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Socio-Hydrogeology and its Application for Promoting Ground Water Management in India

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Abstract

In order to achieve the SDGs (Sustainable Development Goals) ground water management for protecting ground water quality and quantity has assumed a key role. Socio-Hydrogeology (SHG) is a new branch of water related sciences which promotes taking hydrogeology or the ground water science to the society, especially to the rural society and farmers, as the farmers are the greatest users of ground water. SHG stresses the need to educate the civil society regarding the principles of hydrogeology in simple language so as to ensure society's participation and cooperation in conservation and reducing pollution of ground water. In order to practise SHG, the research work and the research funds available to Universities and Government Institutes should be oriented towards solving the practical problems faced by the society. SHG includes an active role for hydrogeologists for communication with rural society about water related Geohazards like drought, flood, desertification, aquifer salinization, tsunami, etc. and for effective remediation after their occurrence. Many NGOs and industries in India, especially the cement manufacturing industries, are following the principles of 'responsible resource development' related to surface water and ground water and are in a way promoting Socio-Hydrology (SH) and Socio-Hydrogeology (SHG), respectively.

Introduction

Globally, large quantities of ground water are being pumped mainly for agricultural use, which is a consumptive use because 70% of ground water applied to the crops/orchards is used by the plants for their physical growth and is lost by transpiration and evaporation. Ground water pumpage in India, China and USA in the year 2010 was 251.00, 111.95 and 111.70 cubic kilometers respectively [1], making Indian farmers the largest user of ground water. Socio-Hydrogeology (SHG) aims at taking ground water science to farmers in a language which is easy for them to understand.

SHG is relatively a new subject on which only one or two references are available over the internet [2]. In comparison, Socio-Hydrology (SH) is an older subject and has received more attention. SH aims at understanding the co-evolutionary dynamics of human-water systems or the human-water interface. SH aims at solving various problems related to sustainability, purity and environmental impacts created by human intervention in the natural hydrological processes in river basins. SH is thus the basic science in Integrated Water Resources Management (IWRM) which is to be achieved through concerted cooperation between various stakeholders. SH also includes soil conservation which is not directly included in IWRM which in fact should have been termed as IWSM (Integrated Water and Soil Management). The farming community has to realize the importance of protecting the soil from erosion. If water from rainfall could not be managed properly during a year, there is always a chance to erect water conservation structures and improve rain water management next year. But if a kilogram of soil is lost, it takes thousands of years for the natural processes to recreate or replace it.

Since November 2005, under the UNESCO's initiative of taking sciences to the society there has been an increased activity in explaining the importance of conservation and protection of surface water and ground water resources to the society, including politicians and policy makers. Each year, on World Water Day on 22nd March, newspapers carry news and articles on water resources and the need to protect them from pollution and to use them prudently. Some of these articles also refer to the importance of ground water management and form a part of SHG.

Socio-Hydrogeology (SHG)

As mentioned earlier, SHG aims at taking ground water science to the society, especially to the rural society including farmers who are the largest end-users of surface water and ground water. In India, 89% of ground water extracted is used in the irrigation sector, making it the highest category user in the country. This is followed by ground water for domestic use which is 9% of the extracted groundwater. 50% of urban water

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requirements and 85% of rural domestic water requirements are also fulfilled by ground water [4].

The Author had his first-hand experience in SHG in 1969 when he was studying for post-graduate Diploma in ground water at Hebrew University of Jerusalem. For a news-paper in western India, he wrote a series of articles about ground water management in Israel in simple local language which the farmers would understand and appreciate.

If hydrogeology is divided into two parts; theoretical and practical; SHG belongs to the second part which is related to provision of sustainable groundwater supply of suitable quality for domestic, industrial and agricultural use. It aims at providing more information on ground water to the rural community and encouraging its involvement in resource management. During the International Water Supply and Sanitation Decade (1980-1990) rural community was actively engaged in drinking water supply management, along with hydrogeological experts from Government Departments and from NGOs. A recent paper by [2] on SHG deals with hydro-geochemical investigations and 'Bir-al-Nas' giving local villagers a sense of attachment and ownership of a dug-well providing drinking water supply. (Bir-al-Nas in Arabic means People's well).

Applying SHG at Farm Level

In order to achieve SDGs (Sustainable Development Goals) related to long-term availability of ground water for irrigation and for domestic use, the farmers need to be informed about various factors contributing to sustainability of ground water supply. SHG at farm level includes the following factors:

1) Importance of watershed management through soil and water conservation structures.

2) Importance of maintaining forest cover of appropriate species of local grasses, bushes and trees over the watersheds.

3) How to get 'more Crop per Drop' of ground water by using improved irrigation methods.

4) Importance of pumpage control in over-exploited aquifers especially in the coastal aquifers.

5) Promoting recharge augmentation during rainy season by putting decanted runoff water into dug wells and bore wells.

6) Constructing 'Percolation Tanks' on small streams for recharge augmentation after the rainy season.

7) Importance of desilting village tanks, farm ponds and percolation tanks, after every three years of rainy season.

In order to follow the principles of SHG, the hydrogeologists from NGOs, Universities and Government Departments, while doing the field work in rural areas for their research projects are expected to interact with village community and provide answers, in simple language, to questions such as those mentioned above.[3] These hydrogeologists should also try to get more information on the general ground water condition in the village and enquire about the problems, if any, faced by the community regarding quantity or quality of ground water.

Another way for hydrogeologists to promote SHG is to write books on ground water in simple, local language and also write newspaper articles on local ground water problems and suggest solutions. The Author and his father (who was one of the pioneering Hydrogeologists in India) wrote a book in Marathi language of western India. The translation of the Book's title would be "Ground Water Science Made Easy for Every One". Limaye and Limaye [5] indicating that the society appreciates such work.

The above book has highlights the importance of watershed protection and management. Watershed is the meeting point or the interface between Climatology and Hydrology-Hydrogeology. In view of the climate change and the increasing number of erratic high intensity rainstorms, this interface must be made like a shock-absorbing, resilient cushion. This cushion is created through watershed protection with forestation and with 'soil and water conservation' structures. These structures include small bunds on streams, contour bunds for farms, contour trenches on hill slopes and percolation tanks on first and second order streams. It is important to complete such works with funding from Government schemes, with technical guidance from Government Departments and NGOs, and with active participation of local villagers. During this active participation the villagers learn how these water conservation structures improve recharge to ground water and reduce runoff. Within two to three years they experience that the stream draining the watershed which used to dry-up in summer has now become perennial. The wells which used to dry-up in summer now support irrigation of small plots of vegetables or sugar-cane and bring more money to the farmers. In SHG the farmers start taking care of the water conservation structures so as to obtain sustainable benefits from them. After completing the improvement of one watershed many NGOs move over to another watershed and motivate the farmers there. NGOs therefore play an important role of promoting SHG.

SHG could also be practiced during water resources conferences. When national/international hydrogeological conferences are organized, the Organizing Committee should invite local industrialists and farmers to a 'special session' of the conference for a face-to-face interaction between the experts and the users of ground water. This has been successfully tried in some conferences organized in India by the members of Association of Global Groundwater Scientists (AGGS) and International Association of Hydrogeologists (IAH).

Today, when natural forces and human activities are both equally responsible for changing the face and the environment of planet Earth, sustainable ground water management has assumed a critical role in our efforts towards achieving SDGs (Sustainable Development Goals), especially in 'low-income - high-population' countries. Socio Hydrogeology (SHG) takes ground water science to the farmers and motivates

them for watershed protection, soil and water conservation, augmentation of ground water recharge and prudent use of ground water for domestic use and for irrigation so as to get 'more Crop per Drop' of ground water. The resulting improvement in rural health and rural economy is an important step towards achieving SDGs.

Conclusion

SHG includes empowering of the rural communities and farmers by Hydrogeologists through information on ground water resources so as to achieve a balance between ground water pumpage and recharge. It also ensures active participation of farmers in watershed management and forestation so as to achieve more recharge to ground water. In a way, SHG introduces village community to socio-friendly and eco-friendly development of ground water. Here, the principles of Geoethics [6] come very close to SHG, as Geoethics is the meeting point of Geosciences, Geo-resources, Social Sciences, Environmental Sciences and Philosophy.

References

1. http://www.ngwa.org/Fundamentals/Documents/global-groundwater-use-fact-sheet.pdf
2. Re V (2015) Incorporating the social dimension into hydrogeochemical investigations for rural development: The Bir Al-Nas approach for socio-hydrogeology. Hydrogeology Journal 23: 1293-1304. [View Article]
3. Limaye, S.D. "Socio-Hydrogeology and low-income countries: taking science to rural society" Hydrogeol Journal (2017). [View Article]
4. Suhag R (2016) Overview of ground water in India. pp. 5 Website [View Article]
5. Limaye DG, Limaye SD (2012) Sarvansathi Sulabh Bhujal Shastra 4th Edition (Ground water science made easy for everyone). Sakal Prakashan Publications. pp :156 pages. [View Article]
6. Limaye SD (2014) Geoethical approach to industrial development of Georesources and groundwater use: The Indian experience. In: Peppoloni S, Di Capua G (eds) Geo mechanics and Geology Geological Society, Special Publications, London, pp: 419. [View Article]

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