Journal of Global Resources Volume 4 (02) July 2018 Page 01-10
ISSN: 2395-3160 (Print), 2455-2445 (Online)

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MANAGEMENT OF WATER RESOURCES AND PEOPLE'S PERCEPTION IN MAHOBA DISTRICT OF BUNDELKHAND REGION OF UTTAR PRADESH

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Abstract: *Water is one of the most important natural resources on the earth. At the same time, it is becoming a scarce resource in many parts of the world today including India where some parts are facing water scarcity while some other areas possess plethora of water resources. Bundelkhand region is one of the pertinent regions of the country happens to be particularly Mahoba district of this region which is currently facing the acute water crisis and severe shortage of water. This study explains the present condition of water resources and examines the causes of water crisis and water depletion problem by using primary and secondary data and found that increasing pressure of human and livestock population, deforestation, urbanization and industrialization, expansion in agriculture land, intensive agricultural and its allied activities, including rigorous mining and quarrying on large scale, domestic demands of water supply are some of the prime major factors for surface and ground water depletion.*

Key words*: Water, Region, Management, Scarcity, Expansion.*

Introduction

Unquestionably, water is one of the most important natural resources on mother earth. Water is increasingly becoming scarce resource in many parts of the globe including India. India being a geographically vast country has some parts facing water scarcity while some other parts have abundant water resources. Bundelkhand region is one of the important regions of the country particularly Mahoba district of the region which is currently facing the acute water scarcity and water depletion problem. The study region is a drought prone area of the country due to scanty rainfall and consecutive monsoon failure. The entire region is documented as one of the agricultural backward and poorest regions of the India. Currently, this rain-fed region is facing huge scarcity of water over the last couple of years it has been witnessed that the region in question has been reeling under the severe drought situation in spite of a number of rivers like Betwa, Ken, Urmil, Sahzad, Mandakani, Jamni, Yamuna and Saujam being in existence there. However, these rivers are the seasonal rivers but not the perennial rivers. This region is termed as one of the backward regions of the country particularly from agricultural point of view because of recurring droughts, water scarcity, high rate of evapo-transpiration, crops failures, scanty and erratic rainfall, poor irrigation facilities, declining agriculture productivity, land degradation, mal-nutrition, population migration and hunger and food insecurity. The series of all these relevant factors are by and large liable for the economic backwardness of the entire region. Consequently, a line share local population of the villagers is forced to migrate from the Bundelkhand region to other parts of the country to get their livelihood security and to survive their lives.

Water is considered as an essential natural resource not only for life but almost for all the biotic and a biotic activities operating on the earth surface. Literally, this valuable resource is manageable because of its capability of diversion, transportation and storage including recycling. By applying different types of modern techniques and traditional methods, and launching of massive water awareness programmes from time to time, it can be conserved and managed for increasing millions of people. Therefore, keeping in view the constant growing demands for water resources, there is an urgent need to save the precious gift of God given to the mankind. The term, "*water management*" connotes to economies applied in the usage of water be it

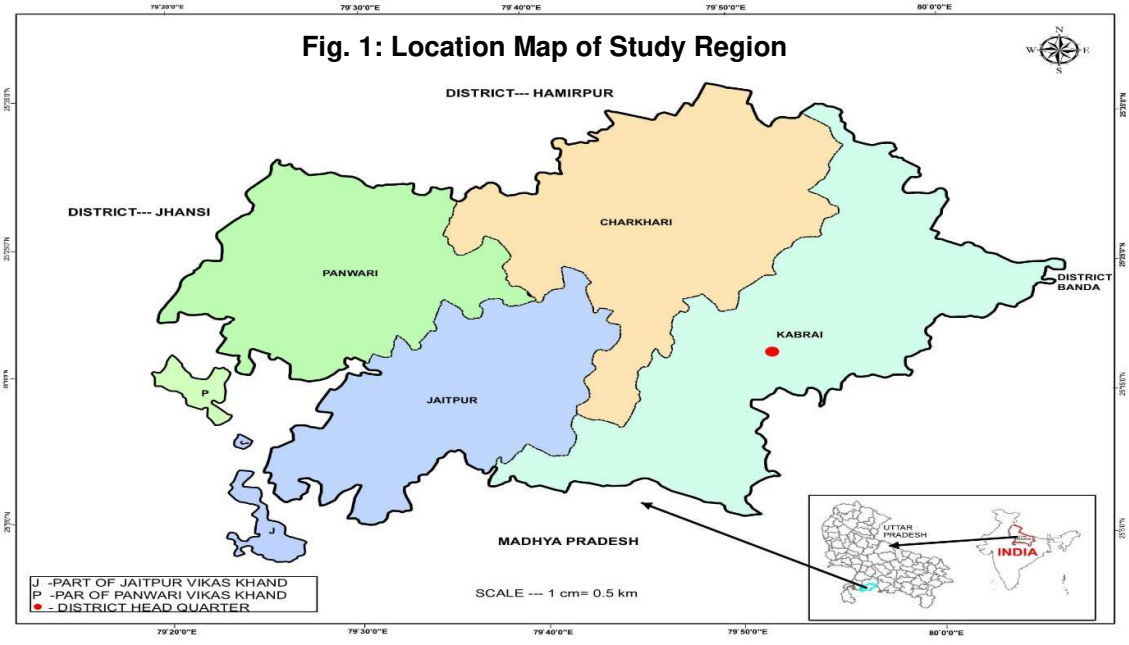
ground water or surface in order to ensure judicious distribution of water to as many uses as possible. According to a United Nation's estimate by the year 2025 two thirds of humanity will face shortage of fresh water. So, it becomes necessary to investigate the current status of water resources and assess its importance in the study region as well and find out the prime causes of the prevailing water shortage problem and people's perception of the region concerned.

Geo-Physical Profile of the Study Region

The designated study area is the part of Bundelkhand region (Banda[1], Chitrakoot[2], Hamirpur[3], Jalaun[4], Jhansi[5], Lalitpur[6] and Mahoba[7]) which is situated between $25^0 01' 30''$ and$25^0 39' 40''$ north latitude and from $79^0 15' 00''$ to $80^0 10' 30''$ east longitude. It consists of an area of 3,144 Sq.km comprising 3 tehsil (Kulpahar, Charkhari, Mahoba), 4 development blocks (Jaitpur, Kabrai, Charkhari and Panwari) and 521 villages inhabited by 8, 75,858 people with the population density of 279 persons per sq. km. as per 2011 census which is very low vis-a-vis the state i.e. 829 persons per sq.km. The rural area covers 3116.1 Sq. Km. and urban recorded 27.9 Sq. Km. There are 247 Gram Panchayats and 521 Revenue villages. The study region ranks 48th in terms of literacy with 65.3 percent which is lower than the state average of 67.7 percent. The another distinction of the region is that there are 86 uninhabited villages out of total 521 villages, where Kulpahar tehsil has the highest number of inhabited villages 227 while Charkhari tehsil has the lowest number of inhabited villages (83). In the area under study (Mahoba district) holds the distinction of being the smallest district in terms of population in the entire state of U.P. (71th ranks).

It is located in the south western part of the Uttar Pradesh which is an agrarian state and shares geographical boundaries with Hamirpur district in north, Madhya Pradesh state in south, Banda and Jhansi district in east and west respectively. The district came into existence having been bifurcated from Hamirpur district of Uttar Pradesh on February 9, 1995. Before its creation it had been under the jurisdiction of Jhansi Division but presently it is one of the districts of Chitrakoot division. Due to small land holdings and limited irrigation facilities including harsh climatic condition in most of the areas crops are harvested only once in a year. Pulses, wheat, sorghum and oilseeds are the main crops of the region. The research area is famous for its betel leaf (*Paan*) across the state. Due to scarcity of water, the district is backward in various agricultural crops production and productivity. Geologically, the district comprises Precambrian Bundelkhand massif dolerites, granites and quartz reefs confirmatively overlain by quaternary alluvium. The major rivers of the region are Dhasan, Urmil, Birma and Arjun which are seasonal. Physio-graphically the area has been divided into two parts viz., 1. Southern parts having high reliefs with hillocks and; 2. Northern parts having relatively low relief with low hillocks.

Fig. 1: Location Map of Study Region



The average annual rainfall is 864 mm in the study area. The climate is typical sub-tropical punctuated with long and intense summer. About 87 percent of the annual rainfall is received from south-west monsoon and the soil has been formed by the weathering of granites. Clay and loamy soil is dominant in the entire region. Mahoba district mainly comprises hard rock formation of Bundelkhand massif. The rainfall does not percolate and store subsurface since the rocks are of massive and compact nature. However, secondary porosity in the form of joints and fissures allow some water to percolate inside the earth. On the basis of hydro-geological information ground water occurs in two forms: (i) Shallow zone- the phreatic conditions are only limited to the overburden of rocks the depth of which is maximum up to 35-40 m, (ii) Deeper fracture zones, the ground water occurs in fractures and joints and the potential fractures are encountered from around 35 m to 96 m in some places. Being the hilly and rugged terrain the occurrence of ground water in this terrain is highly uncertain. The annual ground water recharge of the region was 47,046.58 hm. (hectare meters); the net annual ground water availability was assessed to be 42, 341.92 hm. (hectare meters). The existing gross ground water draft for all users was 20,978.59 hm. The net ground water availability for future irrigation development was 20,863.84 hm. The stage of ground water development is 49.55 percent (2004).

Aims and Objectives of the Research Study

- To find out the current status of water resources available
- To analyze and assess the status of water resources in spatio-temporal perspective
- To analyze and highlight the major causal factors of water scarcity and water depletion
- To know and understand people's perception regarding research problem
- To suggest the inclusive and appropriate strategies for sustainable management and conservation of water resources

Data base and Research Methodology

The entire research study is based on both primary and secondary data collected by a detailed structured questionnaire which covered four Blocks Jaitpur, Kabrai, Panwari, Charkhari and 10 villages from the each block of Mahoba district have been earmarked. This study conducted interview with 400 respondents to elicit their personal observation and know the people's perception regarding the research problem. So, sampling method has been used and the whole survey was conducted in order to get the precise observation. Apart from that the secondary data has also been collected from different types of sources viz., District Census Hand book, District Gazettes, District Statistical Book, Department of Geology, Uttar Pradesh, Central Water Commission (CWC) Govt. of India, National Water Development Agency Govt. of India, Ken Betwa link Details Project Report (DPR), Govt. of India, Ministry of Water Resources, River Development and Ganga Rejuvenation, Integrated Watershed Management Programme, Uttar Pradesh, Water Management Directorate of Uttar Pradesh, Land Development and Water Resources Department of Mahoba District etc. The concerned literature including the reputed journals, project reports and related research papers, books have also been studied, consulted and quoted at relevant places. Precisely, all the data has been analyzed by applying various statistical methods and techniques. Apart from this, water resources data has also been highlighted with the help of maps, charts and tables including all other relevant information to understand the problem from different perspectives.

Status of Ground Water Resources

a) Status of Water Resources in India

The average annual water flow of Indian rivers is about 1,869 million per metre^3 out of as little as 690 million metre^3 or to the tune of 36.92 percent water is suitable for human consumption. The mighty rivers like the Indus, the Ganges and the Brahmaputra possess about 60 percent of surface water in India. About 95 percent surface water which is drained through various rivers into the seas and oceans. The potential of underground water in the country is around 434 million metre^3. Generally, India receives about 400 million ha. Meters of precipitation this evaporates immediately from the soil and about 15 million ha. Meters flow out into the sea. Intensive research has been conducted for the management of conservation water resources in India by many subject experts including geo-hydrologists, geologists, geographers, economists and agricultural scientists from different dimensions to assess and highlight the status of surface

and groundwater particularly those in Bundelkhand region of U.P. including the various parts of the country as well as potentiality of water resources for future needs of society. Some of the very important studies which are indeed very relevant and familiar in the present research work are Athavale, R.N. (2003), Iyer, Gopal K. and Roy, Upendra Nath (2005), Agarwal, Anil and Narain, Sunita (1992), Agarwal, Anil and Narain, Sunita and Khurana, Indira (ed.) (2001), Agarwal, A., Tinker, J. et al (1980), Bhargava, R.N., Sinha, R.S. Dutta. V (2010), Biswas, A.K. et al (eds.) (1991), Chauhan, G.S. and Dubey, R.N. (2004) etc.

b) Status of Water Resources in Uttar Pradesh

Uttar Pradesh is one of the leading agrarian States of India. It is very rich both in surface and in terms of ground water resources .The state is characterized by sub-tropical climate and the average annual rainfall is estimated to be around 1,000 mm, of which nearly 85 percent occurs mainly during monsoon period. The rainfall is highest in northern and eastern part of the state which gradually decreases towards the west and the south-west. The state owns two geomorphic units' viz., (i) Ganga plains (ii) Bundelkhand plateau. The southern part of the state comprises hard rock's of Bijawar and Vindhyan groups.

The rainfall pattern is not uniform and it varies ranging from above 1,600 mm in the southern part to above 350 mm in the north- western part of the State. The statistical table of the study region relating to the rainfall during the time series (1980-2016) depict that the trends are not uniform but there are certain ups and downs and the rainfall quantity has reduced drastically from 2001 onwards (Table 1). As it has been already described the Mahoba district which is the study region is located in the water deficit and drought prone area known as Bundelkhand region, it received 258.08 mm rainfall during monsoon season (June – September) less than normal rainfall that is 776.4 mm (-67 percent deficit) in Mahoba district (Ground Water Year Book, 2014-15) .The overall picture reflects that the entire state received abundant amount of rain water during the monsoon season. However, the southern part of the state particularly Bundelkhand region there of including the study region received relatively less quantum rainfall and it is known as "*drought prone area as well as water crisis region"* of the state. The state Net Annual Ground Water Availability is 71,57,487.72 (ham.) and Net ground water availability for future irrigation development is 18,98,010.72 (ham.). The stage of ground water development in Uttar Pradesh is 73.78 (Table 2).

Status of Water Resources in Study Region

The study region which is part of Bundelkhand-Vindhayan plateau landscape is located in the southern part of Uttar Pradesh. From water availability point of view, the entire area is problem ridden and drought prone particularly the hydro-geological conditions are rather inclement consequently, the ground water availability is very low. Due to constant exerting population pressure of both human and livestock and intensive agricultural and developmental activities in and around the area, the consumption of ground water has increased many folds. Consequently, all the four blocks of the Study region have been declared over-exploited and critical zone (Department of Ground Water U. P. 2013). From agricultural point of view, the region is socio-economically backward and under developed. Agriculture is the main stay of the local masses and of their livelihood security; the farming community got only one crop in a year. Moreover, the productivity of various agricultural crops is rather less as compared to the state average productivity. The main and sole liable factor behind the scenario is that the irrigation facilities is minimum and the agriculture system is entirely dependent on rainfall which is very less in relation to the northern part of the state.

The average annual rainfall in the study region is around 864 mms. Approximately, 90 percent of the annual rain-fall is received during the months of June to September, July and August being the receiving maximum rain months in the entire area. The variation in the rainfall from year to year is sharp declining trends (1980-2016). The climate is characterized by sub-tropical in nature punctuated with long and intense summer. May is the hottest month with mercury rising up to 47.5^0 C. while January is usually the coldest month with the temperature going up to 8.3^0 C. The region is drained by the Dhasan, Urmil, Birna and Arjun rivers. Dhasan is

the main river of the area and it is right bank tributary of the Betwa river which originates (Vindhayachal mountain range) in Begumganj tehsil of Raisen district in Madhya Pradesh.

Table 01: Annual Mean Rainfall between 1980-2016 (in mm)

Year	Annual Mean Rainfall	Year	Annual Mean Rainfall	Year	Annual Mean Rainfall
1980	1294.71	1992	711.09	2004	N/A
1981	1058.76	1993	702.97	2005	448.00
1982	1429.52	1994	1335.47	2006	444.00
1983	1171.15	1995	905.48	2007	366.00
1984	834.09	1996	1102.03	2008	679.00
1985	1235.75	1997	893.29	2009	488.00
1986	864.02	1998	1052.74	2010	539.9
1987	625.04	1999	1227.61	2011	800.00
1988	854.25	2000	869.79	2012	566.80
1989	821.16	2001	856.43	2013	870.80
1990	1518.61	2002	743.00	2014	379.80
1991	589.63	2003	N/A	2015	370.20
				2016	843.10

Source: Rainfall Statistics of India – 2016, Hydromet Division, India Meteorological Department (Ministry of Earth Sciences), Mausam Bhawan, New Delhi

As per Report on Dynamic Ground Water Resource of Mahoba District (as on 31.2.2004)the annual ground water recharge of the study region was 47,046.58 ham, the net annual ground water availability was 42,341.92 ham whereas the existing gross ground water 8 drafts for all uses is 20,978.59 hm. The net ground water availability for future irrigation development was 20,863.84 hm. for the target area. The statistical table illustrate that the stage of ground water development of study region was 110.76 percent (Table 2) which is considered to be in the over exploited zone whereas in case of 4 blocks of study region is very serious and alarming, For instance, Kabrai block , where the stage of ground water development is recorded 130.62 percent followed by Jaitpur block 120.27 percent that is considered the over-exploited zone in 2011 (Table 3).The rest of the two blocks are considered Panwari and Charkhari were recorded to be critical. Whereas the stage of ground water development in the year 2013 of the 4 blocks is by and large almost the same with certain fluctuations (Table 3).

Table 02: Region wise Ground Water Resource Potential of Uttar Pradesh, 2013

#	District/ Region	Net Annual Ground Water Availability (ham)	Exiting Ground water draft for irrigation (ham)	Draft for industrial & domestic water use (ham)	Exiting gross ground water draft for all uses (ham)	Allocation for domestic and industrial requirement supply up to next 25 years	Net ground water availability for future irrigation development (ham)	Stage of ground water developm ent (percent)
1	Uttar Pradesh	7157487.72	4838368.71	442185.20	442185.20	649149.50	1898010.72	73.78
2	Bundelkhand Region	440439.82	214772.88	20492.36	235265.23	30945.78	198575.62	53.42
3	Mahoba District	17522.13	17720.33	1686.39	19406.72	2674.69	144.50	110.76

Source: Department of Ground Water, Govt. of Uttar Pradesh, report on ground water scenario district Mahoba, 2016-17

The region consists of a good number of ponds, dams, canals, streams, wells, and tube wells in order conserve the rain water during the Monsoon. The major and well known dams of the area are Urmil, Majagawan, Kabrai, Arjun and Chandrawal located at various pertinent geographical locations and all these have been constructed by the Govt. of U.P. for irrigation purposes only whereas the total number of ponds are 18 which cover the substantially large area predominately Keerat sagar, Madan sagar, Kulpahar, Bela sagar, Vijay sagar, Salarpur, Urwara, Kamalpur, Chhitarwara (built up during Chandela's rulers) Urwara, Kamalpur, Chhitarwara (built up during Chandela's rulers).

Table 03: Comparison of Status of Block-wise ground Water Availability and Utilization

Block	Ground water Assessment Area (ha)	Net Ground water Recharge (ham)	Existing Gross Ground water Draft For All Uses (in ham)	Net Ground Water Availability For Future Use (ham)	Stage Of Ground Water Development (%)
	As On 31-3-2011				
Panwari	68673	3379.77	3172.58	207.19	98.87
Jaitpur	35430	4111.71	4945.35	0	120.27
Charkhari	50123	3763.42	3600.1	163.32	95.66
Kabrai	18494	4913.17	6417.39	0	130.62
Total	172720	16168.07	18135.42	370.51	111.35
As On 31-3-2013					
Panwari	68673	3619.8	3598.17	21.63	99.4
Jaitpur	35430	4498.6	5316.8	0	118.19
Charkhari	50123	4032.08	3909.21	122.87	96.95
Kabrai	18494	5371.65	6582.54	0	122.54
Total	172720	17522.13	19406.72	144.5	109.27

Source: Department of Ground Water, Govt. of Uttar Pradesh

According to the people's perception the various factors are as under

Out of 1,600 respondents (400 each block) as many as 45 percent people perceived that the less rainfall and recurring droughts is the major factor of water depletion, the second most important factor of (both surface and ground water) is deforestation and increasing population, as per the 23 percent people's perception; the third important factor is rising number of tube wells (Table 4)

Table 04: Major Causes of Water Depletion (in percent)

#	Causes	Charkhari	Jaitpur	Kabrai	Panwadi	Study Region
1	Wells	14	15	9	6	11
2	Tube-wells	17	19	17	16	17
3	Less Rainfall	40	42	48	50	45
4	Deforestation	23	21	22	26	23
5	Other	5	3	4	2	4
	Total (%)	100	100	100	100	100

Source: Personal Survey

Whereas 11 percent people's perception was that increasing no. of dig wells are the main factors of surface and ground water depletion followed by other pertinent factors. These above given factors were based on the people's perception while as per the various facts, figures, reports and other scientific studies the other relevant factors of water scarcity and water depletion were mainly :

- Less and erratic rainfall.
- Exerting pressure of population of human and livestock.
- High rate of evapo-transpiration.
- Small area under forest cover.
- Acute imbalance between rate of withdrawal and rate of recharge of ground water.
- Low level of awareness for conservation & management for water resources among the rural masses particularly in farming community.
- Gradual diminishing of traditional methods of water resource conservation.
- Growing area under agricultural operations.
- Excess withdrawal of ground water through diesel pumps and tube wells for irrigation of agricultural crops and drinking purposes.
- Production of maximum water consuming crops by farming community for their economic benefits like peppermint, sugarcane, wheat etc.
- Continual rise in numbers of hand pumps, wells and tube wells.
- Intensive illegal mining and quarrying activities and to increase constructional activities including massive deforestation.

Apart from the factors highlighted above, there are the other important issues relating to water depletion and water conservation in the study region that have been analyzed on the basis of people's perception one by one:

1. As per the people's perception (33 percent), the traditional methods of water conservation are ponds and tanks followed by check dams and bandhi (bandhi is the local terminology that refers to the formation of high-rise structure made up of loose soil by the farmers to harvest water for agricultural uses in Bundelkhand region) . About 28 percent (Table 5) respondents have no idea regarding the traditional methods of water conservation.

Table 05: Traditional Methods of Water Conservation (in percent)

#	Methods	Charkhari	Jaitpur	Kabrai	Panwadi	Study Region
1	Pond/Tank	37	33	28	33	33
2	Check dam	39	18	31	38	32
3	Others	7	10	6	6	7
4	No idea	17	38	35	23	28
	Total (%)	100	100	100	100	100

Source: Personal Survey

2. While people's perception was very clear in case of modern methods of water conservation that have the great impact on agricultural crops and their productivity. The main crops of the study region are Wheat, Pea, Arhar, Gram, Oilseeds and peanuts. It was the perception of about 30 percent respondents that piped modern method is unique to conserve water resources (Table 6) in drought prone and rain-fed areas**.** It has been proved useful and very successful in agricultural operations and water is supplied through pipe where the supply of water is moderately less. There are several others modern methods as well to conserve and save water resources viz., tree plantation, dams and sprinkling system including rain water harvesting.

Table 06: Modern Methods of Water Conservation (in percent)

#	Methods	Charkhari	Jaitpur	Kabrai	Panwadi	Study Region
1	Water Harvesting	2	3	2	3	3
2	Sprinkling system	18	12	12	9	13
3	Piped water supply	24	34	30	32	30
4	Dam	3	3	4	8	5
5	Plantation	27	22	26	25	25
6	Others	3	1	2	3	2
7	No idea	23	24	25	21	23
	Total (%)	100	100	100	100	100

Source: Personal Survey

3. The ground and surface water depletion has also equal degree of impact on various other phenomena and anthropogenic activities in the study region like natural vegetation, crop yields, growth of grass land on the food and fodder including livestock particularly during the drought period when there is no grass and fodder available for livestock during summer season where water crisis remains throughout the year except in rainy season. As per people's perception water crisis period is recorded during March to July almost every year. About 41 percent people's observation reveals that the month of May holds the distinction of being a month riddled with acute shortage of water in the study region when the farmers community , local masses and other biotic and a biotic phenomenon are in the grip of water crisis followed by month of June (38 percent) including a small period of July (Table 7).

Table 07: Month of Water Crisis during the Year (in percent)

#	Months	Charkhari	Jaitpur	Kabrai	Panwadi	Study Region
1	March	5	5	3	5	5
2	April	16	10	9	10	11
3	May	39	35	48	41	41
4	June	34	43	38	37	38
5	July	7	7	4	7	6
	Total (%)	100	100	100	100	100

Source: Personal Survey

4. It has also been observed that water crisis is considered to be an annual natural event. As per people's perception (45 percent) the frequency of water crisis is around after every 3 year, while 44 percent people's perception is that the frequency of water crisis is after 2 years interregnum while 11 percent people's perception is that the frequency is water crisis every year in the study region (Table 8).

Table 08: Frequency of Water Crisis in Periodic (in percent)

#	Frequency (year)	Charkhari	Jaitpur	Kabrai	Panwadi	Study Region
1	Every year	14	17	7	7	11
2	Every two year	41	47	40	48	44
3	Every three year	45	37	54	45	45
	Total (%)	100	100	100	100	100

Source: Personal Survey

Suggestions

Relevant strategies both long and short term for conservation and management of water resources have been discussed below one by one in the domain area:

1. It has already been mentioned that Irrigation facilities are severely limited in the entire region and less rainfall further worsens the condition. In view of the same, there is an urgent need to conserve and manage maximum water resources in the target area. To achieve this goal, the Govt. of UP, particularly the Department of agriculture has launched various important schemes namely "*Khait Talab Yojana, Maidh Bandhi", "Dig Well Schemes", "Construction of Check Dams",* for conservation and management of water resources and soil conservation. It has also been observed by the researchers during the field survey that the above prestigious schemes did not implement and monitor properly to get the desired results. To implement such schemes, the suitable selection of the check dams, hand pumps, wells, and tube-wells should be constructed at the right place. Besides, big water structures should be constructed in the lower hill dominated areas so that the huge amount of rain water may be naturally store therein. That is the best traditional method to save and conserve water resources for future needs of the people. Special incentives should be given to the farmers to create water structures in their farms especially in the low lying locations and tree plantation and pasture land should also be promoted and encouraged in order to recharge the ground water. It is also one of the best traditional methods to recharge underground water resources.
2. It has been observed that the local farmers are producing those agricultural crops for their economic needs which are more water consuming like peppermint, sugarcane, wheat, pea etc. In order to save ground water resources, more emphasis should be laid on cash and commercial crops for better output as well as less consumption of water.
3. Just before the rainy season, awareness programmes should be launched in the study area with public and private partnership by involving farming community, local people and NGOs, to clean and remove the debris deposited in the aquifers, ponds, wells and Streams in order to increase their water storage capacity. For this purpose financial assistance should be given to the local masses and farmers to clean and dig up their structure of water resources owning to increase the water storage capacity in and around their agricultural owing.
4. Illegal mining activities should be checked on priority basis in the various parts of domain region. It has been perceived that the intensive illegal mining activities are going on in the various areas particularly in those areas which are hills-locked. To get granite stone and the

other varieties of stone to sell at high prices in the market. Subsequently, almost all the hill areas which are laden with different varieties of bushes and trees and have lost soil moisture and soil particles as well as capacity to germinate new tree and plant species. Moreover, such hill areas are the better source of seepage of ground water resources. The another important phenomenon related to the same issue is that the rain water is preserved by the hill areas through streams and channels which are the effective and unique sources of water conservation also slow down the pace of recharging of ground water. Hence, the Govt. should ban mining and quarrying activities on urgent basis in order to conserve and manage water sources and to ensure sustainable growth as well.

5. For conservation and management of water resources preference should also be accorded to the horticultural crops namely mangoes, guava, pomegranate, papaya, amla (*phyllanthus emblica*) etc. and it should be promoted among the farming community. It will be a multipurpose source to increase their income and livelihood security and to recharge the underground water resources. Another important benefit of the horticultural crops is that it will also helpful to check the migration of people to a great extent.
6. As the study region is retaining the undulating and uneven topography including the hard pan strata, due to which the rain water cannot percolate into the earth. The hard pan strata restrict the seepage of ground water beneath the ground. As a result, the limited water quantity is consumed by the existing local soil. In this process during the rainy season a huge quantity of water received during the monsoon season could not reach the underground layers which remains replenished. So, keeping in view the hard pan strata of the study region (upper layer of the soil), effort should be made that the rain water should reach inside the earth properly with the help of modern technology like- injected wells or dig well recharge, induced recharge from surface water resource and percolation tanks.
7. The domain area is rain fed area and to preserve and manage maximum water during the monsoon season, awareness campaigns should be launched at local level by involving farming community, local masses, women, youth and civil society to conserve and store the rain water in their agricultural fields, ponds, wells, channel streams, and other water structures for future purposes. Simultaneously, afforestation programmes should be launched during the rainy season by involving farming community and local people. If the same practice is continued up to some series of years, the number of plants and natural vegetation area will increase to maintain the ecological balance and to recharge and to seepage the rain water into the lower part of the soil.

Conclusion

In so far as the study region is concerned, water scarcity is a very serious and challenging issue that is being faced by not only the Mahoba district of Bundelkhand region but by almost various parts of the Bundelkhand region. The ground water resources are the key and main natural resources on which the entire population is surviving. It is the main and the sole most important natural resource that plays an important role in the rural economy of a particular area. However, due to the exerting pressure of population of human and livestock, high rate of urbanization and industrialization, expansion in agriculture land and domestic demands of water supply etc. are the major factors for surface and ground water depletion. Apart from the factors highlighted in the above discussion by eliciting people's opinion regarding their depletion. All these factors are responsible directly or indirectly for the depletion of ground water resource and ultimately water resources are becoming scarce commodity and the entire region is heading towards severe water crisis.

Therefore, keeping in mind the depleting ground and surface water resources of the study region collective efforts should be made in order to conserve water resources. To manage and conserve water resources in the study region farmers should be prompted to opt for sprinkling and drip irrigation system including rain water harvesting system. Similarly, both the traditional and modern scientific methods should also be adopted in order to conserve water resources by involving the farming community, local people and civil society as well. The managemant of water storage by government is largely based on modern techniques like construct of big dams ratther than employing on traditional methods. Local bodies are not paying attention to such efforts. This study also found that there was no separate provision of drinking

water and irrigation facilities and population had to face acute drinking water in the month of May and June. The major and prime objectives are to ensure controlled exploitation and optimum & judicious use of ground resources, to implement ground water recharge programme on a large scale in an integrated manner and to bring over-exploited/critical blocks into safe category in a time bound manner, to effectively implement conjunctive use of surface water and ground water, to promote efficient methods of water usage in the stressed areas, to give priority to the river basin/watershed approach in ground water management planning and conservation. But there is an urgent need to implement and monitor its various targets by the state Govt. Though, this policy is not implemented fully and the govt. should instruct and monitor its function to implement it in an effective manner by visting the fieldsfrom time to time to achieve the target fixed for the management of water resources in the state as well as in the study region.

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