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Rain Water Harvesting and Artificial recharge in Haryana

Review Article

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Abstract

Rain Water Harvesting is an age-old system of collection of rainwater for future use. Statistics shows that during the last four decades, groundwater wells and tube wells have increased many fold, mainly in arid and semi-arid regions of India. The method of groundwater extraction was unplanned and uncontrolled. This caused hydrological imbalance, deterioration in water quality and the rise in energy requirements for pumping. Majority of the population in the cities today are groundwater dependent. Thus, there arises a need for augmenting the rain water through rain water harvesting and artificial recharge. Haryana state is located in the north western part of India which covers 1.35% of the geographical area of the country. The average stage of groundwater development in Haryana is 109% which indicates that groundwater withdrawal is more than its recharge per year. This recharge can be compensated by the artificial recharge and rain water harvesting. The state has 84% area feasible for artificial recharge. The recharge can be done by various methods suitable for rural and urban areas in relation with the physiographic structure of the area. This all costs Rs.1255.30 crores for the construction of 44,727 recharge structures.

Keywords: Hydrological imbalance; Groundwater development; Physiographic structure; Augment; Feasible

Introduction

Groundwater is a major source of freshwater in India. The share of groundwater in the net irrigated area is 61%, and about 60% of the irrigated food production depends on groundwater for irrigation in the country [1,2]. It provides 70% of water for domestic use in rural areas and about 50% of water for urban and industrial requirements [3]. Productivity of groundwater-irrigated areas is more than canal-irrigated areas by one-third to one-half because it offers greater control over water supply [4].

Statistics shows that during the last four decades, groundwater wells and tube wells have increased many fold, mainly in arid and semi-arid regions of India. This led to huge withdrawal of groundwater for the agriculture, industrial and domestic needs. This resource has become an important source of drinking water and food security for teeming millions of the state. The demand for water is already outstripping supply. Majority of the population in the cities today are groundwater dependent. In spite of the municipal water supply, it is not surprising to find people using private tube wells to supplement their daily water needs. The prevailing situation of India has been notorious of being poor in management of its water resources. As a result, the groundwater table is falling at an alarming rate. The stage of groundwater development is more than 100% in many blocks of Haryana, India, which indicates that groundwater withdrawal is more than its recharge per year [5].

The method of groundwater extraction was unplanned and uncontrolled. This caused hydrological imbalance, deterioration in water quality and the rise in energy requirements for pumping. Disposal of industrial effluents and sewage of cities into rivers and other water bodies has also resulted in contamination of groundwater. Therefore, immediate remedial actions need to be undertaken to avoid a national water crisis.

Natural replenishment of ground water reservoir is slow and is unable to keep pace with the excessive continued exploitation of ground water resources in various parts of the country. This has resulted in declining ground water levels in large areas of the country. In order to augment the natural supply of ground water, artificial recharge to ground water has become an important and frontal management strategy. The techniques of artificial aquifer recharge interrelate and integrate the source water to ground water reservoir and are dependent on the hydro-geological situation of the area.

Rain is a primary source of water for all of us on earth. Thus, the other secondary sources of water like rivers, lakes and groundwater are completely dependent on rain. There are two main techniques of rainwater harvesting first, is the storage of rainwater on surface for future use and second, is recharge to groundwater. Through rain water harvesting the directly collected rainwater can be stored for direct use or can be recharged into the groundwater.

Rain Water Harvesting, is an age-old system of collection of rainwater for future use. But systematic collection and recharging of ground water, is a recent development and is gaining importance as one of the most feasible and easy to implement remedy to restore the hydrological imbalance and prevent a crisis. Rain water harvesting means capturing the rain where it falls. It involves collection and storage of rainwater at surface or in sub-surface aquifer, before it is lost as surface runoff and prevention of loses evaporation and seepage. It also aimed at conservation and efficient utilization of the limited water endowment of physiographic unit like, watershed. There are various ways of water harvesting. The most common ways are capturing run-off from rooftops, capturing run-off from local catchments, capturing seasonal flood water from local streams, conserving water through watershed management.

Study Area

Haryana state is located in the north western part of India and covers an area of 44,212 sq.km. It forms 1.35% of the geographical area of the country. Around 97% of the state area is plain and known as Indo-Gangetic plain. The state forms the part of Ganga and Indus basin. The state has an average annual rainfall of 615 mm. Major part of the state is occupied by alluvium. The southern part of the state is underlain by consolidated formations of the Delhi system and northern part is underlain by Siwaliks.

Based on yield potential characteristics of aquifers, according to the Haryana central ground water cell profile the state can be divided into three zones. The first comprises of 26,090 sq.km in parts of Sirsa, Hissar, Bhiwani, Mahendergarh and Jind districts, where tube wells can yield 50 m^3/hr. The second falls in parts of Hissar, Kurukshetra, Karnal, Bhiwani and Gurgaon districts, covering an area of 7100 sq.km tube wells in this zone, which can yield between 50-150 m^3/hr. The third extends by 9200 sq.km in parts of Ambala, Kuruskshetra, Karnal and Sonepat districts, where the yield varies between 150-200 m^3/hr. An area of 1660 sq.km in parts of Gurgaon, Bhiwani and Mahendergarh districts is underlain by consolidated formations, where the yield prospects of aquifers are limited (Haryana Central Ground Water Cell).

Objective and Data Source

The present study emphasized on the rain water harvesting and artificial recharge in Haryana. It highlights the scenario of groundwater development in Haryana and the district wise cost of proposed amount for building artificial recharge structures in Haryana. It also, explains the various methods of rain water harvesting and artificial recharge to mitigate the problem of groundwater decline. The study is based on the secondary data available from the Report on "Master plan for artificial recharge to ground water in India" available from Central Ground Water Board [6].

Ground water development scenario

The minimum and maximum annual fluctuation of fall of groundwater is 0.03 m and 7.13 m in Haryana during the January 2012 to January 2013. In Haryana, the net annual replenishable ground water resource has been assessed to 9.31 BCM (Billion Cubic Meters). The Net annual ground water availability of state has been assessed to be 8.63 BCM. Net annual draft of the state has been estimated tobe 9.45 BCM. The average stage of ground water development in the state is 109%. Out of 113 assessment units, 55 blocks has been categorized as 'over exploited', 5 blocks as 'semi-critical' and 11 blocks as 'critical' and 18 as 'Safe' blocks from groundwater point of view [2].

Recharge structures and cost estimates

The main recharge structures suitable in the state are recharge shaft, horizontal trench with or without injection wells and check dams. The average cost of a recharge shaft to recharge 0.015 MCM (Million Cubic Meters) water annually will be around Rs. 2.50 lakhs and of check dam to recharge 0.04 MCM annually will be around Rs. 50 lakhs in Aravali hills and Rs. 30 lakhs in Siwaliks. The total cost of building 44,727 recharge structures required for ground water recharge will be Rs. 1255.30 crores. The district wise area feasible for artificial recharge in percent, volume of water required for recharge and cost estimates is given in Table 1.

It is estimated that influence of recharge schemes as proposed will be observed in about 16,000 sq. km and it will not only check decline in ground water level but rise of water level up to 0.5 m per year is expected. In Haryana state almost entire cultivable area in northern and eastern parts is under irrigation by surface or ground water. The area falling in southern and south western parts have less irrigation facility. The additional recharge to ground water will bring about 1, 37,000 ha of additional area under assured irrigation.

Methods and Techniques of Groundwater Recharge

The methods of groundwater recharge by augmenting the rain water are based on the area classified as urban and rural in relation with the physiographic structure of the area.

Urban areas

In urban areas, the water available from roof tops of buildings, paved and unpaved areas goes waste. This water can be used to recharge the aquifer. This needs a rain water harvesting system which is designed in a way to occupy small space for collection and recharge system. Here, roof top rain water harvesting can be a very effective tool to fight the problem of water shortage. This depends upon the

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Table 1: District wise details of artificial recharge structures in Haryana.

District	Area feasible for artificial recharge (%)	Volume of water required for recharge	Total costs (Rs. in Lakh)
Ambala	76	1041	2585.0
Panchkula	100	868	2502.5
Yamunanagar	100	1952	550.0
Kurukshetra	100	6099	8177.5
Kaithal	100	4722	14240.0
Karnal	100	4176	5042.5
Panipat	100	1865	2850.0
Sonipat	49	1305	2870.0
Rohtak	00	00	0.0
Jhajjar	18	221	3145.0
Faridabad	100	980	2742.5
Palwal	100	882	4140.0
Gurgaon	100	3421	7262.5
Mewat	55	1188	3417.5
Rewari	100	4192	11192.5
Mahendragarh	100	11019	13552.5
Bhiwani	88	12404	10992.5
Jind	87	2657	6302.5
Hisar	76	2556	4387.5
Fatehabad	100	3957	10392.5
Sirsa	100	6548	9185.0
Haryana	**84**	**72053**	**125530**

Source: Central Ground Water Board (2013)

amount of rainfall and the roof top area. Thus, larger amount of rain water is harvested from roofs with large area. A few techniques of roof top rain water harvesting in urban areas are used which involves recharge through recharge pit, recharge trench, recharge well and recharge tube well.

Rural areas

In rural areas rain water harvesting is done by considering watershed as a unit. Surface spreading techniques are common in such systems as the quantity of recharged water is also, very large. Various techniques may be used to save water going waste through slopes, rivers, rivulets and nalas. These techniques involves rain water harvesting through gully plug, contour bund, gabion structure, percolation tank, check dams, recharge shaft, dug well recharge and groundwater dams or subsurface dyke.

Conclusion

It can be concluded from above findings that rainwater, if conserved and utilized using the rainwater harvesting technology, can be an effective tool of replenishing ground water resources. The average stage of ground water development in Haryana is 109%. According to the master plan framed by CGWB, in Haryana 84% of area is feasible for artificial recharge. It will cost Rs.1255.30 crores for the construction of 44,727 recharge structures. But still most of the recharge schemes languish after completion is because of poor or no maintenance. This reduces effectiveness of recharge schemes to a great extent within few years of construction. Main reason for this is large quantity of silt that comes with rainwater. Moreover technology to exclude silt in running water before recharge should be developed. Thus, it is very important to keep separate funds under operation and maintenance every year after construction. This can easily be handled with the support of local residents. The study also, explains various methods of groundwater recharge suitable for rural and urban areas in relation with the physiographic structure of the area.

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