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Problems of Groundwater of Pakur District: A Geographical Study

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ABSTRACT: Groundwater has played an important role in the maintenance of India's as well as Pakur's economy, environment and standard of living. India is the largest groundwater user in the world. Through the construction of millions of private wells, there has been a phenomenal growth in the exploitation of groundwater in the last five decades. The factors driving this expansion include poor public irrigation and drinking water delivery, new pump technologies, the flexibility and timeliness of groundwater supply, and government electricity subsidies. As a result, 29 percent of the groundwater assessment blocks in the country are classified in semi-critical, critical, or overexploited categories with the situation deteriorating rapidly.

Keywords: Groundwater, environment, phenomenal, technologies, flexibility,

I. INTRODUCTION

The district average annual rainfall is not much abundant by national level, yet. much of this rain falls in relatively brief deluges during the monsoon and there is great disparity across different regions. However, these happenings are resulting in a rapid and very worrying deterioration in the district groundwater resources, a deterioration that is underlined by current events. Groundwater comprises 97 percent of the world's readily accessible freshwater and provides the rural, urban, industrial and irrigation water supply needs of 2 billion people around the world. As the more easily accessed surface water resources are already being used, pressure on groundwater is growing. The government has no direct control over the groundwater use by millions of private well owners, both in rural and urban areas. In part, this is due to the absence of a systematic registering of wells with attached user rights and metering. In an indirect way, groundwater use is sometimes limited through power shedding with limited hours of electricity supply, especially in rural areas. The potential social and economic consequences of continued weak or nonexistent groundwater management are serious. Aquifer depletion is concentrated in many of the most populated and economically productive areas—and the consequences will be most severe for the poor. Furthermore, climate change will put additional stress on groundwater resources, while at the same time having an unpredictable impact on groundwater recharge and or extraction availability. Widespread groundwater pollution could render the resource useless before it is exhausted. It also must be noted that indiscriminate abstraction of groundwater aggravates the quality problems, and thus a well integrated management approach to the resource quality and quantity is needed. A gradual approach is needed to improve groundwater management within the existing institutional framework and available information. Groundwater is fundamental to the nation's water security and the degradation of this resource may prove a threat to economic and social development. Prominent drivers of over extraction include: inefficient usage, energy subsidies in agriculture, pollution, and population growth. The public good characteristics of aquifers compel strong government regulation, but this is proving difficult to Pakur's achieve in India. Water security is widely recognized as one of the major challenges to economic and social development

II. REVIEW OF LITERATURE

The water table has fallen too quickly due to the lack of replenishment from the rains and over extraction. Tube-wells which have been production are now dry. Water shortages are currently widespread in some major cities, and these were experienced across the country during the 2009 drought. While a lack of reservoir infrastructure is also a contributing factor to current shortages, the fact that groundwater resources are proving inadequate to compensate as before indicates that what was once a problem of long-term sustainability has developed into an urgent crisis one that is fundamental to India's broader water security today and for a long time to come. Groundwater is a critical resource in the country, accounting for over 65% of irrigation water and 85% of drinking water supplies (**World Bank, 2010**). Urban water supply infrastructure is often poor and unreliable: well drilling is typically the most economic means of obtaining household water (**World Bank, 2010**). The problems are going to get worse unless urgent remedial measures are taken. So, we have some sense of why India's groundwater is being unsustainably exploited, but why is this so important? Aside from the physical absence of the resource, the state of groundwater quality in India is a critical health issue (**Chakraborti, Das and Murrill, 2011).**

In the last few decades, this pressure has been evident through rapidly increasing pumping of groundwater, accelerated by the availability of cheap drilling and pumping technologies and, in some countries, energy subsidies that distort decisions about exploiting groundwater. This accelerated growth in groundwater exploitation—unplanned, unmanaged, and largely invisible— has been dubbed by prominent hydro geologists—the silent revolution. It is a paradox that such a vast and highly valuable resource—which is likely to become even more important as climate change increasingly affects surface water sources—has been so neglected by governments and the development community at a time when interest and support for the water sector as a whole is at an all-time high (**Héctor and others, 2011**).

Study Area (Pakur District)

The district Pakur,is located between 21^0 58'N to 25^0 18' N and 83^0 22' E to 87^0 58'E in the north eastern part of the state of Jharkhand, is surrounded by Sahibganj, Dumka, Godda, and state of West Bengal. This hilly district structured by Rajmahal trap's rock type, alluvium, Laterite and Gondawana have the geological formation, with geographical area of 1805.59 Sq. km.The district posses as 9.00422 lakh population. The district is rich in natural resources like Coal, Forest resource etc. The area and population of district are 2.27% & 2.83% of the state respectively. After the formation of the district in 1994, insufficiency of water is continuously widened, people ofthe district often desire to settle near water resource of the region. Almost all major rivers become dry in the district most of year while shows the scarcity of water. Groundwater level is continuously decreasing due to overexploitation of water in crop producing area in the district. Because of falling groundwater table, people are making deeper hand pump or boring gradually. While recharging rateof underground water is much lesser than withdrawal of water. It is a hilly region and an emerging district, having monoculture (mostly paddy) agriculture. Due to cultivation surface soil continue to be used and degraded, so food grain production is always become lesser than previous year. Area of Agricultural land is also gradually decreasing due to roads, factories, construction of houses and urbanization. Besides the soil degradation and erosion also help to decrease agricultural production. The inflated rate of urbanization and industrialization of the district, water demand has increased for the sector of agriculture, industry, and for urban areas. Therefore the use of this natural resource should be reasonable for enhancing socio-economic condition of this district.

III. DATABASE AND METHODOLOGY

This present paper is based on government offices reports, some primary observations, researches conducted by the research scholars, review of related literatures, websites, Published reports and articles by different states, central government, local bodies and NGO's secondary data collected. All data sources have been applied to have a conception of the water conservation and management problem in the study area.

Problems Related To Water Logging

- Water logging
- Groundwater recharge
- Slimity and alkalinity
- Drought
- Over-exploitation of

- Water losses during transit and application
- Decling water table
- Deterioration of groundwater quality
- Ignorance of farmers towards rational

Water logging is a situation when the water-table rises to an extent that soil-pores in the root zone area saturated, thus suffocating the crop roots. Water logging can also be caused by excess soil moisture due to periodic flooding, overflow by runoff, over-irrigation, seepage and impeded subsurface drainage. An agricultural land is said to be water logged when water saturates the root zone of the crop normally grown in the area and cuts off the normal circulation of the air of the soil in the root zone. This adversely reduces the yield of the land. However, the water table in the study area is generally sufficiently below the ground level. Therefore, the rise of groundwater under capillary processes does not affect growth of plants. In fact, the average groundwater level is 8 m. in 60.69 per cent of the study area, while, it is below 3-5 m. in 36.82 per cent. In total approximately 99.64 per cent of the study area has groundwater level 8 m. below ground level (bgl.) during pre- monsoon period (Tab. 3.4 a. and 3.4 b.).

Major parts of the study area come under less than 10 m. of groundwater level in monsoon period whereas, 0.36 per cent of the study area has deeper than 8 m. of groundwater level (Tab. 3.4 a. and 3.4 b.). Low land areas, in the middle (mainly Maheshpur block) and northern part (mainly Pakur and Hiranpur blocks) suffer from water logging to some extent.. The problem of water logging is serious to a limited extent in parts of pakur main canal area (mainly in Pakur block) where expanse of fertile lands become water logged. The position may further deteriorate when canals run to their maximum capacities.

Table 1: District Pakur: Waterlogged Areas During Heavy Rainfall Years

Blocks	ReportedAreas (ha)	Waterlogged Area (ha)		Total Waterlogged Area (ha)
		Area ofDrains	Area of Plain Land Along Natural Drains	
Pakur	221.71	50	98	148
Hiranpur	273.29	13	48	61
Maheshpur	448.93	45	96	141
Amrapara	413.05	88	102	190
Litipara	169.60	12	16	28
Pakuria	279.01	09	17	26
Total District	1805.59	217	377	594

Source: I. Flood and Waterlogging Problems in District of Jharkhand. National Geographer, Vol. XXXV, No. 1+2+3 (Jn., July-Dec. 2008), Page 98-152.

II. Unpublished data collected from the office of the Groundwater department Dumka-32, Dumka and E.E., Irrigation Division, Dumka, Santhal Parga

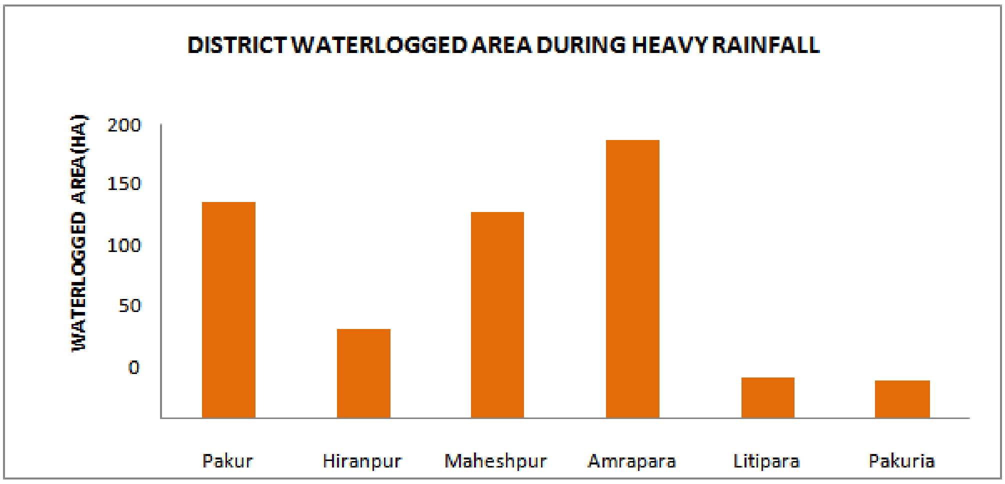

Fig:1

The block-wise waterlogged areas are given in Table 1. Maximum waterlogged area is found in (Amrapara block) (190 ha) due to over-irrigation whereas minimum is in (Pakuria block) Block (26 ha) (Fig. 6.3). The problem of water logging is due to inadequate surface drainage, seepage from canal systems, over irrigation of fields, obstruction of natural drainage. The seepage of the canal water from (Pakur block) main canal and its distributaries (Hiranpur); canal's distributaries (Maheshpur block); block main canal and other distributaries (Pakur block);other distributaries and some minor (Pakuria block) creates water logged areas (Fig.1, 2 and 3). The problem is accentuated due to poor drainage condition in the study area.

Problems Related To Groundwater Recharge

Those alluvial areas where coarse sand with kankar is found have better aquifer and much amount of groundwater resources. Through the hydro-geological study with the help of strata chartit has been found that upper surface of north-western part of the study area is covered with 50 m thick clay layer. After that depth of 52 m, a 54 m thick aquifer with kankar and sand is found. So, this part of study area is recharged by the Banshloi River throughout the year. Northern parts of the study area have good aquifer because of fine sand, medium sand and clay with inclusion of kankar whereas, middle and southern parts of the study area do not have good aquifers due to thick formation of clay and hard rocks which do not allow rain water to percolate. Therefore, groundwater does not get recharged properly through natural process in the area.

Problems Related To Soil Salinity and Alkalinity

Soils having soluble salts in the potential crop root zone, to the extent that they interfere with the growth of most crop plants, are called saline soils. The saline soil contains excess of sodium salts while the clay complex still contains preponderance

Table 2: District Pakur: Distribution of Salt Affected Soil (Usar)

Blocks	Total ReportedArea (ha)	Usar Area (ha)			Total Usar Area (ha)
		A Class	B Class	C Class	
Pakur	21821	133	737	168	1038
Amrapara	41305	825	2265	606	3696
Maheshpur	44893	243	667	178	1088
Hiranpur	27329	184	706	133	1023
Litipara	16960	343	1317	323	1983
Pakuria	27901	777	1933	566	3276
Total Rural	180209	2505	7625	1974	12104
Total Urban	350				--
Total District	180559	2505	7625	1974	12104

Source: I. Flood and Waterlogging Problems in District of Jharkhand . National Geographer, Vol. XXXV, No. 1+2+3 (Jn., July-Dec. 2008), Page 87-121.
II. Unpublished data collected from the office of the Soil Conservation Officer, Dumka

The presence of chloride and sulphate of sodium gives a white colour to the encrustation formed on the surface and the soil is known as white alkali. If the water table of a saline soil recedes and the precipitation is sufficient to wash down the soluble salts, it gives rise to alkali soils. During the washing out of the salts from the surface layer, the calcium clay that is normally present in saline soil is converted into sodium clay.

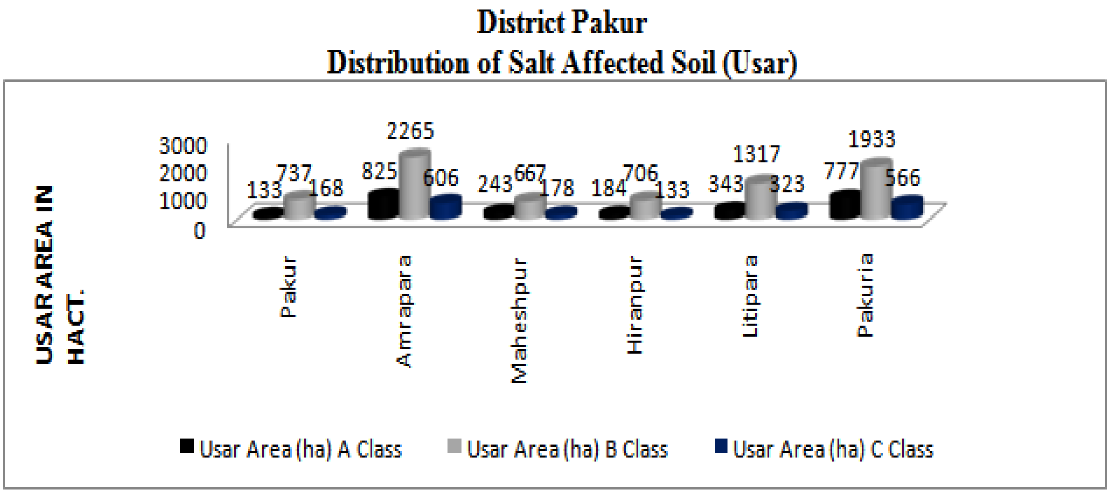

Fig: 2

Sodium clay is easily dispersed and is washed down in the lower layer, where it forms horizon 'B'. The soil becomes alkaline due to the presence of sodium carbonate liberated in these soils. The pH of alkali soils is usually more than 8.5 and exchangeable sodium constitutes more than 15 per centof total exchangeable captions.

The block wise distribution of usar lands are given in Table 2 and Figure 6.4, 6.5 and 6.6. Thus, the problem of soil salinity and alkalinity arises mainly due to high concentration of soluble salts of calcium, magnesium and sodium in the soil. During Rains, the salts are leached down from the upper layer and in some cases, they accumulate in the lower layer if the drainage is impeded. During the dry season, due to evaporation the salt moves up the root zone or even on the ground surface. The leaching and evaporation processes thus lead to the development of saline and alkaline soils. This badly affects the agriculture, soil fertility and plant growth and it converts fertile land into barren land. In the study area almost 18 per cent of total reported area is suffering from saline and alkaline problem. The block wise figure and pattern of distribution is not available. As mentioned earlier this problem is directly related to water logging. It occurs in patches along the canal irrigated area mainly in Maheshpur, Pakuria and Pakur blocks. The seepage of water through canals, inadequate surface drainage and submergence due to floods are some of the noticeable causes of the development of this problem.

Problems Related To Drought

When amount of water available from precipitation and soil moisture is not sufficient to meet the demand of evapotranspiration, a condition of water deficit occurs and is known as drought. The National Irrigation Commission (1972) has defined that an area receiving less than 75 cm of annual rainfall is liable to suffer from drought conditions. When rainfall deficit is between 25 per cent and 50 per cent below the normal rainfall, the drought is termed as moderate and when the deficit is in excess of 50 per cent it is known as severe drought. Drought in Pakur district occurred in 2002,2004, 2008, 2014,2016, 2018 and 2022 and moderate drought occurred in 2010. The drought caused almost complete damage to paddy and other kharif crops during the years.

Problems Related To Over-Exploitation of Groundwater Resources

The major problems associated with unscientific and unregulated development of groundwater is over-exploitation of groundwater resource leading to a fall of water level in tube-wells and pumping sets and causing failure of the wells and tube-wells or deepening of structures resulting in higher cost of pumping. is depleting fast in many areas due to its large scale withdrawal by various sectors.

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Table 3: District Pakur: Groundwater Development 2016-17

Blocks	**Gross Groundwater Recharge (ham)**	**Total Irrigated Groundwater Draft (ham)**	**Balance**	**Stage of Groundwater Development (per cent)**	**Category of Blocks**
Amrapara	4727.80	4174.51	553.29	88.30	**Semi-critical**
Litipara	5803.29	3111.88	2691.41	53.62	**LessCritical**
Pakuria	4870.57	4492.59	377.98	92.23	**SemiCritical**
Maheshpur	5472.58	4920.14	552.44	89.90	**Semi-critical**
Hiranpur	5449.84	3906.13	1543.71	71.67	**Semi-critical**
Pakur	4097.03	6185.60	-2088.6	150.98	**Critical**
Total District	**30421.11**	**30190.85**	**3630.23**	**91.11**	**SemiCritical**

Source: Computed on the basis of Table 3.9 and 5.6.

Due to rapid increase in groundwater irrigation means and lack of surface water irrigation in all blocks, there is the problem of over-exploitation of ground water in all blocks of the study area. As is evident from Table 3 and Fig. 6.7 that total ground water utilization in the study area is 91.11 per cent of the net ground water recharge but at spatial level it varies from 53.62 per cent in Litipara to 150.98 per cent in Pakur block.

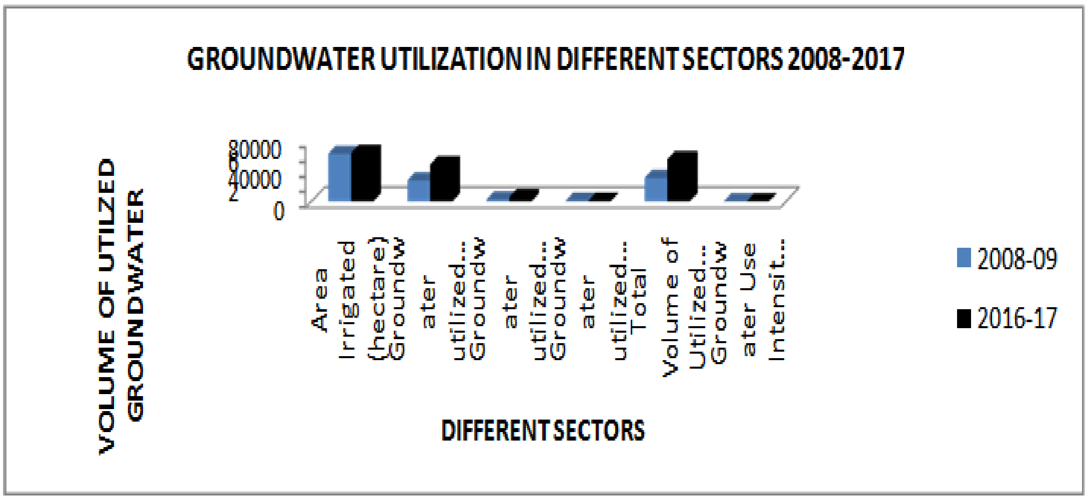

Fig: 3

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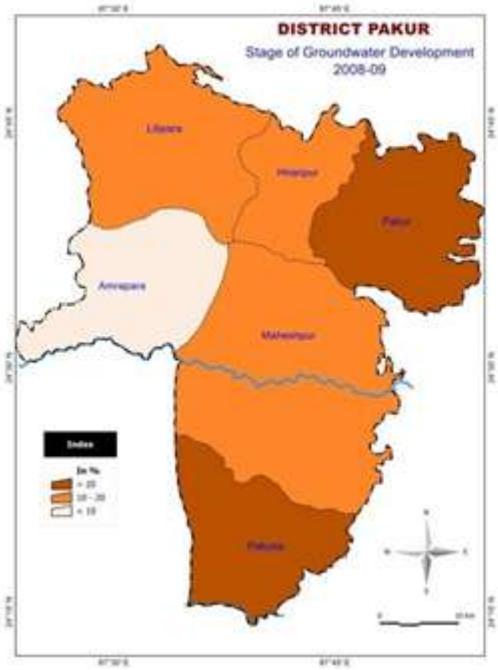

Fig: 4

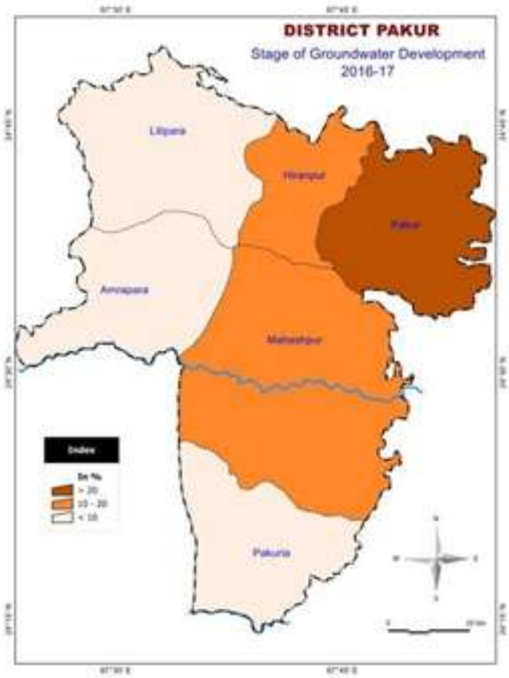

Fig: 5

Pakur (150.98 per cent), Pakuria (92.23 per cent) block with irrigation more than 90% falls under critical category and thus, further development of ground water is not allowed by 'NABARD'. Another block Amrapara (88.30 per cent), Maheshpur (89.90 per cent), Hiranpur (71.67 per cent) comes under 'semi-critical' category and there is limited scope for ground water development. None of the block is in 'safe' category. The problem of over-exploitation in Litipara and Pakuria block is related to increase in number of ground water-irrigation means and lack of canal irrigation.

According to irrigation intensity (Tab. 5.3) Litipara block has shown the highest percentage change (+32.81) between 2008-09 and 2016-17

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followed by Amrapara (+15.08) and Pakur (+11.35). Maheshpur (1.13) and Hiranpur (1.12) fall under the highest irrigation development index category due to percentage increase of gross irrigated area to cultivable area (Tab. 5.5). Similarly, intensity of groundwater utilization has increased more than twice in Amrapara block (21 per cent in 2008-09 to 50.48 per cent in 2016-17) and in Pakuria block (31.06 per cent in 2008-09 to 61.99 per cent in 2016-17) due to the highest increase in private tube-wells (+177.42 per cent) and pumping sets (+65.48 per cent) during the period 2008-09 and 2016-17. Thus, an unplanned growth in groundwater irrigation means has been the main factor responsible for over-exploitation of groundwater and the decline in water table and groundwater reservoir.

Problems Related To Water Losses During Transit And Application

The water management efficiency in agriculture in the study region remains very low, implying that the existing system of operation, distribution and use of groundwater resource is inadequate. Heavy losses of water take place at various stages in the irrigation system during transit and application in the field. According to **National Irrigation Commission (1972**) about 45 per cent of water is lost as seepage in transit before reaching the field. In high textured soils and poorly managed and operated transit system these losses are much higher.

In the study area about 84.86 per cent and 89.62 per cent of the total groundwater has been used in irrigation in 2008-09 and 2016-17 respectively (Tab. 5.3). Application losses on the field, following adoption of faulty irrigation practices and seepage from canal system account for about half of the water.

In the study area irrigation water losses are mainly due to the over-irrigation and by seepage from canal system as most of the canals are unlined and groundwater irrigation is dominated by unlined open field channels. So, there are the chances of more water losses. The total amount of groundwater seepage from canal is 1088.46 ham. the return seepage from irrigated fields in thestudy area accounts to 958.33 ham. i.e. 35 per cent of the total released at canal outlets i.e.2956.9 ham (Tab. 3.10).

Problems Related To Declining Of Groundwater Table Alluvial deposits comprising medium to coarse grained sands and gravel are the main source of ground water supply for the shallow and deep tube-wells of the study area. Water table depth data shows that due to rapid development of ground water irrigation means and increase in ground water irrigated areas, water table is going down in some areas of Pakur, Hiranpur, Maheshpur and pakuria blocks. The maximum pre-monsoon water table decline has been 0.125 m (Hiranpur), 0.042 m (Amrapara) and 0.017 m (Litipara) during 2008-09 to 2016-17 (Fig. 3.6). While maximum pre-monsoon decline has been .223 m in Maheshpur, block during the same period. The maximum decline of water table in Pakuria and Pakur is associated with the less-availability of canal irrigation in these blocks (Table 3.4).

Problems Related To Deterioration Of Groundwater Quality

There is deterioration in quality of ground water due to heavy pumping and use of chemical fertilizers and pesticides. Ground water of the study area is of moderate quality, and it can be used safely only in permeable soils. The ground water near Litipara with medium salinity and medium sodium hazards falls under C_3 S1 group and is not suitable for irrigation (**Rai, 2004**).

The quality of groundwater changes as it passes through the water distribution system. Groundwater quality deterioration affects every sector of water resource. The source of water pollution from industrial effluents, poorly treated sewage and runoff of the agricultural chemicals combined with unsatisfactory household and community sanitary conditions. Agriculture causes pollution of ground and surface water by nutrients and pesticides, as a consequence of leaching nitrate and phosphate concentration in groundwater has been rising. This deterioration of the groundwater quality is due to less use of organic manures and increasing use of inorganic fertilizers which also damage the physical structure of the soil besides affecting its water holding capacity. Groundwater quality is also being affected by wastewater infiltration into subsoil. Due to ingress of saline water in other areas, water has become unusable.

In the study area as stated earlier the quality of groundwater in some parts of Litipara block is bad having high electrical conductivity (EC) of more than 762 micro mhos/cm. Similarly, high TDS is found in Litipara, Hiranpur Pakur and Maheshpur (more than 320) and a high degree of hardness makes the water unsuitable for drinking, irrigation and industrial purposes (Fig 4.5).

The pH value is more than 8 over the entire area but the highest pH value of 8.22 is found in Pakuria block. This may be attributed to the presence of white kankar formation at depth in the soil profile which supplies the required

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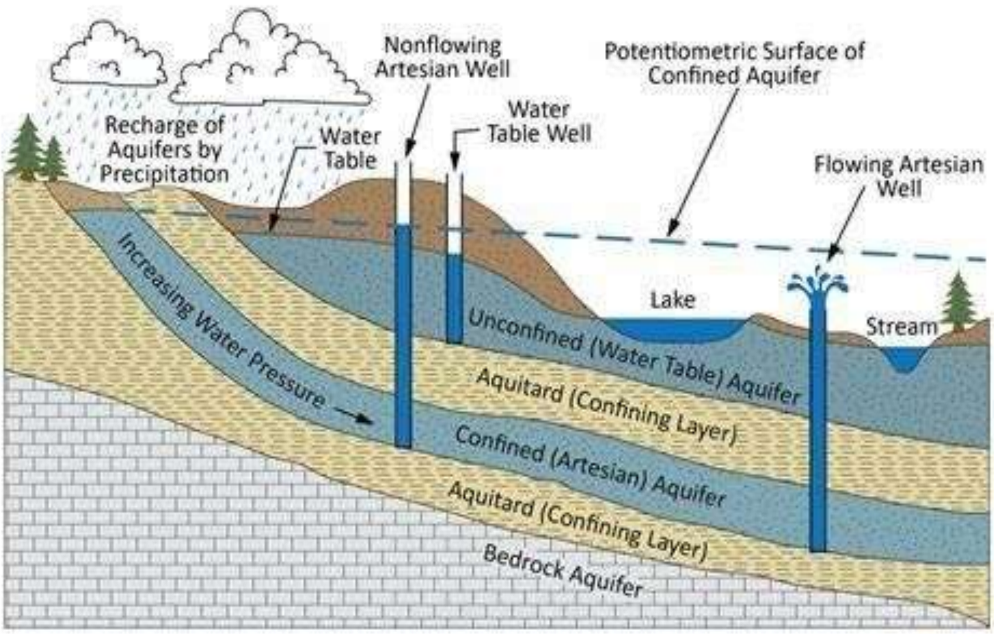
$CaCO_3$ to the groundwater to keep it under alkaline condition Pakuria and litipara block comes under the medium to high saline category due to high electrical conductivity (762 µs/cm) (Tab.4.5, 4.7, 4.8 and Fig. 4.1, 4.3). So, this type of groundwater is safe only in permeable soils and moderate leaching. This part of study area falls under **C_3S_1** category of sodium hazard (SAR) due to high percentage of sodium in soils (Tab.4.5 and Fig. 4.3). In all blocks of the study area the groundwater is hard. Very hard groundwater is found in Amrapara, Pakur,and Litipara blocks. The groundwater in Litipara blocks is extremely hard, which is not suitable for agricultural puposes (Tab. 4.9, 4.10 and Fig. 4.4). As for drinking purposes, the groundwater in Litipara and Maheshpur block has medium chloride contents (37 ppm) (Tab. 4.5). this has moderate groundwater quality. Therefore, suitability of groundwater for irrigation is safe only with permeable soils and moderate leaching. It is due to 762 µs/cm electrical conductivity, 495 TDS, 800 pH value, 273 ppm of bicarbonate, 60 ppm sulphate ions, 39.20 ppm of calcium ions,48.41 ppm of hardness, 0.86 ppm of SAR and 47.61 Permeability Index in groundwater.

Problems Related To Ignorance Of Farmers Towards Rational Groundwater Use

Lack of knowledge and awareness in farmers of the study area regarding water use for irrigation creates problems for the crops growth and production. The appalling ignorance of the famers about the rational scheduling of irrigation in crops is a big hurdle to efficient use of the irrigation groundwater in the study area. Over-irrigation, field to field irrigation, uncontrolled and untimely irrigation without any regard to soil characteristics, critical stage of plant growth, evaporative demand, applied inputs etc. lead to canal irrigated area of middle, western and the northern part of the study area.



Conservation and Planning of Groundwater Resources

The unplanned and non-scientific development of ground water resources, mostly driven by individual initiatives has led to an increasing stress on the available resources. The adverse impacts can be observed in the form of long-term decline of ground water levels, de-saturation of aquifer zones, increased energy consumption for lifting water from progressively deeper levels and quality deterioration due to saline water intrusion in coastal areas in different parts of the country. On the other hand, there are areas in the country, where ground water development is still at low level in spite of the availability of sufficient resources. Similarly, the canal command areas suffer from problems of water logging and soil salinity due to the gradual rise in ground water levels (**Jha, 2007**). In addition to the sufficient availability of replenishable ground water resources in the phreatic zone, there is a vast in-storage ground water resource in the deeper zones i.e. below the zone of ground water fluctuation. The estimates of in storage ground water resources on the prorate basis up-to a depth of 400 m works out to be 10812 bcm , out of which nearly 10633 bcm is available in the areas occupied by alluvial and unconsolidated formations. Surprisingly the three major states occupying the alluvial plains i.e. Uttar Pradesh, Bihar Jharkhandand West Bengal, have a share of the in storage ground water resources to the tune of 7652 bcm which is more than 70% of the total (**Jha & Sinha, 2012**).

In this context there is an urgent need to explore various befitting options for optimal utilization of these resources In order to address various issues related to ground water, keeping in view the climatic change, there is a need to prepare a comprehensive road map with identified strategies for scientific and sustainable management of the available ground water resources in the country so as to avert the looming water crisis. In addition to addressing the issues of declining water level, the strategies should also focus on the imbalances in ground water development in the country, reasons thereof and suggesting measures including accelerated development of ground water in areas with low stage of ground water development. Therefore, conservation of groundwater resources becomes of great significance for the development of an area in a socio-ecological frame. Besides, all plans and programmes, true conservation is ultimately something of the mind, i.e., human awareness regarding use and misuse and responsibility towards future generation. In general, the aim is to obtain water in required quantity and quality at the least coast. Thus, the central issue in water resources planning is to match the supply and demand imbalance through structural facilities of storage, conveyance application and their operation.

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