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Impact of drought on drinking water resources of Himachal Pradesh

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ABSTRACT : In India drought occurrence is most prominent feature in Western Rajasthan, Gujrat and some other parts of India. However drought like situations also occurs in some parts of western outer Himalayas. One such region is Himachal Pradesh. Himachal Pradesh is experiencing drought like situations since last decade. The intensity of drought is increasing year after year and for the past six years Himachal is facing acute drinking water shortage during summer months. The present study is based on secondary data obtained from line departments and interactions of the authors with people in the rural areas. An attempt has been to assess the impact of drought on drinking water sources of the state. There is need to change some existing policies relating to water management to tackle the water shortage during water scarcity.

Keywords : *Impact of drought, Drinking Water Resources, Water harvesting, Himachal Pradesh*

INTRODUCTION

Droughts are the resultant of acute water shortage due to lack of rains over extended periods of time affecting various human activities and lead to problems like widespread crop failure, un-replenished ground water resources, depletion in lakes/reservoirs, shortage of drinking water and reduced fodder availability etc. Often a region adopts itself to a certain level of water shortage based on the long-term climatic conditions experienced by it. Any negative departure from these levels creates conditions of drought, depending on the intensity and duration of this deficit. Thus drought conditions differ from region to region. Because drought affects many economic and social sectors, scores of definitions have been developed by a variety of disciplines and the approaches taken to define it also reflect regional and ideological variations. The Indian subcontinent is predominantly characterized by a tropical monsoon climate, where climate regimes are governed by the differences in rainfall, rather than temperatures. The most important feature is the seasonal alteration of atmospheric flow patterns associated with monsoon. There are two monsoon systems operating in the region-the southwest or summer monsoon and the northeast or the winter monsoon. The summer monsoon accounts for 70 to 90 percent of the annual rainfall over major parts of South-Asia. There is a large variability in the monsoon rainfall on both space and time scales. Consequently the Indian region experiences drought or flood in some part of the country or the other almost every year during the monsoon period (June-September).

In past, droughts have periodically led to major Indian famines, including the Bengal famine of 1770, in which up to one third of the population in affected areas died; the 1876-1877 famine, in which over five million people died; and the 1899 famine, in which over 4.5 million died. (Nash 2002) (Colier and Webb 2002).

All such episodes of serve drought correlate with El Nino-Southern Oscillation (ENSO) events (Kumar *et. al.*, 2006) (Caviedes 2001). El Nino-related droughts have also been implicated in periodic in Indian Agricultural output.(Caviedes 2001) Nevertheless, ENSO events that have coincided with abnormally high area surfaces temperatures in the Indian Ocean- in one instance during 1997 and 1998 by up to 3°C have resulted in increased oceanic evaporation, resulting in usually wet weather across India. Such anomalies have occurred during a sustained warm spell that began in the 1990s (Nash 2002). A contrasting phenomenon is that, instead of the usual high pressure air mass over the southern Indian Ocean, an ENSO-related oceanic low pressure convergence center forms; it then continually pulls dry air from Central Asia, desiccating India during what should have been the humid summer monsoon season. This reversed air flow causes India's droughts (Caviedes 2001). The extent that an ENSO event raises sea surface temperatures in the central pacific Ocean influence the degree of drought.

There are many types of drought. Hydrological draught is brought about when the water reserves available in sources such as aquifers, lakes and reservoirs fall below the statistical average. This paper looks at drinking water resources management perspective of Hydrological draught like conditions during the summer months in region of Himachal Pradesh

Study Area

Himachal Pradesh is small state in north-west Himalayas. The state of Himachal Pradesh is located between 30°-22' and 30°-12' north latitude and between 75°-47' and 79°-4' east longitude. The mountainous state has altitude ranging from 350 m to 7000 m above mean sea level. (SCSTE 2002)

Himalayas, the abode of snow, is a perennial source of water and is responsible for the greenery that is seen in the valleys and spurs. As long as the natural resources of the

Himalayan region were sufficient to provide the needs of the people, it was not felt to give a thought on the depleting resources of the region. Gradually it led to over-exploitation of the available resources and has created a series of problems.

To assess the status of drinking water sources affected in the state during summers a study was conducted on all the piped drinking water supply sources by measuring their discharge. The main objective of study was to identify the areas where the water resources get affected during summer and to assess the impact of drought on various drinking water sources. There are 7989 piped water supply schemes in the state and about 9987 drinking water sources have been taped.(Sharma 2007)

MATERIALS AND METHODS

The study covers the entire state of Himachal Pradesh. Both primary and secondary data matrices have been collected and used in the paper. While published and unpublished sources are taken in account for secondary data, the primary data was generated based on spot verification and field observation.

A preliminary field visit of the area affected was made to get an idea of the drinking water sources in the study area. Primary data were collected through personal observation method from the selected sites in the study area. The data include the information relating to type and location of water sources whose discharges get reduced during summers. The secondary data used in the study were collected from Irrigation and Public Health Department, Rural Development Department, Department of Science & Technology. In commensurate with the objectives of the study, various concepts and mathematical tools were employed. In general percentage, ratios and averages were worked out to interpret the results.

RESULTS AND DISCUSSIONS

Himachal Pradesh has provided piped drinking water to entire of its population by spending a huge amount of money. The study has shown that there are 7989 piped water supply schemes in Himachal Pradesh. It addition to it there are number of traditional drinking water sources in this Himalayan belt. The main traditional sources for the drinking water in the area are wells, baolies, springs, ponds and khatries.(Sharma 2006) The entire population of the state has been supplied with piped drinking water.

The population of Himachal Pradesh has grown from 23.86 lakh in 1951 to 60.78 lakh in 2001. Thus the population has grown more than 2.5 times in a period of 50 years. Taking the present growth trend in to consideration, the population is expected to further rise to 98.61 lakh in 2031 (Sharma 2007). This will be about 1.6 times of the population in the year 2001 Table 1.

The drinking water demand has grown 2.4 times in rural areas and 6.8 times in urban areas in a time period of 50 years (Sharma 2007). The demand will further rise 1.62 times in rural area as well as urban areas in the next 30 years Table 2.

The drinking water sources of only 3.2% water supply schemes get affected more than 75%. The drinking water sources of 4.67% schemes get affected between 50 to 75%. The drinking water sources of 6.71% schemes get affected between 25 to 50% and the drinking water sources of 7.33% schemes get affected up to 25%. Thus the sources of only 22.3% of the piped water supply schemes get affected during summers Table 3.

During the year 2009 the district which was affected most is the Solan, where 38.12% of habitations got affected during summer. The other districts which were affected i.e, where the discharge of drinking water sources is reduced are Sirmour 29.2%, Hamirpur 5.55%, Kangra 17.05%, Bilaspur 27.31%, Mandi 14.54%, Shimla 15.05%, Kullu 10.15%, Chamba 1.6% and Una 8.03% Table 5.

Most of these schemes fall in Shiwalik hills. The total population affected during the summers is 768579. Thus 11.1% of the rural population feel scarcity of water due to reduction in discharge of sources Table 4.

During the year 2009, the total number of rural habitations which got affected are 6804, i.e 15.0% of the total habitations of the state Table 3.2. This year 26704 persons in 3 towns of the state felt scarcity of water in summers.

During drought years there is massive mobilization of water-tankers in summer months when acute shortage of water is felt. On average 400 water tankers are deployed to cope up the demand of drinking water during summer in the state. Table 6 During year 2009, 704 water tankers were deployed to supply water to the affected population. Most of the tankers were deployed in Bilaspur, Solan, Mandi, Una and Kangra districts.

Most of the water supply schemes, whose discharge gets reduced during summers, fall in Shiwalik hills. The middle and upper Shiwaliks are the recent deposits constituting the main geological formations. The Shiwalik comprises conglomerate, friable micaceous sandstone, siltstone and claystone. Water holding capacity of the soils is low. Soils are susceptible to excessive soil erosion and land slides due to water. Due to irregular, undulating topography, shallow depth, steep slopes, coarse texture, poor soil structure, scanty vegetative cover and erratic rainfall, during dry periods the soil profile dries up quickly on account of evaporation and transpiration. The crops experience drought like conditions and consequently the crop yields and discharge of water sources are affected adversely.

Most of the sources, whose discharge get reduced during summers are spring sources

Analysis of the rainfall data shows that there is no decline in average rainfall incident at a place in Himachal

Pradesh. While there are year-to-year fluctuations, no declining trend is discernible from the data available. The belief that the problems of water scarcity are due to reduction of rainfall is not supported by the rainfall data. However some erratic rainfall pattern has been observed in the recent past in the region. The problems of water scarcity are due to population growth, increase in per capita demand, urbanization, agricultural use and industrial demand.

Baories, dug wells, step wells, khatries and springs are the traditional water harvesting structures that have been used as source of drinking water in this region over the centuries. In many villages these systems have fallen into disuse with the spread of piped water supply. The size of catchments limits the quantity of water collected. The water demand has risen many times. Mostly it is sometime not possible to meet the demand of the villagers from the local sources.

Every year a huge amount of money is spent by government on installation of new hand pumps in the water scarcity areas. On average 540 hand pumps are drilled every year in the state Table 6. These hand pumps are mostly installed in areas where there is road connectivity.

Table 1 : Expected population and increase in daily drinking water demand in HP (in kilolitres).

Year	Total Population (in Lakh)	Urban population (in Lakh)	Rural population (in Lakh)	Urban water demand @ 135 litre per head per day	Rural water demand @70 litre per head per day	Total water Demand
1	2	3	4	5	6	7
2001	60.78	5.96	54.82	80460	383740	464200
2011	71.22	7.00	64.42	94500	450940	545440
2021	83.92	8.22	75.70	110970	529900	640870
2031	98.61	9.66	88.95	130410	622650	753060

Source : Sharma, M R, 2007, 'Depletion of Drinking Water sources in H.P', IIHS, HP University, Shimla-5

Table 2 : Increase in total daily drinking water demand in Kilolitres.

Year	Total Population (in Lakh)	Urban population (in Lakh)	Rural population (in Lakh)	Urban water demand @ 135 litre per head per day	Rural water demand @70 litre per head per day	Total water Demand
1	2	3	4	5	6	7
1951	23.86	0.98	22.88	13230	160160	173390
1961	28.12	1.77	26.35	23895	189450	208345
1971	34.60	2.42	32.18	32670	225260	257930
1981	42.81	3.25	39.56	43875	276920	320795
1991	51.71	5.00	46.71	67500	326970	394470
2001	60.78	5.96	54.82	80460	383740	464200

Source : Sharma, M R, 2007, 'Depletion of Drinking Water sources in H.P', IIHS, HP University, Shimla-5

Table 3 : Summary of Water Supply Schemes whose discharge got reduced during summers.

S.No.	Year	Total No. of Water Supply Schemes	Schemes affected by reduction in quanity of water during summer					
			0-25%	25-50%	50-75%	> 75%	Total water supply schemes affected	Year-wise percent age of the total schemes affected
1	2009	8315	985	746	516	313	2560	30.8%
2	2008	7989	615	612	430	245	1902	23.8%
3	2007	7989	456	453	363	193	1435	18.3%
4	2006	7989	394	42	263	136	1235	15.5%
5	2005	7989	351	461	282	459	1553	19.4%
6	2004	7989	740	550	400	210	2023	25.3%
Average	8043	590	540	376	259	1790	22.3%	
		Percentage of Schemes Affected	7.33%	6.71%	4.67%	3.2%	22.3%	

Source : Department of Irrigation & Public Health, HP Govt., Shimla -1 (2009)

Table 4 : Summary of Population affected during summer due to reduction in discharge of sources.

S.No.	Year	Total No. of habitation	Habitations affected by reduction in quantity of water during summer	Towns affected	Population affected		Total Population affected
					Rural	Urban	
1	2009	45367	6804	3	1018870	26704	
2	2008	45367	6315	3	815730	24152	
3	2007	45367	3785	3	734014	23191	
4	2006	45367	3145	15	578285	18091	
5	2005	45367	2809	5	453780	20800	
6	2004	45367	5200	9	888841	9020	
		Average	4676	6	748253	20326	768579
Percentage of Population affected					768579/6930000 = 11.1%		

Assuming last decadal growth rate @1.753%, the present population of Himachal Pradesh is 69.30 Lakh

Source: Department of Irrigation & Public Health, HP Govt., Shimla -1 (2009)

Table 5 : Population affected during summer due to reduction in discharge of sources (2009).

S.No.	Name of District	Total No. of habitation	Habitations affected by reduction in quantity of water during summer	Towns affected	Population affected		Percent of Habitations affected
					Rural	Urban	
1	Chamba	7776	124	7	4103	800	1.6%
2	Kangra	6141	1047	0	97725	1213	17.05%
3	Una	1617	130	0	25800	0	8.03%
4	Hamirpur	2520	140	0	25781	0	5.55%
5	Bilaspur	2325	635	2	70960	0	27.31%
6	Mandi	7358	1070	0	142041	0	14.54%
7	Kullu	3270	332	2	38460	0	10.15%
8	Lahul & Spiti	346	0	0	0	0	0
9	Shimla	6840	1030	1	43935	4591	15.05%
10	Solan	3310	1262	3	153823	0	38.12%
11	Sirmour	3540	1034	0	114437	0	29.2%
12	Kinnour	324	0	0	0	0	0
	Total	45367	6804	15	717065	26709	

Source : Department of Irrigation & Public Health, HP Govt., Shimla -1 (2009)

Table 6 : Year-wise List of Water Tankers deployed & New Hand pumps installed.

Year	Water Tankers Deployed	New Hand pumps installed
2003	494	467
2004	317	157
2005	286	96
2006	307	517
2007	248	714
2008	391	1257
2009	704	567
Grand Total	2749	3777
Average	392	540

Source : Department of Irrigation & Public Health, HP Govt., Shimla -1 (2009)

SUGGESTIONS

It would be nice to conclude on an optimistic note. It is possible to surmount the problems of water scarcity during summer in the near future. The following measures are required to be adopted in the next five years.

1. Sustainability of drinking water sources will have to take into account the State's ecological diversity. Imposing some technology in the varied regions of the State will be unsuccessful. The relevance of each technology in its local context must be addressed.
2. The issues involved in the sustainability of drinking water sources are intricate and interlinked planning for their sustainability must be ecosystem-specific and location specific. The control of these systems must lie with the people and the system must be based on the needs and capacities of the people so as to ensure their sustainability.
3. The various methods of artificial recharge both direct and indirect methods need to be encouraged. This is probably the best approach for creating year round availability of water.
4. Himachal Government has made a provision for roof water harvesting as a mandatory feature for all new constructions in the towns. All the existing urban houses should be persuaded to add this facility to their houses. Domestic roof water harvesting should be encouraged in villages also.
5. The Aquifer Storage and Recovery (ASR) technique, comprising recharge of a well during the period of surface water surplus and use of this storage to meet the increased summer requirements can be practiced in villages of lower Himachal to recharge few selected wells during monsoon, in place of tankers.
6. The present legal provisions allow an individual landowner to pump as much water as he can from any depth. This needs to be changed. Groundwater needs to be declared a common property resource of the residents of a watershed.
7. There should be restriction on the indiscriminate drilling of bore wells by individuals. It should be regulated through competent state authorities.
8. The tradition of annual desilting of the surface water harvesting structures and their feeder channels has to be revived.
9. Governments should develop the courage to prohibit cultivation of water guzzling crops such as paddy and sugarcane in areas which they have declared drought-prone.
10. The remarkable achievements have been achieved in Rajasthan and Gujrat through community effort of water harvesting. The work carried out by the people of drought prone Thanagazi area of Alwar district of Rajasthan has resulted in their having enough food, fodder and water and also transformed the local ephemeral streams into perennial rivers. These type of experiments need to be replicated in the state.
11. The Government should give the communities the right to manage their own water resources in watersheds/mini basins having catchments of up to 2000 Square kilometers.

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