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Abstract:

Human wellbeing and environmental sustainability are the key factors for economic development, which are directly dependent on the water source. Water resources of the state continue to play a crucial role in the sustainable development of the states in the years to come. Groundwater is another vital source for meeting nearly half of the demand for irrigation, industrial production, and municipal water needs for both rural and urban areas. Underdeveloped countries depend on the primary sector more for their livelihood, and groundwater resource is the primary source for their agronomic practices. Because 1/3rd of the agricultural land depends on rainfall in India, the others have been cultivated with surface water and groundwater resources. The surface water source will not be available longer than groundwater. Farmers depend more on groundwater. Due to large output and productivity nowadays, farmers have been digging more bore wells in the land than required and, at the same time-consuming, more power to lift water. These scenarios destroy the agricultural lands' quality of soil by over lifting the water, and there might be land sliding, groundwater exploitation, loss of fossil water, etc.

Agricultural dependency has been declining for several reasons, and if agriculture continues the exploitation scenario, what are the severe problems for the future generation? Therefore, the study aims to analyze the influence of the exploitation of groundwater resources through digging bore wells on the sustainability of agricultural lands. The study planned to consider the primary and secondary data using descriptive research analysis.

Keywords: Groundwater, Sustainable agriculture, Fossil water, land sliding.

Introduction:

Underdeveloped countries depend on the primary sector more for their livelihood, and groundwater resource is the primary source for their agronomic practices. Because 1/3rd of the agricultural land depends on rainfall in India, the others have been cultivated with surface water and groundwater resources. Due to less surface water resources, farmers are digging more bore wells and consuming more without consideration for the next generation. Human

well-being and environmental sustainability are the key factors for economic development, which are directly dependent on the water source. Water resources of the state continue to play a crucial role in the sustainable development of the state in the years to come. Groundwater is another vital source for meeting nearly half of the demand for irrigation, industrial production, and municipal water needs for both rural and urban areas. The surface water source will not be available longer than groundwater, so farmers depend more on groundwater. Due to huge output and productivity, farmers have been digging more bore wells in the land than required while consuming more power to lift water. These scenarios destroy the agricultural land quality of soil by over lifting the water, and there might be land sliding, exploitation of groundwater, loss of fossil water, etc.

The crisis of water resources, management and development, has been getting severe today due to uneven spatial distribution of the required quantity of water resources. Excess use of groundwater for irrigation has been adversely impacting the need for drinking water in recent years, directly impacting the quality and quantity of groundwater. Better groundwater management practices and planning for artificial groundwater recharge can only improve groundwater resource sustainability in the coming years. Due to the continuous withdrawal of groundwater to meet the demand, dug wells tapping the phreatic aquifers have been dry for the last two decades, which has had a tremendous impact on the phreatic aquifer system, surface water bodies and rural water supply schemes in the area and also on the quality of groundwater (S N Ramaiah et al. 2017).

There is little evidence of agricultural adaptation due to wells drying up. Farmers take up a relatively higher proportion of off-farm employment opportunities in areas with a more developed manufacturing sector. Water scarcity and other environmental changes may dramatically affect global food security, social stability, and progress toward achieving Sustainable Development Goals (SDGs). Natural resource development planning, particularly groundwater resources, is a significant aspect. It is emerging to have information about the magnitude and extent of its availability for exploitation to ensure a continuous supply and to avoid the danger of overexploitation and other harmful effects (Jacob et al. 1999).

In India, even though the surface water gets renewed through the monsoon season, most areas face a severe scarcity of drinking water, irrigation and industrial needs of society. More than 85 per cent of the water supply is needed for irrigation and drinking water in rural areas in India, which groundwater resources maintain. The groundwater-surface water crisis is

becoming scarce due to indiscriminate exploitation to meet the requirements of the ever-increasing demands of the growing population. The importance of groundwater has been recognized, and greater emphasis is being laid on its judicial use and better management (Anuradha et al. 2010). According to pessimists, millions of "water refugees" might leave rural regions and engulf cities, creating social instability as water runs out. One example is how the extreme drought in Syria exacerbated the civil war.

Objective

- To critically evaluate the impact of the exploitation of groundwater resources on the sustainability of agricultural lands through digging bore wells.

Materials and Method:

The present study employs an analytical research framework using primary and secondary sources of information. A few Karnataka districts with significant groundwater issues, such as north Karnataka and some middle Karnataka districts were randomly selected for the study. An observational study and a systematic questionnaire were used to collect the data on the impact of bore wells on groundwater. Furthermore, the study analyzed secondary data to examine the effects of drilling bore wells without scientific consideration on next-generation farmers, focusing on the data from 2018-19, 2019-20 and 2020-21. Using tabulations and graphs along with descriptive statistics, we analyzed secondary data, which helps us understand how bore wells are sustainable for agricultural and non-agricultural activities.

Results and Discussions:

Location of the study area

The major developing countries with sufficient irrigated land will also take one fine day and face groundwater scarcity. The State of Karnataka in India has a geographical area of 1 91, 761 sq. km. and is situated between N. Latitudes $11^0$31" and $18^0$45' and E. Longitudes $74^0$12' and $78^0$40'. The Central Ground Water Board manages the groundwater wells in the Karnataka state four times a year, viz. May (between 20th and 31st), August (between 20th and 31st), November (between 1st and 10th), and January (between 1st and 10th).

Table 1: Number of Ground Water Monitoring Wells in Karnataka from May 2018 to January 2021

Period of Measurement		Number of Wells Monitored		
		Dug Wells	Piezometers/Tube Wells	Total
2018-19	May	1474	319	1793
	August	1475	321	1796
	November	1406	262	1668
	January	1445	286	1731
2019-20	May	1442	271	1713
	August	1436	269	1705
	November	1432	275	1707
	January	1413	262	1675
2020-21	May	No Bore wells Due to COVID-19		
	August			
	November	1437	275	1712
	January	1413	262	1675
Total		14373	2802	17175

Source: Groundwater Year Book of Karnataka

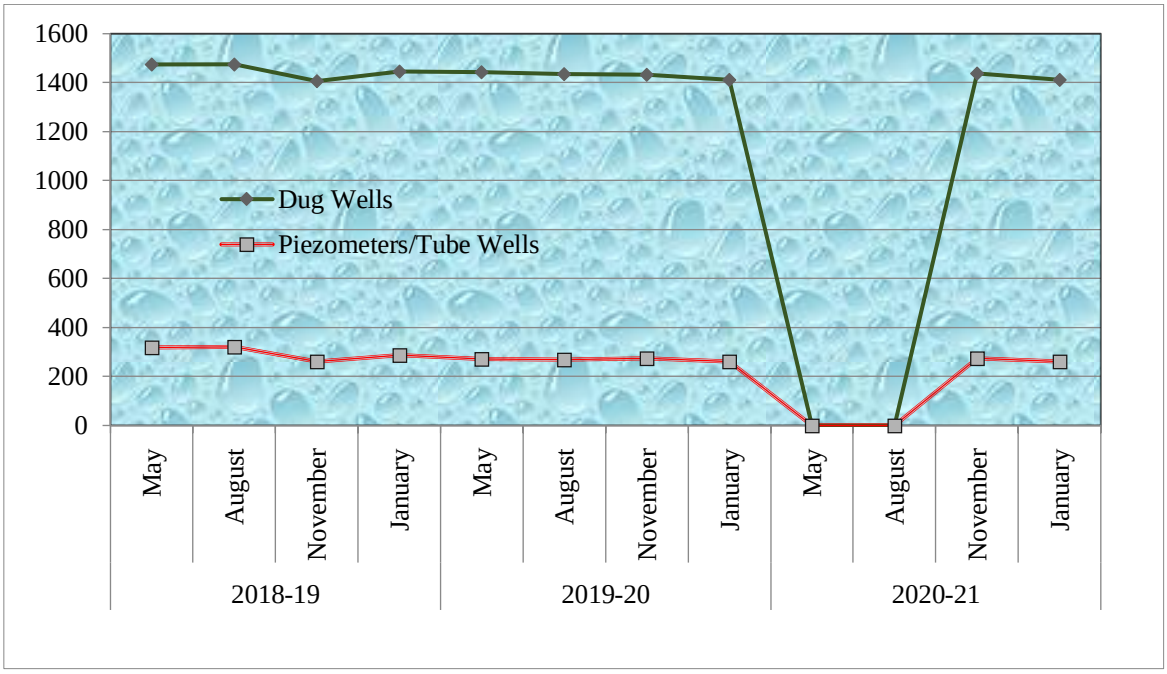

Figure 1: Groundwater Monitoring Wells across the states from 2018-19 to 2020-21

The above table and depicted graph reveals that the information about the groundwater monitoring wells across the state in terms of dug wells and tube wells from May 2018 to January 2021. The data was gathered with the help of the Central Ground Water Board yearbook of Karnataka over the given years. The quantity of dug wells seems to be constant over the three years, but it has been declining slightly, which we can clearly understand from

the figure below. The tube well instalments have also been falling along with the dug wells. Between August and November 2018, both dug wells and tube wells declined immediately.

The reason for declining Dug Wells and Tube Wells as per the survey of CGWB

- Groundwater in each state has revealed a distributing decline in groundwater levels in 69% of the wells in Karnataka. The situation of Karnataka was worse than the dry state of Rajasthan, which recorded a groundwater level decline in 50% of the wells surveyed. The national average was 69%, slightly better than that of Karnataka.
- Rapid construction activity and population growth in the urban centres and faulty cropping pattern in the rural areas in Karnataka
- Four central states of south India performed worse growth water resources such as name Andra Pradesh, Tamil Nadu, Kerala and Karnataka. These were not only witnessed for the worse groundwater resource and also concerned with the decline rate much lower than the national average. In comparison, 87% of wells in Tamil Nadu, 75% in Andra and 70% in Kerala showed a decline in groundwater levels.

This should remind the state to be prepared for a dry summer and may be worse ahead. Several researchers pointed out that Karnataka has reached a critical stage in groundwater issues, adding, "If the situation persists, soil levels will sink, posing a threat to lives. Despite the fact that farmers and others are digging more and more bore wells, many of them have failed. In order to be effective, rainwater harvesting must be made mandatory for all. It should be scientifically done to catch water at the ground level."

Table 2: Total Number of Ground Water Monitoring Wells in Karnataka during 2018-2021

Year	Number of Wells Monitored		
	Dug Wells	Piezometers/Tube Wells	Total
2018-19	5800	1188	6988
2019-20	5723	1077	6800
2020-21	2850	537	3387
Total	14373	2802	17175

Source: Groundwater Year Book of Karnataka

Impact of over-exploitation of Ground Water on Agricultural Land

Groundwater development is found on an immense scale all over the study area. Earlier groundwater development in the room was only through dug wells. Gradually the farmers

switched to commercial crops, especially vegetables like carrot, cabbage, beetroot, radish, tomato, beans and cash crops like mulberry and flowering plants from traditional crops like paddy and ragi, jowar and maize. This type of change pattern of crops changed the groundwater scenario drastically, and almost all the dug wells have been dry for the last two decades. The groundwater level in the area declined beyond the reach of drilled wells. Over-exploitation of groundwater has its impact not only on the groundwater system but also on surface water bodies, which harms the survival of faunal species like frogs, fishes and birds etc. (Munch et al. 2007)

Over-exploitation of groundwater in the area has a tremendous impact on the groundwater system and food production. The agricultural land occupying food crops was gradually replaced by Eucalyptus plantations (S N Ramaiah et al. 2017).

- Farmers or Households suffer a drastic decline in the agricultural level of income following the loss of access to groundwater due to the drying up or "failure" of their first bore well.
- Households can largely offset the income effects mechanisms.
- Farmers severely failed in using modern technology, which increased productivity and well returns.
- Most agricultural farmers were shifted to non-agricultural activities such as nearby manufacturing industries, self-employment, allied activities, etc.
- The presence of local industrial development mediates the effect. In areas with higher employment levels in large firms, households are better able to increase off-farm income to offset losses on the farm where fewer large firms exist and total income declines.

Even when income is maintained, adaptation does not appear to be costless, as there is evidence of substantial asset dissimulations and an increase in debt, which may undercut the ability of households to smooth consumption in the event of future income shocks. In addition, older children leave school and take up employment, potentially leading to long-term impacts on human capital accumulation and future income.

Ground Water Management

During the literature survey, the researcher noticed that many bore wells were drilled, so the borewells did not consider the spacing between the wells. This adversely affects the groundwater body and the natural groundwater system. Advanced groundwater irrigation

systems like sprinklers and drip irrigation help manage this valuable resource (Srinivasa Rao et al. 2000). Presently, a small number of farmers are adopting drip irrigation in a few villages. This type of irrigation system is to be adopted by every farmer all over the area to minimize groundwater withdrawal.

It is necessary to manage the water resources scientifically by adopting water conservation, efficient use of water in irrigation, crop management, social forestry, etc., has become important for the area with an integrated approach (Jacob et al. 1999)

The following Integrated Approaches have to be initiated.

- The area gets very scanty rainfall during the southwest monsoon season. However, the site sometimes gets heavy rains during the northeast monsoon season. During such torrential rains, surface runoff is available in streams, which can be utilized for the artificial recharge of groundwater.
- Suitable artificial recharge structures like check dams, sub-surface dykes, lakes, Krishi hondas, and canals can be constructed at selected places.
- There are a large number of dug wells that have been dry for the last two decades. Farmers can use these drilled wells to recharge groundwater by diverting the surface runoff available during the monsoon period to these drilled wells through a proper supply channel.
- Bunds in agricultural lands, contour bunds in the area having rolling topography, and trenches will also help recharge groundwater.
- Rooftop rainwater harvesting is also the best option.
- It is the right time to create awareness among the public, especially the farming community, about groundwater conservation and how the farmers are responsible for groundwater level decline by exploitation of groundwater for their irrigation needs.
- Mass awareness programmes at taluk/village levels are also essential to conserve and protect this precious resource for future generations.

The study suggests that loss of access to irrigation water, a critical input to farming in semi-arid regions, persistently reduces the viability of agricultural livelihoods. There is little indication that households can adapt to these losses through shifts in agricultural practices. Much of the affected land remains fallow or cultivated with low-value field crops, raising concerns about the impacts on aggregate food production.

On the other hand, households seem to be relatively successful in offsetting agricultural income losses through a reallocation of labour to off-farm employment, which leaves total income little affected. The reallocation of labour is achieved without substantial resort to migration or even employment in nearby villages, arguing against the likelihood that worsening groundwater trends will result in large waves of "environmental refugees".

Conclusion:

Groundwater use through bore wells is more than industrial production and Municipal corporations. Its use is enormous where it is availing more for the farmer's activities, but they do not know how efficiently to utilize the groundwater. As of anticipated findings, farmers do not see the structure of groundwater sources, such as namely Static and Dynamic nature of groundwater and also noticed that there is a scientific basis to that person who points out the water resources on our land through his power of resistance. Based on this, they can use the sources well and connect the power supply, which is precisely required.

Overall, the study warns about the extent of the failure of wells resulting from groundwater depletion and persistent drought and sheds severe doubts on the notion that farmers will be able to adapt their cultivation to the changing conditions. This suggests that increasing water scarcity can have grave consequences for future food production. On the other hand, the study also shows that economic growth in non-farming sectors, such as services and manufacturing, can help employ and sustain the incomes of affected farming households. Policies that can help agriculture conserve water and encourage more firms to set up operations in rural areas can help avert the threat farmers who live in water-scarce parts of the world increasingly face.

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