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ENVIRONMENTAL IMPACTS OF OVEREXPLOITATION

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Abstract

This paper deals with environmental Impact of over exploitation of Natural Resources in India. From Himalayan region to south Indian regions conditions of groundwater exploitation exaggerated. Littering and solid refuse disposal is increasing, being complicated by new synthetic materials that do not break down. Pollutants, refuse leakage and hazardous wastes are disposed or inappropriately, and are contaminating land, reefs and water supplies. Land clearing is not well regulated. Especially on small islands with high rainfalls poor engineering or exposed soils are especially dangerous situations special study has been made of Almora towns, Kandi region, Himalayan region, Indus- Gangetic plains, Mehsana aquifer and Crystalline aquifers of Cauvery basin.

Keyword: *Natural Resources, Groundwater Exploitation, Sustainability, Threats.*

Introduction: Nevertheless, a comparison across the country offers us a possibility of comparing across the same bias assuming similar errors due to this methodology. We first start from the Himalayan region where groundwater exploitation has not been very high, but has been showing pockets of disturbance in the past decade. Most rural areas in the mountains and towns in this region depend on spring water for their domestic and other uses. In the past, such use of spring water was not exploited on a large scale, but is now widespread and therefore leading to overexploitation. One example is that of the Almora Town .Spring water is essentially groundwater that is discharged at points where the piezometric surface intersects the ground level. Therefore, the discharge of springs is closely related to exploitation of groundwater and development activities in recharge areas of the springs. The major problem with such springs in mountain towns such as Almora is the pollution levels due to inadequate protection. This when combined with increasing use cause lowering of discharge and poor water quality. Fast developing areas in the Himalayan region such as the Doon Valley face critical problems of groundwater exploitation .Such valleys are composed of rich intermontane alluvial aquifers recharged by the springs originating in surrounding hills, in this case the Mussourie Hill region. However, there is a combined effect of the springs being diverted for other uses and high overdraft in the valley region that results in depleting groundwater levels in the Doon Valley. The Siwalik and foothill region of the Himalayas are characterized by typical groundwater problems. The Kandi region spanning from Kashmir region, Punjab and Haryana is the transitional zone between the Siwaliks and the plains . Deep groundwater tables, high speed of groundwater flow, uncertain composition of aquifers and some challenges associated with the groundwater use in this area. In such areas, even any moderate development of groundwater results in high levels of exploitation. In the Himalayan region more than in any other place, the impact of groundwater development on interaction between surface and groundwater is clearly visible. Springs are one example of this interaction. Lack of protection of recharge areas has led to drying up of a large number of such mountain springs all across the Himalayan region (Valdiya and Bartarya 1989). But this is visible in the lean season flows of the Himalayan rivers for which much of the non-monsoon flows are fed by base flow components from contributing catchments. The effluent nature of Doon Valley aquifer into the Son River is one example. Ongoing research is looking at this magnitude of base flow contribution and its variation with high groundwater development in the catchment areas.

Objectives:

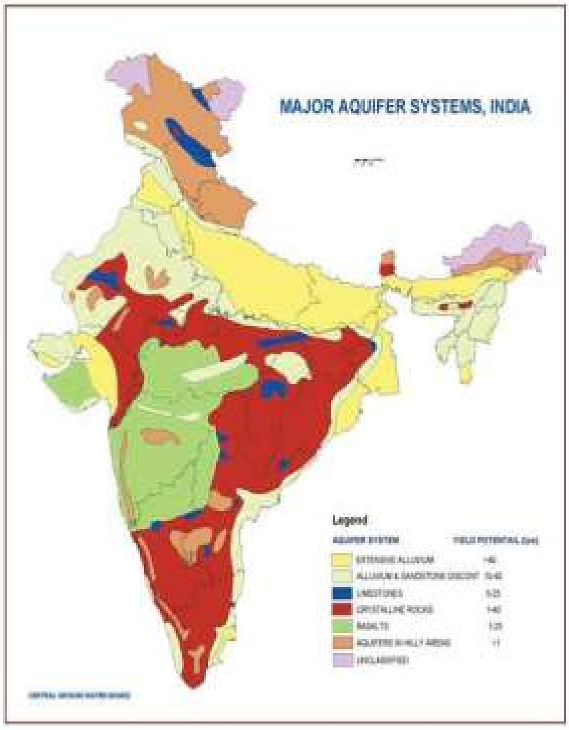
1. Study of groundwater management failure.
2. Explain specific socio-economic impacts resulting from over abstraction and pollution.
3. Anylaise intersectoral competitions between irrigated agriculture and urban water supplies.
4. Verify intense competition among water users (private and public).
5. To study competition between communities located at recharge and discharge areas of aquifer systems.
6. Anylaise competition over transboundary aquifers (exploitation and pollution).

The Indus-Gangetic Alluvial plains from Punjab up to West Bengal form the main groundwater occurring region of the country. There is a vast variation, however, in the aquifer structures, availability of groundwater and groundwater quality across this region. The Punjab plains have in the past 3-4 decades witnessed a boom in groundwater use and many authors have studied this problem of depleting water quality and fall in water .Many districts of Punjab show 100 % or greater levels of exploitation which is exhibited by a secular decline in pre-monsoon water tables except for extremely wet years. The Bist-Doab tract lying between the Beas and Sutlej rivers consists of several districts that have now local aquifers with an annual decline of more than a meter in phreatic water levels. The problem with authenticating these facts with scientific observation lies in the poor quality of data referred to earlier. Most water level data sets collected by agencies are fraught with missing data, inconsistent information and lack of agreement with local 'common sense'. An analysis of pre-monsoon water level data of Bist-Doab area of 33 monitoring wells show 22 % of missing data in the data set. The central and eastern parts of the Indus-Gangetic Plains have in general a problem of economic access to groundwater rather than actual physical scarcity. In these regions with poor rural electricity, a marginal rise in diesel prices or a few meters fall in water table results in groundwater irrigation becoming economically unfeasible for many crops and small landholders. Therefore, even a 50-60 % level of current groundwater exploitation in many of these eastern areas can cause difficult access to groundwater. The alluvial aquifers of North Gujarat are another zone of high groundwater exploitation. In the highly overexploited Mehsana aquifer, water tables have been falling at rates of more than a meter every year and currently the 5th or 6th aquifer is being used by wells that are the deepest ones in the country. Spurred by the dairy industry and high water yielding crops, this region has witnessed one of the extreme cases of groundwater overuse. This exploitation has also led to quality problems in water, especially high levels of Fluoride as a result of exploiting water of high residence time (> 1,000 years) that has led to excessive mineralization. Crystalline aquifers of Tamil Nadu show a high degree of groundwater exploitation since the past 2-3 decades. The Noyyal River basin, a sub-basin of Cauvery, is a representative example of typical problems facing other areas of the state. Increasing fluctuation of water levels in wells and secular decline has lead to high failure rate in this area. The percentage of open wells dried up was 48.68 % compared to borewells 9.99 %. Due to low specific yield, most of the hard rock regions in peninsular India have very less water bearing capacity, therefore overexploitation of groundwater reflects high fluctuations in water levels across seasons within a year. A typical stratum in hard rock terrain comprises a top soil of few cms to a meter thick followed by top weathered zones of few meters depth followed by the base rock. Due to this, competitive well deepening has led to elimination of shallow wells from the groundwater irrigation scene. This also increases well failure that can be as high as 50 % (Mayilsami et al. 2007).

Precambrian Crystalline Province-This comprises most of peninsular India from the southern tip and ranging up to Delhi. Except for most of Maharashtra state, this mass of Plutonic, Igneous and Metamorphic rocks are of contiguous extant. Groundwater occurs mostly in the weathered zone in the top 10-20 meters, but connection with deeper groundwater is observed at many locations. In most areas, the top weathered zone is underlain by mostly impermeable rock with local or regional fractures yielding storage and transport of water. These entire formations mostly are poor aquifers with low specific yield.

Precambrian Sedimentary Province-Located in 4 distinct regions of the country, these sedimentary formations mainly contain limestone, shale, sandstone, quartzite and local conglomerates. These are located in a) Cuddapah Basin of Andhra Pradesh, b) Raipur Basin of Madhya Pradesh, c) Vindhyan Basin and d) Western Rajasthan Basin. Karstification is observed in varying degrees and some local formations can be sources of springs e.g., as found in Himalayan foothills of Uttaranchal.

Gondwana Sedimentary Province-This province is located in patches of Gujarat, Rajasthan and the coal belt of Eastern India; fluvial or lacustrine consolidated to semi-consolidated shale or sandstone and is generally not highly water bearing. The total thickness of these sediments is up to 6,000 m and can be variable at different locations.



Deccan Trap Province-This is an important province comprising almost the entire state of Maharashtra and parts of others states, e.g., Saurashtra in Gujarat, Western parts of Madhya Pradesh and areas in Karnataka, Rajasthan and Andhra Pradesh. It occupies an area of 500,000 sq. km and consists of volcanic products such as tuffs, breccia, ash and intertrappean basalts. The overall thickness of these flows can be thousand meters or more in some places. Mostly, the water bearing stratum is a top weathered zone up to 50 meters. But at specific locations, the presence of individual horizontal flows can allow large amounts of groundwater storage.

Cenezoic Sedimentary Province-This comprises some coastal plains on the Malabar and Coromandel coasts and coastal areas of Kutch and Saurashtra and a region of folded rocks in the far eastern parts of the country. It is underlain by semi-consolidated conglomerates, sandstone, shale and lignite.

Cenezoic Fault Basins-Three fault basins – Narmada, Poorna and Tapi – fall within this province. These contain lenses of sand and gravel along with silt and clay. These are generally good aquifers providing a high yield. The valley fill can range from 50 m to 150 m in thickness. Groundwater quality in the Poorna Basin is highly saline and unfit for irrigation or domestic purposes.

Ganges-Brahmaputra-Indus Alluvial Province-This is the main region of groundwater occurrence in the country with deep high-yielding aquifers and several perennial rivers feeding recharge into these aquifers. Sloping down from the Himalayan foothills, the province can be divided into the a) Bhabhar: high sloping region of the foothills with unsorted sand and gravel offering high infiltration and recharge into lower areas and having deep water table b) Terai: gently sloping region beyond the Bhabhar with tongues of permeable sand, clay and gravel with shallow water table and c) Axial region of deep alluvium comprising sand, gravel and clay aquifers, multi-layered and connected with depth up to several kilometers at some locations.

Himalayan Highland Province-This is a highly folded and faulted zone of mainly sedimentary rocks extending all over the northern region of the country to the far-east. These rocks are mainly limestone, sandstone and shale with some crystalline rocks including granite. Groundwater is characterized by spring in hollows between mountains and intermontane valleys which could have sand and alluvium yielding highly. Some of these intermontane valleys also serve as conduits to recharge the lower plain aquifers. This sub-division maybe further refined in terms of groundwater provinces. When comparing statistics of groundwater across the country, the first question that crops up is what is the appropriate unit to be considered? It is common practice amongst different disciplines to use the administrative units for this purpose. But those units are less suitable for assessing groundwater. One option is to refine better this definition of groundwater provinces and consider these units as groups of districts. In consistency with the division of the country into groundwater provinces, we can classify the country into sub-regions based on these aquifer types. However, the water availability and stress on aquifers also depend on the specific river basin it lies in. For example, the alluvial aquifers of Sabarmati Basin would be much more stressed than those in say, Ganges Basin since the Sabarmati River basin is as a whole a closed river basin. With this in mind, we have divided the country into the major river basins and aquifer types taking a total of 26 river basins or sets of river basins and 7 aquifer zones. This gives a total of 182 sub-regions across the country. Some of these regions are geographic units, for e.g., the Ganges alluvium, the Basalts of Luni which is the Saurashtra basalt block, the Krishna alluvium which corresponds to the delta stretches and so on. This division can provide us with a better unit for the comparison of groundwater use and development that reflects the nature of the aquifer and water availability within the sub-region.

Impacts on Groundwater Quality Due to Overexploitation- Another level of constraint on further expansion of groundwater based irrigation is the quality of groundwater. Both inland and coastal salinity together impose restrictions on the expansion of irrigation in some areas. Pockets of coastal areas are experiencing seasonal and long term trends of inland migration of high saline water due to various reasons – increased pumping, decrease in river flow, coastal aquaculture, and tidal effects. A combination of these along with geologic and geomorphic factors cause the variable salinity along the Indian coast. We view the salinity aspect as another constraint in this picture of groundwater based irrigation. Salinity in coastal region is a widespread problem in the entire coast in the world. In order to increase the productivity of sustainable fresh water from the coast, proper mechanism of salinity should be understood thoroughly. Those need extensive study and research on meteorology, geomorphology and geology of the area. Coastal India can be divided into mainly four physiographical divisions. East coast plain, west coast plain, Gujarat plain and Indian islands are those major divisions. The East coast deltas of major rivers like Ganga, Mahanadi, Krishna, Cauveri, and Godavari are affected by salinity much more compared with the hardrock region. Intensity and mechanism of salinity in those deltas also differs depending upon their soil composition and meteorology. On the other hand, in the west coast mainly Kerala is affected by salinity due to inland movement of sea water through creeks. Gujarat coastal area is a most severely salinity affected region by combined effects of all the scenario mentioned above. And its geomorphology and meteorology are favorable to salinity. The West Bengal coastal area mainly faces tidal effects and inherent salinity.

Groundwater dependence of urban areas for each city class type.

Size class of urban centers	%Water drawn from	
	Surface source	Ground source
Metropolitan cities	88	12
Class I cities	64	36
Class II towns	52	49
Total no. of cities/towns	78	22

A combined picture of all these factors give us a scenario in which the growth of groundwater based irrigation can be thought about. These environmental constraints and urban requirements are identified here as the major factors. Many areas that have much potential in groundwater development, e.g., parts of Bihar and West Bengal, are limited by the availability of land and also affected by an energy crisis of pumping groundwater. Overall, it is clear that there are very few areas where growth in irrigation can be achieved merely by the usage of more groundwater and without improvement in more productive use of this water.

Findings of the study

Extent of groundwater exploitation: Groundwater has emerged as a productive resource in view of the limited supply of surface water and scanty rainfall in India. Nearly half of the irrigated area in the Nation is under groundwater irrigation. The compound growth rate of net irrigated area reveals that the progress in terms of groundwater irrigation development was quicker than that of surface water. There is a positive change in terms of canal irrigation due to the recent investment made by the government in canal irrigation. However, surface irrigation as a whole has shown a mixed trend in terms of contribution to net irrigated area. Irrigation as a percentage of net sown area by tank decreased. This could be due to several reasons – India is historically dependent on tank irrigation, but the region may be going through a phase wherein the old traditional collective system of tank management is collapsing with newer organisations yet to be established. It is important to note that the share of open well irrigation in net sown area declined while area under bore well irrigation increased. This indicates that farmers increasingly resorted to groundwater irrigation through bore wells as a result of progressive lowering of groundwater tables. The area under canal and bore well irrigation showed positive change over a period of time while other sources registered negative changes because of old community ownership and management shifted towards market-oriented management mechanisms and technological innovations leading to the emergence of deeper bore wells ingesting larger quantities of groundwater reserves. The nation has witnessed three stages of groundwater development since the 1950s. Each stage was unique in character, from dug wells to very deep bore wells fitted with submersible pump sets. The change in irrigation technology was also accompanied by changes in the cropping pattern. As bore well technology became widely available, the irrigated area expanded intensively with water intensive crops. This improvement was associated with several socio - economic as well as ecological implications. The irrigation intensity, an indicator of agricultural efficiency, reveals that the potential of irrigation has been declining marginally over a period of time indicating that the expansion of irrigated area could result in a negative marginal increment. The response of the state to check groundwater exploitation was in terms of policies to increase supply and curtail demand. These policies include direct and indirect forms of regulations. Adoption of the model bill and creation of regulatory authorities were the direct forms of regulation to check over exploitation of groundwater. The control on institutional finance was an indirect form of regulation. Unfortunately, the indirect form of regulation was inequitable in its effect on access to groundwater resources for the poor marginalised farmer. Neither the direct nor the indirect forms of regulations were helpful in checking the over-exploitation of groundwater in the state. Therefore, exploitation of groundwater resources for private gains continued.

Conclusion:

1. Increasing use cause lowering of discharge and poor water quality.
2. The hard rock regions in peninsular India have very less water bearing capacity, therefore overexploitation of groundwater reflects high fluctuations in water levels
3. The water availability and stress on aquifers also depend on the specific river basin it lies in pockets of coastal areas are experiencing seasonal and long term trends of inland migration of high saline water due to various reasons – increased pumping, decrease in river flow, coastal aquaculture, and tidal effects.
4. There are very few areas where growth in irrigation can be achieved merely by the usage of more groundwater and without improvement in more productive use of this water.
5. Littering and solid refuse disposal is increasing, being complicated by new synthetic materials that do not break down. Pollutants, refuse leakage and hazardous wastes are disposed of inappropriately, and are contaminating land, reefs and water supplies.

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