Inglis has the following connections, centered on studies of catchments in Western Ghat and in the plains of Maharashtra:

For Non-Ghats (Hilly) region with Precipitation 'P' less than 200cm.

Run off = [P*(P-17.78)] /254 Where 'P' is precipitation stated in centimeters.

Average annual rainfall in Ruikhed, India = 80 cm.

Runoff as per formula given by Inglis = {P*{P-17.78}}/254

= [80 (80-17.78)]/254

= 4.004 cm

5. PROPOSED WATERSHED MANAGEMENT TECHNIQUES WITH ESTIMATES

5.1 Farm Pond

Farm ponds are similar to small water tanks and designed to store surface runoffs produced from the region of the drainage basin. The Farm ponds are the systems to store water, address different needs of farming, including irrigation water source, cattle feed, fish production, etc. Every pond site is special and thus custom built. The drainage hydrology is designed to produce accurate rushes. In an emergency spillway the river from the flood will easily escape the dam if used to construct a larger-scale disaster.

Table -2: Estimation of the Farm Pond

Sr. No.	Specifics	Measure	Rates (INR)	Amount (INR)
1	Site markings according to drawing and as guided by the respective Engineer.	Lump-sum	₹500.00	₹500.00
2	Excavation done in moist or dry kind of hard soil, which includes compaction, dressing and disposing the material which is excavated through side slope to the sides of cutting 1:1, etc. For excess, material leads upto 30.0 m and elevate to 3.0 m as guided by respective Engineer.	465.0 Cubic meter	₹100.0	₹46500.00
3	Sowing of grass seeds as recommended by concerned person.	2.0 Kg	₹500.00	₹000.00
4	Boulder structure construction to slope 1:1 by making use of stones which are available at the site as guided by respective Engineer comprising the lead upto 30.0 m etc.	10.0 cubic meter.	₹500.00	₹000.00

The total cost of a farm pond in rupees= ₹53000/-

5.2 Check Dam

Check Dam is recommended over places with milder grades over more critical waterways. Design & construction of eternal monitoring dams to safeguard the correct capacity and passable excess water production for the long term reliability of the dam to be prevented on the downstream side. The chosen position for the inspection barrier includes sufficient soil thickness or weathered content for rapid regeneration of stored water. The water found inside such buildings is generally confined to the river and typically less than 2 m long. The water was engineered to flow over the wall based on stream depth.

Table -3: Estimate of Check Dam

Sr. No.	Specifics	Quantity	Rate (Rupees)	Amount (Rupees)
1	Site cleaning done for excavation as guided by respective Engineer.	Lump-sum	500.00/-	500.00/-
2	Site marking as guided by Engineer.	Lump-sum	500.00/-	500.00/-
3	Excavation in moist or dry kind of hard soil, as instructed in drawing as guided by respective Engineer.	10.0 cu. m	150.0/-	1500.00/-
4	Concrete masonry wall construction as shown in drawing including curing etc. complete as guided by Engineer who is in charge.	30 cu. m.	3500.0/-	105000.00/-

The over-all cost of the check dam in rupees =1,07,500/-

5.3 Vanrai Bandhara

For places with gentle routes, Vania bandhara is suggested around more appropriate waterways. The Vania bandhara or Bunds, with firearm-packaged bags packed with local soil or sand, are rendered over a creek or small channel. Both bags are carefully sealed and positioned as a shield to the ground. This is a temporary device built along a watercourse, both to capture water and to minimize the speed of a stream in order to improve the amount of water penetration. This continues to fill the aquifer under the river bed and thus raises the amount of groundwater in the region. Usually, at the end of the monsoon, Vanrai Bandhara is established, and lasts till the next moonsoon begins.

Table -4: Estimate of Vanrai Bandhara for 1m length

Sr. No.	Specifics	Quantity	Rates (Rupees)	Amount (Rupees}
1	Bags	78	5.00	390.00
2	Labour for filling, packing, constructing.	10	200.00	2000.00
3	3 HDPE film (high density polyethylene)	2.0 m2	90.0	180.00

The total amount for 1m length of vanrai bandhara =2570/-

5.4 Rainwater Harvesting

The notion of rainwater harvesting includes "squeezing rainwater as it falls." A considerable proportion of the rainwater which falls on the surface of the earth runs into rivers and streams, eventually into the sea. The aquifer can only be recharged on average 8-12% of the cumulative runoff recharge. The rainwater extraction method involves the accumulation, whether for primary usage or to raise freshwater supplies from situated catchment areas, such as buildings, level / sloping areas etc., based on local requirements.

Table -5: Estimate of Rainwater Harvesting

Sr. No.	Specifics	Quantity	Rate (Rupees)	Amount (Rupees)
1.	P.V.C. water tank	5000 lit	3	15000.00
2.	V.C. pipe / gutter	P 25 RM	90.00	2250.00
3.	Fitting accessories	Lump-sum	500.00	500.00
4.	Plumber	2	500.00	1000.00
5.	Filter	1	800.00	800.00
6.	Support below tank	Lump-sum	1000.00	1000.00

The total cost of rainwater harvesting for one home = 20550/-

5.5 Nala Bunding

Nala bunds are nala-wide embankments intended to regulate erosion, percolate water, and increase soil humidity. The movement of surfacewater through Channel is inhibited and water is reserved in a perpendicular soil / rock superficial for a larger body by a set of tiny package or weirs in the selected nala bunds. For places with more gentle hills, Nala bands are formed by more significant streams of second order. A nala bund functions like a small tank.

Table -6: Estimate of Nala Bunding

Sr. No.	Specifics	Quantity	Rate (Rupees)	Amount (Rupees)
1	Cleaning of the area required for excavation as guided by respective Engineer.	Lump-sum	500.00/-	500.00/-
2	Marking of specific site as instructed by respective Engineer .	Lump-sum	500.00/-	500.00/-
3	Excavation done in dry or moist, hard soil, as given in drawing and as instructed by Engineer.	10.0 cu. m	150.0/-	1500.00/-
4	Construction of wall having concrete masonry as shown in drawing which includes curing and more as guided by Engineer .	15 cu. m.	3500.0/-	52500.00/-

The total amount of nala bunding in rupees =55000/-

5.6 Suitable sites for water harvesting structures

Installation of contour charts, river boundary chart, irrigation charts, land use chart, soil map as well as top sheet of Ruikhed wetlands are suitable locations for river storage systems. The following water extraction models are presented, according to morphometric research and field study.

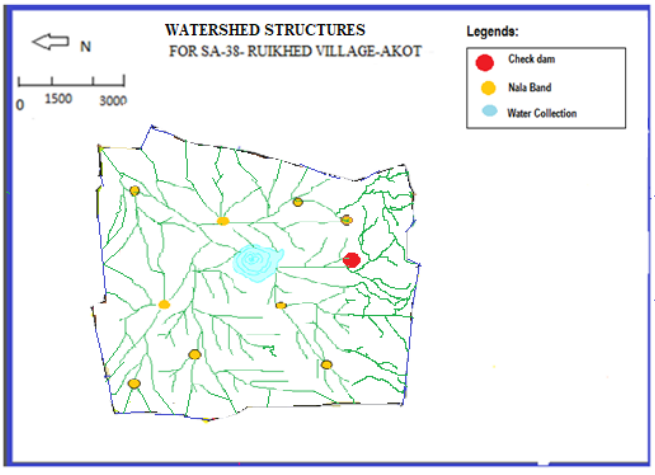

Fig -2 Water Harvesting Structures for Ruikhed Watershed

6. PROPOSED WATER STORAGE IN WATERSHED

By calculating total runoff, average demand, and availability of water in Ruikhed village, the following amount of water is proposed to be stored in suggested watershed management structures.

Table -7: Proposed Storage of Water in Watershed

Sr. No.	Type of Structure	Quantity of Structures	Water Storage (m^3)	Total Water Available (m^3)
1	Farm Pond	1	1836	1144255 m^3 per year
2	Check Dam	1	3,00,000	
3	Vanrai Bandhara	1	30,000	
4	Rainwater Harvesting	200	12419	
5	Nala Bunding	10	8,00,000	

7. CONCLUSIONS

1) The region of Ruikhed, India is absolutely depending upon precipitation for water as there is not any Perennial river available. If watershed development practices are executed, it will growth the irrigation possible, which eventually surges crop production, which will increase the standard of living and financial condition of individuals of Ruikhed, India.

2) Numerous watershed techniques like Check Dams, Farm ponds, Vanrai Bandharas, rainwater harvesting, nala bunding would be instigated to cope up with the increasing demand of water.

3) For building recommended constructions in the Ruikhed, India total of INR ₹48,35,920/- are required as the fund as per the survey carried on January 2020.

4) Such kinds of watersheds will address irrigation and drinking water issues effectively.

REFERENCES

[1] Ajay Singha,, Sudhindra N. Pandab, Veronica N.E. Uzokwec, Peter Kraused An assessment of groundwater recharge estimation techniques for sustainable resource management Elesevier Groundwater for Sustainable Development 9 (2019) 100218.

[2] B.M. Jha, Chairman & S.K.Sinha, Scientist D Towards Better Management of Ground Water Resources in India, Central Ground Water Board Bhujal Bhawan, C.G.O. Complex, NH IV, Faridabad- 121 001, Haryana, India.

[3] C. S. P Ojha, P. Nema, Techno-economic evaluation of soil aquifer treatment using primary effluent at Ahmedabad, India.Water Resources,35(9),2179-2190, ISSN 0043-1354,2001.

[4] Hadi Jafari, Abdolaziz Sudegi, Rahim Bagheri Contribution of rainfall and agricultural returns to groundwater recharge in arid areas Elsevier Journal of Hydrology 575 (2019) 1230–1238

[5] Hossein Hashemi Quantifying groundwater recharge contribution through natural and artificial recharge areas by groundwater modeling Department of Water Resources Engineering and the Center for Middle Eastern Studies, Lund University, Lund, Sweden

[6] Hussain Musa Hussain, D.C. Singhal, H. Joshi1, M.S. Rao, B. Kumar and S. Kumar GROUNDWATER RECHARGE AND QUALITY: A CASE STUDY OF ROORKEE TOWN, UTTARANCHAL National Institute of Hydrology, Roorkee-247 667, India

[7] I.P. Senanayake, D.M.D.O.K. Dissanayake, B.B. Mayadunna, W.L. Weerasekera An approach to delineate groundwater recharge potential sites in Ambalantota, Sri Lanka using G.I.S. techniques Elesevier Geoscience Frontiers 7 (2016) 115e124

[8] John M. Stiefel & Assefa M. Melesse & Michael E. McClain & René M. Price & Elizabeth P. Anderson & Narendra K. Chauhan Effects of rainwater-harvesting-induced artificial recharge on the groundwater of wells in Rajasthan, India Hydrogeology Journal (2009) 17: 2061–2073

[9] Mark Everard Community-based groundwater and ecosystem restoration in semi-arid North Rajasthan: Socio-economic progress and lessons for groundwater-dependent areas Elesevier EcosystemServices16(2015)125–135.

[10] Petra Döll, Bernhard Lehner and Frank Kaspar Global Modeling of Groundwater Recharge Proceedings of Third International Conference on Water Resources and the Environment Research, Technical University of Dresden, Germany, ISBN 3-934253-17-2, Vol. I, 27-31.

[11] T.S. Anuraga, L. Ruiz , M.S. Mohan Kumar , M. Sekhar , A. Leijnse a Estimating groundwater recharge using land use and soil data: A case study in South India Elesevier agricultural water management 84 (206) 65 –76

[12] Usman Khalid Awan , Ali Ismaeel A new technique to map groundwater recharge in irrigated areas using a SWAT model under changing climate Elesevier Journal of Hydrology 519 (2014) 1368–1382

[13] V. K. Jain, Ajai Singh, O. P.Soni. Method of artificial recharge of ground water in Madhya Pradesh, India. Advances in Water Resource and Protection 1(1),11-21,January 2013.

[14] Ground Water Year Book Of Maharashtra And Unionteritory Of Dadra And Nagar Haveli (Water Year 2014-15)(Aap 2015-16).

[15] Ramaswamy Sakthivadivel 33 First East Street, Kamarajnagar, Thiruvanmiyur, Chennai 600 041, Tamil Nadu, India The Groundwater Recharge Movement in India.

[16] Simon Chevalking, Lenneke Knoop, Frank van Steenbergen Acknowledging the contributions, inputs, comments and support from Katharine Cross (I.U.C.N.), Jac van der Gun (I.G.R.A.C.), Jaime Hoogesteger (W.U.R.), Hugo de Vos (MetaMeta), Sanne van Aarst (MetaMeta), Richard Soppe (WaterWatch), Gerhard Lichtenthaeler (G.T.Z.), Olaf Verheijen and Albert Tuinhof (Acacia Water). Ideas For Groundwater Management Issue 1 IWMI-Tata Water Policy Program Innovations in Groundwater Recharge.

[17] Central Ground Water Board Ministry Of Water Resources Guide on Artificial Recharge to Ground Water.