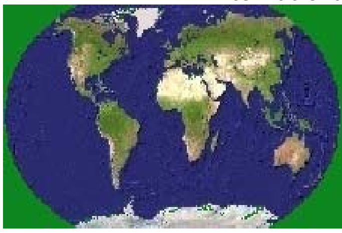

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Exploration and Management Strategy of Groundwater Resource Manasa Area, Neemuch, Madhya Pradesh, India

Eshwar Lal Dangi, Pramendra Dev

Abstract
In India, Madhya pradesh is one of such states, which faces the acute problem of water crisis, resulting in the depletion of groundwater levels and even drought phenomena. In the view of worth of water resource, it is considered desirable to carry out investigation in manasa area located in the Neemuch district of Madhya Pradesh. The study is concerned with the concept and planning of groundwater resource management by estimation of groundwater potential, groundwater recharge and groundwater draft. The groundwater potential has been determined by using rainfall infiltration and hydrodynamic methods. The Groundwater recharge and annual draft has been calculated 2880.08 x 10^4 m^3 and 11508.42 x 10^4 m^3 the over draft of the study area has been determined 704.58 x 10^4 m^3 in year 2010-2011 thus it is essential in implement a skim to reduced existing over draft of Groundwater in order to check the depleting Groundwater levels that is resulting into paucity of water supply to the populace. The prepare a plan for the exploration and management of groundwater resource to provide a curative solution to provide the demand of sustained water supply for different human applications.

Keywords: Groundwater Recharge, Rainfall infiltration, hydrodynamic methods and groundwater draft.

1. Introduction
India, Madhya pradesh is one of such states, which faces the acute problem of water crisis, resulting in the depletion of groundwater levels and even drought phenomena.
The water resource is of vital importance for the optimum development of agriculture and acts as a only potential substitute of surface water demand of populace. The groundwater resource is of immense importance due to its characteristic nature of availability at the point of use for varied applications. In the view of worth of water resource, it is considered desirable to carry out investigation in manasa area located in the Neemuch district of Madhya Pradesh, to prepare a plan for the exploration and management of groundwater resource to provide a remedial solution to cater the demand of sustained water supply for different human applications. This paper deals with the problem of groundwater resource management of a part in Manasa area Neemuch district.

Location of the study area
The present study area is located in manasa block of neemuch district, of the malwa plateau in Madhya Pradesh, within latitudes from 24^0 18' to 24^0 30' N and longitudes from 75^0 5' to 75^0 15' E (Survey of India toposheet no. 45 P/3, Figure 1). The study area covers 371 km^2 in vicinity of manasa.

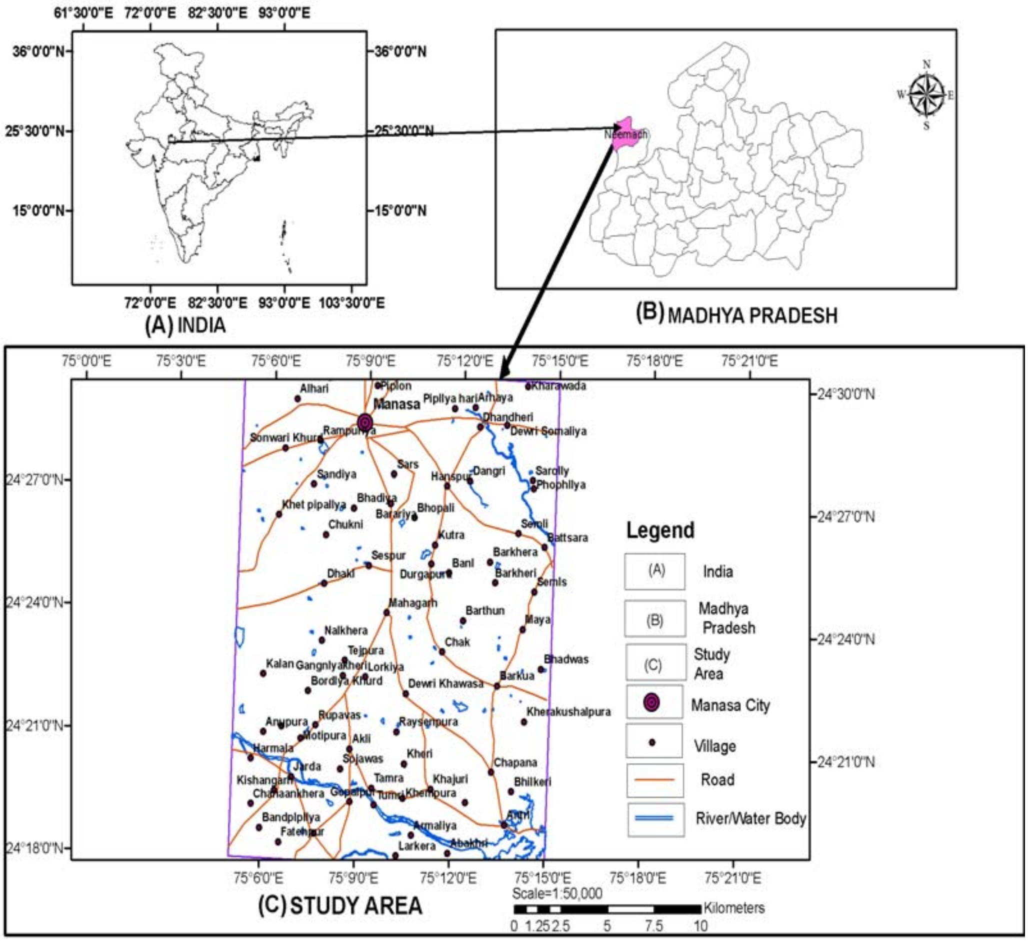

Fig 1: Location map of Manasa study area, Neemuch district, M.P.

Concept of Exploration and Management

The concept of exploration and management of groundwater resource has been discussed in this chapter. The exploration deals with the searching of a suitable location of groundwater occurrence for the exploitation. The management of groundwater resource involves the availability of groundwater quantity and suitable quality for the efficient management planning of groundwater resource for regular water supply.

Exploration planning of groundwater resource on logical ground is the vital requirement prior to exploitation in any river basin or a particular geographic area. The systematic planning of groundwater resource development requires the study of both quantity and quality of the groundwater besides the, identify and location of aquifer boundaries, extent of the aquifer, hydraulic characteristics of aquifer, hydraulic interconnection or correlation of deep, aquifer, and relations of fresh water to saline water, saline water may overlying fresh water (Nagabhushaniah, 2001; Karanth, 2003). The exploration and prospecting programmers of groundwater resource are conducted on the basis of occurrence of groundwater in sufficient quantity and good quality for exploitation.

Management of groundwater resource consists of both technical and integrated groundwater management (Burdon 1973). The technical management deals basically with technical considerations and methods. The integrated management considers wider aspects of groundwater and its integration with other sources of water, such as precipitation, surface runoff desalinated water, and extends to policy, legal socio economic as well as financing and economic aspects of management. Karanth (2003; 2009) remarked that "Overall integrated groundwater management extends the basic work of technical groundwater management into policy organizational and financial fields and more broadly, the consideration in totality of water resources, actual or potential in the basin".

Material and Mathod

Estimation of Groundwater Gotential

The present study area located in vicinity of Manasa (Neemuch district, M.P.) constitutes a part of Nimbahera limestone (Vindhyan Super Group) and comprising of different basaltic lava flows (Deccan Volcanic Province). The groundwater occurs under both unconfined and confined conditions. The hydrogeological survey involves the recording of data in respect of dug wells existing in the study area to delineate the nature of shallow groundwater system.

The estimation of groundwater potential is very essential requirement for formulation of the development planning of the study area. The groundwater potential has been computed by the use of following three methods:

(A) Rainfall infiltration method

Rainfall infiltration is the computation of groundwater potential of the study area has been adopted here in:

Total study area covered 371sq.km, which includes 37 Sq. km area covered by Limestone and 334 Sq. km area covered by Deccan traps. The procedure of groundwater potential estimation is described below:

Area covered by limestone = 37 sq. km = $37x10^6$sq.m

Area covered by Deccan trap = 334 sq km. = $334x10^6$sq.m

Average annual rainfall of the study area
862.35mm = 0.8623 m.
Rainfall infiltration index (RII) of limestone area=17 % (assumed value often Charlu and Dutt, 1982)
Rainfall infiltration index (RII) of Deccan Trap = 10% (assumed value often Charlu and Dutt, 1982)

Groundwater recharge in Limestone area
Groundwater recharge = A × Average annual rainfall x RII
= 37 x 10^6 x 0.8623 x (17/100)
= 54.238x10^4 m^3

Groundwater recharge in Deccan trap area
Groundwater recharge = A × Average annual rainfall x RII
= 334 x 10^6 x 0.8623 x (10/100)
= 2880.08 x 10^4 m^3

Groundwater recharge in total study area =
Groundwater recharge in Limestone area + Groundwater recharge in Deccan trap
Groundwater recharge of study area = 54.238x$10^4$$m^3$+2880.08 x 10^4 m^3
= 2934.318 x 10^4 m^3

(B) Hydrodynamic method
The hydrodynamic method makes its possible to often more reliable values for estimation of Groundwater recharge because it takes into account fluctuations in water levels, which reflects a real picture of the ground water regime. The hydrodynamic method has been developed by central board of irrigation and power (CBIP, 1976) and Adyalkar and Shrihari Rao (1979). Groundwater recharge data used has been calculated by using following equation.
Area covered by Limestone = 37 sq. km = 37 x 10^6sq. m
Area covered by Deccan trap = 334 sq. km = 334 x 10^6sq. m
Average annual water level fluctuation = 10.62
Specific yield for Limestone = 4% and Deccan trap = 3% (assumed value after Charlu and Dutt, 1982)

Groundwater recharge in Limestone area
Groundwater recharge = A x water level fluctuation x specific yield
= 37x10^6 x 10.62 x 4/100
= 1571.76 x 10^4 m^3

Groundwater recharge in Deccan trap area
Groundwater recharge = A x water level fluctuation x specific yield
= 334 x 10^6 x 10.62 x 3/100
= 10641.24 x 10^4 m^3

Groundwater recharge in total study area=
Groundwater recharge in Limestone area + Groundwater recharge in Deccan trap
Groundwater recharge of study area = 1571.76+10641.24 x 10^4 m^3
= 12213 x 10^4 m^3

(C) Groundwater Draft Method
Groundwater draft of the study area has been computed based on the average decline in the water levels form past monsoon to pre monsoon interval. The annual Groundwater draft of the study area has been computed by the following equation.

Area covered by Limestone = 37 sq. km = 334 x 10^6 sq. m
Area covered by Deccan trap =334 sq. km = 334 x 10^6 sq. m
Decrease in water level from past- monsoon to pre monsoon period = 10.34
Specific yield for Limestone = 4% and Deccan trap = 3% (assumed value after Charlu and Dutt, 1982)

Annual draft in Limestone area
Annual draft = A x decrease water level x specific yield
= 37 x 10^6 x 10.34 x 4/100
= 1147.74 x 10^4 m^3

Annual draft in Deccan trap area
Annual draft = A x decrease water level x specific yield
= 334 x 10^6x 10.34 x 3/100
= 10360.68 x 10^4 m^3

Annual draft in total study area=
Groundwater annual draft= Annual draft in Limestone area+ Annual draft in Deccan trap area.
Total Groundwater Annual Draft = 1147.74 x 10^4 m^3+10360.68 x 10^4 m^3
= 11508.42 x 10^4 m^3
Annual over draft of study area = 704.58 ×10^4 m^3

The Groundwater recharge and annual draft has been calculated 2880.08 x 10^4 m^3 and 11508.42 x 10^4 m^3 the over draft of the study area has been determined 704.58 x 10^4 m^3 thus it is essential in implement a skim to reduced existing over draft of Groundwater in order to check the depleting Groundwater levels that is resulting into paucity of water supply to the populace of Manasa area Neemuch district.

Result and Discussion
Groundwatr Development
The ground resource can be devolved by implementation of a plan for growth of water by natural and artificial recharge phenomena. The details of groundwater development planning are incorporated herein: (1) Natural Recharge and (2) Artificial Recharge. The natural recharge is a rather shallow process. The water through this method reaches groundwater mostly during the monsoon period. The best method for the development of groundwater system, which is followed through out world, is the artificial recharge method.
The natural recharge to the groundwater system includes deep percolation from the precipitation, seepage from streams, lakes, and subsurface underflow. The natural discharge or outflow from the groundwater body consists of seepage to streams, flow from springs, subsurface underflow, transpiration, and evaporation.
The artificial recharge has been referred as the replenishment of groundwater through action of man. The artificial recharge practices conserve water for future necessity. These practices provide solution to various problems such as salt water inclusion prevention of land subsidence, filtration of water, recovery of oil from partially depleted oil fields, disposal of liquid waste (Todd, 1980). Artificial recharge has been described by (Fetter, 1988, 1990) as "the process by which the water can be injected or added to an aquifer, the basins, drilled wells or simply the spread of water across the land surface are all means of artificial recharge" Karanth (2003, 2009) considered artificial recharge as *"the process by which infiltration of surface water into ground-water system is increased by altering natural conditions of replenishment"*.

Hence, the artificial recharge has been receiving significance in water management to cater the increasing demand. The important artificial recharge methods of groundwater system include the following: 1. Pit and trench method 2. Spreading method 3. Induced recharge well 4. Recharge well method.

Suggestion for Groundwater Management

It has been visualized that the groundwater reserves in Manasa area can be increased by the implementation of a scheme for ground water development. The concept of artificial recharge has been discussed. The construction of artificial recharge structures such as pit, trench, stop dam, pond, gully plug, percolation tank, sub surface dyke, injection well, and roof-top rain water harvesting system, have been favored for augmentation of groundwater reservoir.

The optimum management of groundwater involves estimation of both the quantity and quality of groundwater, which can be achieved by suitable implementation of a plan of groundwater increase and utilization by controlled water supply. The environmental impacts caused by the construction of artificial recharge structures can be controlled by adopting appropriate remedial measures with a view to allow pollution free water for recharging the groundwater system through artificial recharge structures in the study area.

Conclusion

In study area, the Groundwater recharge and annual draft has been calculated 2880.08 x 10^4 m^3 and 11508.42 x 10^4 m^3 the over draft of the study area has been determined 704.58 x 10^4 m^3 in year 2010-2011, thus it is essential in implement a skim to reduced existing over draft of Groundwater in order to check the depleting Groundwater levels. Since a plan, suitable suggestions have been recorded herein for the target of continued development and management of groundwater resource.

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