Sisyphean Labours

Domestic Water Supply In The Central-Western Himalayas

**Peoples' Science Institute, 252/I
Vasant Vihar, Dehra Doon**

Abstract

Sisyphus\'sis-ə-fəs\n[L, fr. GK Sisyphos] : a legendary king of Corinth condemned to roll a heavy rock up a hill in Hades only to have it roll down again as it nears the top.

Domestic water supply, mistakenly referred to as drinking water supply, is a state subject under the Indian Constitution. But policies and programmes are usually set within a national framework as part of the national Five-Year Plans. Domestic water supply programmes' performance in Himachal Pradesh and Uttarakhand have also followed national trends.

The paper begins with a review of national programmes and their performances. The next two sections highlight the record of domestic water supply programmes in Uttarakhand and Himachal Pradesh with the help of official statistics and some ground truths from micro-level studies and surveys. The implications of these data are discussed in section four. The last section summarizes the main conclusions and recommendations for state policies and programmes.

I. National Programmes

In the first three Five-Year Plans rural domestic water supply was a relatively low priority subject. During this period Rs.100cr, at prevailing prices, were spent on providing 17,000 villages with piped water supply. The work was implemented as part of the Community Development Programme with the governments contributing materials and the beneficiaries providing labour. Urban water supply received a larger allocation than rural water supply in this period.

In the 1970s decade, a new approach was adopted based on the premise that provision of safe domestic water was the responsibility of the government.[1] More funds were allocated for water supply in rural areas than in urban areas. The Special Investigation Division established during the Third Five-Year Plan began the task of identifying villages facing water problems. In 1971-72, it listed 90,000 villages as scarcity-prone, another 62,000 had unsafe water sources and 1,85,000 villages just had dugwell sources. In the IVth and Vth Plan periods, the focus shifted from piped water supply to providing at least one assured (perennial) source of safe water in the problem villages (PV). Funding was increased significantly through the Minimum Needs Programme (MNP) and the Accelerated Rural Water Supply Programme (ARWSP). The former was funded by the states' governments and the latter by the central government. The bulk of the expenditure for urban water supply came from the states' Plans.

The start of the Sixth Five-Year Plan (1980-85) coincided with the start of the International Decade of Water Supply and Sanitation, of which India was a supporter. By then, it was claimed that domestic water supply systems had been installed to cover 84% of the urban population.[2] But this was an over estimate and the coverage was partial and uneven. In 902 small towns with populations below 20,000 the coverage was less than 50 per cent. The urban focus in the Sixth Plan was on small and medium-sized towns and environmental improvement in the slums of the larger cities. It also mooted the possibility of community involvement, particularly for repair and maintenance activities.

During the Seventh Plan a Technology Mission was launched to support the ARWS Programme. A Centrally Sponsored Rural Sanitation Programme (CSRSP) was also started. India's goal for the International Decade was to provide 100 per cent population coverage for domestic water needs and partial sanitary facilities in rural (25%) and urban (80%) areas.[3] By its end, the state and central governments had spent over Rs.11,000cr to achieve coverages of 78% for rural water supply, 2.7% for rural sanitation, 85% for urban water supply and 46% for urban sanitation.

At the end of the Seventh Plan many states claimed full coverage of all the Census villages. But people in far-off hamlets complained of lack of access to the government supply. A survey sponsored by the Rajiv Gandhi National Drinking Water Mission showed many villages with pockets of no access. Hence a new focus emerged in the 1990s targeting a safe and assured supply

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[1] GOI (2000): Guidelines for Implementation of Rural Water Supply Programme, Rajiv Gandhi National Drinking Water Mission, MoRD, Government of India (GOI), New Delhi, p.2.
[2] GOI (1981): Sixth Five Year Plan 1980-85, Vol.II, Planning Commission, GOI, New Delhi, p.400.
[3] *Ibid*, p.399.

of 40 liters per capita daily (lpcd) – within a distance of 1.6 km and an elevation difference of 100 m in mountain areas – to all rural habitations, i.e., upto the hamlet level. The goal was 100% coverage of rural and urban populations for domestic water supply.

The Eighth Plan also recommended charging a fee in rural and urban areas for house connections. It set aside 10% of the MNP and ARWSP funds for operations and maintenance. It targeted towns with less than 20,000 population and started the Accelerated Urban Water Supply Programme for them midway through the Plan. To raise adequate funds, the government sought institutional support, externally added projects and the involvement of the private sector.

Through the 46 years of planning, 1952-97, amounts of Rs 19,300cr and Rs 15,100cr were allocated for water supply and sanitation in rural and urban areas respectively.[4] At the end of this period there were still 88,000 not covered (NC) habitations, 3,91,000 partially covered (PC) settlements and another 1,40,000 had quality problems (QP). The corresponding figures at the start of the Eighth Plan were 1.41 lakh NC habitats, 4.30 lakh PC habitats and 1.51 lakh QP habitats.

Plan	**Rural WS & Sanitation Expenditure in Crore Rs.**	**Urban WS & Sanitation Expenditure in Crore Rs.**
Sixth Plan (1980-85)	2559	1419
Seventh Plan (1985-90)	4536	2558
Eighth Plan (1992-97)	10055*	7000
Ninth Plan (1997-2002)	?	20750

Source: Various Plan documents

The 54th round NSS survey (1998) gave the following coverage data:[1]

Source	**Per cent Families Covered**	
	Rural	**Urban**
Tap Water	19	70
Tubewell/handpump	50	21
Dugwell	26	-
<u>Of the above</u>		
In-house source	31	66
Source within 200m	42	32

[4] GOI (undated): <u>Ninth Five Year Plan 1992-97</u>, Planning Commission, Vol.II, GOI, New Delhi, p. 263.

Though the coverage figures appear within the range of the 100 per cent supply target, the actual situation is quite daunting. As the Tenth Plan notes, "official reports tend to give greater weight to physical and financial progress rather than the quality, reliability and sustainability of services."[5] Coverage does not reveal the daily per capita supply, the functioning of the system, i.e., breakdowns and supply disruptions, year-round performance, quality of water, losses in the lines and equity of distribution.

The Ninth and Tenth Plan documents acknowledged the Sisyphean nature of the problem, the limitations of the technologies and reliance on state departments to fulfill the targets, as well as the governments' increasing inability to finance the required investments. To meet the aims of full coverage of the rural and urban populations in the Ninth Plan period, it was estimated that investments of Rs 26,300cr and Rs 40,000cr respectively would be required.[6] The outlay for urban water supply and sanitation, however, was only Rs.20,750cr. The states and central governments were seeking the help of external funds, financial institutions and users' contributions to make up the balance.

Money Down The Drain

"The task in the Eighth Plan was to increase the coverage of access to safe drinking water to about 94 per cent of the urban population from 84 per cent at the end of the Seventh Plan …. it has been estimated that in terms of estimated 1997 population, the coverage of urban population is unlikely to increase from the level attained in the Seventh Plan."

"The likely expenditure in the Eighth Plan was about Rs 7,000 cr."

-- *Ninth Plan document, Vol II, p.265*.

The reliability of the rural water supply systems (WSS) installed is questionable at best. Some of them are seasonally non-functional, especially during the summer months of peak requirements. Others become permanently non-functional due to failure of the source itself. Since the Eighth Plan, 10 per cent of the funds have been set aside for operations and maintenance (O&M). But the states are unable to supervise such far-flung systems. The Planning Commission has called for people's participation and handing over the responsibility of O&M to the Panchayats. But the latter are unwilling to do so, especially when they do not have the requisite funds or the powers to raise them, and when they perceive the local supply systems to be unviable.

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[5] *Ibid*, p.634.

[6] GOI (undated): Ninth Five Year Plan 1992-97, Planning Commission, Vol.II, GOI, New Delhi, p. 264.

Domestic Water Supply Norms

Rural: State agencies are committed to supply a minimum of 40 liters per capita daily (lpcd) in the rural areas based on the following needs assessment: *

Purpose	Quantity (lpcd)
Drinking	3
Cooking	5
Bathing	15
Washing utensils & house	7
Ablution	10

This supply must be available within 1.6 km or an elevation difference of 100m in mountain areas. Its quality must be safe. At least one handpump/spot-source for every 250 persons must be provided for full coverage. Once the minimum supply of 40 lpcd has been achieved, it is recommended that the supply level be raised to 55 lpcd. Distance, elevation and population norms may also be liberalized by the states, which have fulfilled the minimum norm, subject to cost sharing by the beneficiaries. The Tenth Plan document emphasizes that the above rural norm is a minimum.

A Not Covered (NC) habitat refers to a settlement that does not have any domestic water source within the prescribed distance or elevation norms. If a source exists but its quality is unfit for drinking and cooking purposes, then it is a No Safe Source (NSS) habitation. A settlement that has a safe source within the distance or elevation norms but whose capacity is inadequate, is described as Partially Covered (PC).

Urban: The urban per capita norms cover requirements for domestic needs – drinking, cooking, bathing, washing, flushing toilets, gardening and air-conditioning – plus non-domestic requirements including institutional needs, flushing of sewers, watering of public parks, minor industries, commercial uses, fire fighting, etc. The norms developed by the Central Public Health & Environmental Engineers Organization (CPHEEO) of the Ministry of Urban Development are:**

1. Towns with piped water supply but without sewerage system: 70 lpcd
2. Cities with piped water supply and existing or planned sewerage system: 135 lpcd.
3. Metropolitan and mega cities with piped water supply and sewerage: 150 lpcd.
4. Public stand posts: 40 lpcd.
5. An additional 15 % of the above is provided to account for wastage. Bulk supplies for large industries are assessed separately.
6. There should be at least one source for 150 persons within 100m.

* GOI (2000): Guidelines for Implementation of Rural Water Supply Programme, Rajiv Gandhi National Drinking Water Mission, MoRD, Government of India (GOI), New Delhi, p.2.

** GOI (2003): Tenth Five Year Plan 2002-07, Vol II, Academic Foundation, New Delhi, p.636.

In addition to an alert system of O&M, the Planning Commission has acknowledged the need to ensure that the sources of supply do not go dry. It has mentioned the need for an integrated approach to water resources management on a watershed basis so that the sources get recharged through water harvesting. The Tenth Plan even calls for identification of traditional sources of water and their preservation through community involvement, since they meet a significant part of the peak demand in the summer.

In many urban areas, groundwater levels have begun to drop. The emphasis in the recent Plans has been to encourage water conservation through harvesting rainwater, reducing groundwater exploitation and wastage.

The crucial problem, however, remains. The government continues to entrust the planning of water supply programmes and targets to state agencies. Later the Panchayats, VOs , CBOs, professional institutions and others are entreated to implement, operate and maintain these projects, despite the fact that the Panchayat is the only tier of government that is as far flung as the habitations and hence best located to even plan the projects. The spirit of the 73rd and 74th Amendments demands that local self-government bodies in rural and urban areas should be empowered and enabled to manage all aspects of their water requirements.

II. Uttarakhand

Till the end of the Third Plan, domestic water supply programmes were mainly focused on cities and district headquarters. From the Fourth Plan (1969-74) onwards rural domestic water supply was given primacy. The passage of the Kumaun and Garhwal Water Act (1975) and the Water Supply and Sewerage Act (1975) saw the formation of the Garhwal and Kumaun Jal Sansthans in the respective administrative divisions. They were responsible for supplying water for domestic use, while the U.P. Jal Nigam was given the task of constructing the physical structures. After the formation of the state of Uttarakhand, in August 2002, the Jal Nigam and the Jal Sansthans were merged into the Uttaranchal Jal Sansthan, with one division each in Kumaun and Garhwal. Haridwar district is being looked after by a separate body.

II.1 Rural Domestic Water Supply

Rural domestic water supply trends in Uttarakhand follow the national patterns. An official survey of the eight mountain districts of the former U.P. state, conducted in 1971-72, identified 7771 problem villages (PVs) out of a total 15,166 villages in the region.[7] Of these, 452 were no source (NS) villages. Despite 5817 PVs being covered in the Fourth and Fifth Five Year Plans, a survey report (1985) prepared for the Seventh Plan revealed 4323 PVs. During the International Decade of Water Supply and Sanitation (1981-90) Rs 327cr were spent on supplying water to about 11,000 villages. Yet, in 1991 a survey conducted by the Rajiv Gandhi National Drinking Water Mission (RGNDWM) found 4980 (33%) PC and 871 (6%) NC villages.[8]

The Official Picture

Official data have reported a rapid extension of water supply coverage in the last decade as shown below:

Year	% of Settlements		
	FC	PC	NC
1991[9]	56	19	25
1996[10]	73.5	9.3	17.2
2002[11]	96.7	2.9	0.4

District-wise details given in Table III.1 show that Tehri Garhwal has the maximum number of NC and PC villages. In general, the figures for Garhwal division are better than for Kumaun.

Data compiled by the Uttaranchal Jal Sansthan show that in the first half of 2002 the Garhwal and Kumaun Jal Sansthan units were operating 6018 schemes. Rivers and streams were the sources for

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[7] Bisht.P & Upadhayay. A (2000): Uttarakhand Mein Jal Prabandhan: Ek Sinhavlokan, Naini Tal, 2001, p.27. (in Hindi)

[8] *Ibid*. p.28.
[9] *Ibid*. p.37.
[10] *Ibid*. p.39
[11] Uttaranchal Jal Sansthan (2002): Datasheet (mimeo).

3573 (60%) of them, 2173 (36%) were fed by springs. Pumping schemes numbered 84 (1.4%) while 150 (2.9%) were gravity fed projects.[12]

Table III.1: Status of Rural Domestic Water Supply in Uttarakhand (1.4.2002)

Sl. No.	District	No.of Settlements FC	PC	NC	Total*
1	Chamoli	2379	27	1	2407
2	Rudraprayag	1171	16	2	1189
3	Dehra Doon	1810	104	3	1917
4	Haridwar	530	0	0	530
5	Pauri Garhwal	3818	22	18	3858
6	Tehri Garhwal	3915	324	31	4270
7	Uttarkashi	1037	0	0	1037
8	Almora	4736	138	22	4896
9	Bageshwar	1865	83	8	1956
10	Champawat	1461	45	13	1519
11	Pithoragarh	3899	74	5	3978
12	Naini Tal	2302	75	4	2381
13	Udham Singh Nagar	1053	0	0	1053
14	**Uttarakhand**	**29976**	**908**	**107**	**30991**

* Includes only inhabited settlements.

Source: Uttaranchal Jal Sansthan (2002) datasheet.

Some Ground Truths

The official data show that the state agencies have succeeded in laying a network of rural WSS to cover almost all the habitations in the state. But the crucial question is whether it is able to provide a minimum of 40 lpcd of safe water every day. As mentioned earlier, the Tenth Plan (2002-2007) document highlights the fact that coverage data hide more than they reveal. The issues that interest common citizens and policy-makers are the amount of water supplied daily, its regularity, seasonal variation, potability and cost. Fortunately, many voluntary organizations and professional institutions undertake micro-level studies. Their information taken collectively presents a fairly comprehensive and insightful picture of the ground situation.

Adequacy: A study of 71 villages in Champawat block of the earlier Pithoragarh district was done in 1995-96.[13] Data regarding the per capita daily consumption was presented for 38 villages, of

[12] *Ibid*

which only four met the minimum 40 lpcd norm. Twenty-four villages reported an average of less than 10 lpcd. This study also found that 35 villages – half the sample -- fulfilled their needs from a combination of traditional and natural sources.

People's Science Institute (PSI) carried out a comprehensive rural development survey in all the eight mountain districts of the erstwhile U.P. state in 1998-99. The survey covered about 240 villages, 30 per district on an average and gathered data from over 4000 households, about 500 per district. This study substantiated the 1991 Census data in terms of the coverage of villages by rural WSS. For every district, there was a good match between the two sets of data (See Table III.2).[14] Out of 224 villages for which water use figures were available, barely a quarter (58) consumed more than an average of 40 lpcd. Of the 4077 responding households, again, only a fourth (24.2%) consumed more than 40 lpcd. The district-wise consumption averages ranged between 23.4 lpcd and 40.2 lpcd for Uttarkashi and Pithoragarh respectively, but almost all fell between 21 and 30 lpcd. Once again Tehri-Garhwal showed up as a poor performer, along with Uttarkashi.

Table III.2: Per Capita Daily Water Consumption in Rural Uttarakhand (1998-99)

Sl. No.	District	% Coverage			% Households Sampled					Av. Cons. lpcd	SS No.of Hh
		1991 Census	1998 PSI	SS*	0-10 lpcd	11-20 lpcd	21-30 lpcd	31-40 lpcd	>40 lpcd		
1	Chamoli	89.3	86.6	30	1.3	21.4	30.5	9.6	37.4	25.8	532
2	Dehra Doon	91.8	100	29	4.2	31.8	26.1	13.3	24.7	28.6	551
3	Pauri Garhwal	86.6	85.2	25	4.2	19.1	34.3	18.3	24	29.3	382
4	Tehri Garhwal	92.8	90.0	30	6.3	36.5	35.4	9.0	12.8	26.7	509
5	Uttarkashi	92.4	93.3	27	4.5	31.9	41.1	12.1	10.4	23.4	598
6	Almora	90.9	100	30	4.2	27.9	31.5	11.8	24.6	30.7	524
7	Pithoragarh	90.7	91.3	30	2.5	17.2	31.7	13.8	34.8	40.2	475
8	Naini Tal	90.4	95.6	23	2.4	24.5	29.1	16.6	27.3	28.8	506
9	**Uttarakhand**	**90.1**		**224**	**3.7**	**26.7**	**32.5**	**12.9**	**24.2**	**28.3**	**4077**

Note: (1) *SS: Sample size: No. of villages surveyed.

(2) The districts refer to the 8 mountain districts of the united Uttar Pradesh.

Source: PSI survey (1998-99)

13 Pande M (1997): "*Grameen Samuday Evam Jal Aapoorti Prabandh*", Paper presented at the Jal Samagam workshop, CDS, UPAA, Naini Tal, March 1997, pp.41-43.

14 PSI (undated): Rural Development In Uttarakhand, to be published.

PSI's water consumption data substantiated an earlier study of 135 households in seven villages of Garhwal, by the Govind Ballabh Pant Institute of Himalayan Environment & Development (GBPIHED).[15] It reported an average daily consumption of 29 lpcd. The season of the study was not specified. The villagers used a combination of sources to meet their water needs. The per capita average consumption break-up was as follows:

Drinking	1.5 lpd	5.1%
Cooking	2.8 lpd	9.5%
Cleaning utensils	7.2 lpd	24.5%
Bathing	5.7 lpd	19.4%
Washing clothes	6.9 lpd	23.5%
House cleaning	3.0 lpd	10.2%
Toilet	2.3 lpd	7.8%
Total	**29.4 lpd**	**100%**

Table III.3: Water Consumption Levels in Selected Watersheds

Watershed	District	No. of Villages					Survey Agency (Year)
		Water Consumption Levels (lpcd)					
		1-10	11-20	21-30	31-40	>40	
Uppalgaon	Dehra Doon	0	2	5	1	0	SMTA (1996-97)
Ghattgad	Almora	0	0	6	4	0	VADHU (1999-2000)
Naguragad	Tehri Garhwal	6	0	0	0	0	HPSS (2002)
Inangad	Tehri Garhwal	1	4	0	0	0	GSS (2002)
Bhanajgad	Rudraprayag	0	2	3	0	0	CDI (2002)
Total	**34 villages**	**7**	**8**	**14**	**5**	**0**	
Total	**As per cent**	**21%**	**23%**	**41%**	**15%**	**0%**	

Source: Various Watershed Development Plans

[15] Negi G.C.S., Joshi V & Kumar K. (undated): Him-Paryavaran Newsletter, GBPIHED, Kosi-Katarmal.

Watershed development plans prepared by a few organizations were analyzed to determine average water consumption levels. The data are reported in Table III.3. Nagura Gad in Tehri Garhwal is typical of pockets where the water supply and availability situation is extremely distressful. It has been noted earlier that Tehri Garhwal district has the highest number of PC and NC villages even in the latest data prepared by UJS. It was an under performer in the PSI survey (1995-96) also.

In terms of the distance norm, it is generally noted that people have to walk less to the government's water supply sources than to the traditional or natural sources. The Champawat study (1995-96) reported that people in the 66 reporting villages obtained water from a variety of sources as shown below:[16]

Water Supply Scheme (WSS)	11 villages
WSS + Natural sources	9 villages
Traditional sources	9 villages
Traditional + Natural sources	35 villages
No source	2 villages
Total	**66 villages**

Thus two-thirds of the villages were dependent on natural and traditional sources. The distance to source was as follows:

Less than 1 km	45 villages
Between 1 and 2 km	12 villages
More than 2 km	11 villages

There was no specific data reported for the average distance to the WSS source.

A recent survey (2003) of 40 villages in Uttarakhand by PSI showed that the average distance to the WSS source was only 54m. But these sources could be relied upon for supplying water for only 9 months a year on an average.

Micro-level studies quantify the generally known unsatisfactory water supply situation in the summer season. The Champawat study observed that in 40 reporting villages the supply in summer was 40% lower than the annual average. During summers, people turn to local natural and traditional sources, increasing the time required to fetch water.[17]

The Garhwal Jal Sansthan has reported the results of a survey done during April-June 1998 of the amount of water supplied by 1630 schemes in Dehra Doon, Chamoli, Pauri Garhwal and Tehri Garhwal districts. Seventy per cent of the schemes were unable to supply the minimum 40 lpcd as shown in Table III.4 below.

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[16] Pande M (1997): *op.cit*., pp.36-39.

[17] Negi G.C.S., Joshi V & Kumar K. (undated): *op.cit*,.

Table III.4: Water availability in surveyed schemes, April-June 1998.

District	No of Schemes for which discharge measurement was done	Water Availability			
		10 lpcd	10-20 lpcd	20-40 lpcd	40 lpcd and above
Dehra Doon	243	67	68	40	68
Chamoli	206	05	38	103	60
Pauri	601	17	78	407	99
Tehri	580	42	90	188	260
Total	1630	131	274	738	487
Percentage	**100**	**8**	**17**	**45**	**30**

Source: Garhwal Jal Sansthan, 2000.

Note: The above schemes were 10-15 years old and were designed and constructed for a minimum of 40 lpcd.

Women's Burden

In mountain villages, household chores are usually shared by the female members of the families. A recent study examined the work patterns of rural women in Himachal Pradesh and Uttarakhand.[a] In all, 96 women were interviewed. They included unmarried daughters, mothers and grandmothers. It was found that on an average in a typical family, these women collectively spent 1.5 hrs per day fetching water. Of this period, the daughter contributes 45 minutes, the mother about 15 minutes and the grandmother 30 minutes. In the summer season, the time spent is longer, 1 hour and 45 minutes, while in winter it is 1 hour and 15 minutes. In summer the mother puts in extra time. The seasonal difference is due to the extra distance and the extra amount of water consumed in summer.

* D.Ghosh & R.Chopra (2000): "Work Patterns of Rural Women in Central Himalayas", Economic & Political Weekly (EPW), December 30,2000, pp.4701-4705.

A recent survey (March-April, 2003) done under the Jal Sanskriti project by PSI and a group of voluntary organizations, covered 40 villages in Chamoli, Dehra Doon, Pauri, Rudraprayag, Bageshwar and Pithoragarh districts. About 81 per cent of the 791 households reported that they had access to a government pipeline. On an average, this source provided water for about nine months in a year. Government pipelines provided two-thirds of the summer requirement and about 75% of the winter demand. For the rest almost all the families relied on their traditional water sources. The average amount of water consumed ranged from 36 lpcd in summer to just 24 lpcd in winter

Sustainability: Reviews of the operational status of water supply systems give a picture of the sustainability of the infrastructure installed by the state agencies. The state-wide physical status of rural WSS in 1994, 1998-99 and 2002 are shown below.

Year	% of Schemes		
	Functional	Partially Functional	Defunct
1994[18]	64	21	15
1998-99[19]	-	-	15
2002	83.6	11.5	4.9

The 1994 report by the Kumaun Jal Sansthan (KJS) observed that more than a third of the installed systems were partially or fully dysfunctional. Though PSI's data differed from it at the district level the overall number of defunct schemes in Uttarakhand was almost the same. The differences could be due to the relatively small sample size of PSI's survey compared to the 100 per cent size of the KJS (1994) survey. The 2002 figures are based on a partial survey of 5828 projects by the Uttarakhand Jal Sansthan (UJS). The JS itself operates over 6000 schemes in the state and another 865 projects are under the JN. The UJS data reflects a big improvement in the last eight years. Such data, however, will be more credible if they are compiled by an unbiased agency.

Analyzing the causes of dysfunctional schemes, the KJS noted the following reasons:[20]

- Inadequate finance
- Damage due to natural disasters
- Shortage of staff
- Lack of involvement of community and users
- Low priority to maintenance over new construction
- Non-availability of basic workshop facilities in many areas
- Unwillingness of the staff to serve in remote areas.

Without belittling the problems listed above, it is interesting to note that almost all of them absolve the implementing agency of blame. Commonly discussed reasons like poor planning, departmental inefficiencies, use of poor quality materials, poor workmanship and corruption are not mentioned. The Champawat study noted that the official agencies often did not have adequate source flow measurement data while designing schemes.[21] This point is reiterated by the GBPIHED paper.[22]

Loss of forests coupled with massive land use changes, intense grazing, reduced water retention capacity of catchments, declining rainfall in some localities, etc. have led to diminishing discharge

[18] Sinha V.K. (1996): "Rural water supply schemes and women – with special reference to Kumaun region", paper presented at the seminar on Water Management In The Himalayan Regions Of India, Naini Tal, August 1996.
[19] P.S.I (unpublished): op.cit.
[20] Sinha V.K. (1996): *op.cit*.
[21] Pande M(1997): *op.cit*.,
[22] Negi G.C.S., Joshi V & Kumar K.(undated): Him Paryavaran Newsletter.

of springs.[23] Deforestation, leading to drying up of springs and streams in the middle Himalayas, may be the most important cause of failure of the source itself. Himalayan catchments have a high component of subsurface flow and hence springs activity is extremely vulnerable to deforestation.[24]

Valdiya and Bartarya analyzed the flow data of 41 springs in a pioneering study of the Gaula river watershed in Naini Tal district.[25] They recorded a decline in forest cover in the catchment from 69.6% to 56.8% between 1952-53 and 1984-85. Between 1956 and 1986 the recorded rainfall at Bhimtal, in the watershed, showed a decline of 33 per cent. But decreases in the springs flow were between 25 and 75 per cent, affecting 40 per cent of the villages studied. Some springs had completely dried up. Another study of 60 springs in Kumaun showed that 10 (17%) had ceased flowing, 18 (30%) had become seasonal and discharge reduction was noticed in the remaining 32 (53%).[26] This was attributed to the large scale disappearance of oak forests where these springs were located.

Equity: Data on equity is scarce. PSI's comprehensive rural development study reported a clear difference in the amount of water used in SC/ST households compared to other castes.[27] While fewer SC/ST households received more than the minimum norm of 40 lpcd, a higher fraction received only 11 to 20 lpcd. The differences were large in Almora, Chamoli, Naini Tal and Pithoragarh districts, but nearly negligible in Dehra Doon, Pauri Garhwal, Uttarkashi and Tehri districts.

III.2 Urban Water Supply

According to the 2001 Census Uttarakhand has 80 urban areas which account for 25 per cent (2.1 million) of the state's total population.[28] Some of these are actually suburbs of larger cities. Leaving out the suburban areas, the rest can be classified as:

Class I	> 100,000 population	4 cities
Class II	50,000 < population < 100,000	3 towns
Class III	20,000 < population < 50,000	4 towns
Class IV	10,000 < population < 20,000	7 towns
Class V	5000 < population < 10,000	9 towns
Class VI	<5000 population	34 towns
Total	**urban pop: 2,170,245**	**70 towns and cities**

[23] Negi, G.C.S. and Joshi V. (1996): "Geohydrology of springs in a mountain watershed: the need for problem solving research," Current Science, v71 n.25, pp.772-776.
[24] *Ibid*.
[25] Valdiya K.S. & Bartarya S.K.(1989): "Diminishing Discharges Of Mountain Springs In A Part Of Kumaun Himalaya", Current Science, v58 n.8, pp.417-426

[26] Singh A.K. & Pande R.K. (1989): "Changes In Spring Activity: Experiences of Kumaun Himalaya, India", The Environmentalist, v 9 n 1, pp 25-29.
[27] PSI (undated): *op.cit*.
[28] Sanderson R. (2002): "Urban Population Growth In Uttarakhand", PSI, Dehra Doon. (unpublished)

A survey done by the Kumaun Jal Sansthan showed that in 1993 only 10 towns were being supplied with enough water to meet the normative requirement of 100 to 175 lpcd.[29] The summary results of a more recent review of the operational status of urban water supply systems in 2001 by the Garhwal Jal Sansthan are given below:

No. of Schemes	% Availability of water against demand			
	≤ 25%	> 25% but ≤ 50%	> 50% but < 100%	≥ 100%
61	8 (13%)	16 (26%)	22 (36%)	15 (25%)

Source: Garhwal Jal Sansthan datasheet, 2001.

Thus only 61 per cent of the towns were able to meet more than half their demand. Cities like Almora, Pauri, Pithoragarh, etc. face water shortages at various times during the year. A composite picture of the various problems of urban water supply systems emerges from the vignettes presented in the following paragraphs.

Gopeshwar: The present headquarters of Chamoli district was like a large village with a population of less than a thousand in 1961. Water was supplied from two *dharas* —Vaitarni and Gwesepani—near the village, a well and a one-inch thick pipeline installed in 1925. That was enough for humans and animals. Now the population of Gopeshwar is more than 20,000 and even after laying 25-30cm diameter pipes, people are facing water problems. An earthquake on March 29, 1999, damaged the water mains forcing the people to drink water directly from natural and traditional sources for a week. People had to stand in queues for hours to fill just a bucket from the town's *dharas*.

Pithoragarh: Pithoragarh was also like a small village until 1962 when security reasons forced the expansion of roads in this area bordering on Nepal and China. It expanded rapidly thereafter. In the 1970s the newly established Jal Nigam established the Ghat lift project to pump water about 1000m up from the Saryu River to Pithoragarh. This expensive scheme was considered a panacea for Pithoragarh's water woes. But inadequate maintenance led to leaks and irregular supplies. Now people in various localities get just a bucket of water every three days. New schemes have been added to meet the growing population, which has now crossed 41,000. Local farmers fearing a loss of their water are opposing the Phagaligad scheme on the Thuli *Gad*. The latter is already being used to meet the needs of an army base.

The Ghat pumping project will also be remembered for damaging the city's *naulas* and *dharas*. As along as people got water through pipes, they took no care of these sources. Haphazard growth of the city without the necessary civic infrastructure led to new problems. In localities like Shivalaya and Takana Khet there was no sewer line and people dug sanitary pits. Overflow from these pits polluted groundwater sources including *naulas* located below. Scientists of the Defence Agriculture Research Laboratory based at Panda conducted a study of the city's water quality. They found severe contamination of the groundwater. The local administration had to put up warnings at various *naulas*.

[29] Bisht P. & Upadhyay A (2000): *op.cit*., p.

Pauri: The British selected the little village of Pauri in the 19th century as the headquarters of British Garhwal. Dense oak and rhododendron forests surrounding the village ensured a perennial supply for about 20 natural water sources in the area. Dhara Road was named after an old and historical *dhara* dating back to the 11th century, according to an inscription on it. Water flowed into the *dhara* from a *guhl* originating from the forest below the Lakshminarayan Temple. The *dhara* was damaged when a motor road was constructed in Pauri in 1943. Gradually its water flow stopped and now it is in a highly neglected state. Several other *dharas* including the Collectorate *dhara*, Deputy *dhara*, Jail *dhara* and Bhim *dhara* also became inadequate.

The population of Pauri in 1951 was just 5250. Twenty years later it had doubled but the *dharas* had dried up. To meet the growing needs, the Srinagar-Pauri pumping scheme was constructed in 1975. It was designed to supply 190 lpcd for the expected population over the next 30 years. This scheme has faced maintenance problems and as the town has expanded, people in many localities have no access to its water, despite the construction of 12 tanks for storage and distribution.

Two new projects, a gravity flow one and a lift scheme have now been proposed to end Pauri's water problems. The designed life-span of the Srinagar-Pauri Pumping Project is till 2007. Therefore, as an alternative to this project, a gravity scheme at a cost of almost Rs 20cr from Natghat has been selected. It is claimed that this project will provide sufficient water for the next 25-30 years. However, a pumping scheme has also been formulated at a higher cost despite the failure of the first pumping scheme and successful working of gravity schemes at a low cost.

Dehra Doon: Dehra Doon is a water surplus city. It receives an average annual rainfall of about 180cms, equivalent to 90,000 Ml of water within the city limits. This rainfall alone, can provide almost 450 lpd for each resident today. Runoff from the slopes of the Lesser Himalayas and the Shivaliks adds to this bounty.

The Lesser Himalayas (Mussoorie range), the northern boundary of the Doon Valley, form a formidable barrier to the northward movement of the southwest monsoon clouds, making Dehra Doon one of North India's wettest cities. A part of the rainwater gushes down through several small streams, but a part is trapped by the vegetation on the mountain slopes and released into the soil. A massive limestone belt of in the Mussoorie range traps a tremendous amount of water and releases it to the Doon Valley through perennial springs, like Sahastradhara, Jharipani, Guchipani, Nalapani, etc.

The base of the Doon Valley is a deep bed of gravel. Hence in most of the Valley there is no site to store water. In the southern part of the Valley, relatively impermeable clay soils near the Shivaliks raise the water table. Hence a vast majority of tubewells that supply water to Dehra Doon city are located in its southern part. For a long time villagers in the foothills of the Mussoorie range used masonry canals to tap the mountain torrents just before they reached the Doon gravels. Rani Karnavati is credited with building the first masonry canal in the early 17th century. Water from this canal feeds the city's main water supply works on Rajpur road.

Water Demand: Preliminary Census 2001 data estimated the population of Dehra Doon's urban agglomeration at 5.3 lakhs.[30] Assuming a 30 per cent decadal growth rate, the future water demand can be estimated as below.

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[30] Sanderson R. (2002): *op.cit*.

Year	Estimated Pop	Minimum daily demand @ 165 lpcd*	Maximum daily demand @ 200 lpcd*
2001	5.3 lakhs	87.5 Mld	106 Mld
2010	6.9 lakhs	113.9 Mld	138 Mld
2020	9.0 lakhs	148.5Mld	180 Mld

Assuming a 30% decadal growth rate

Water Supply: Residents of Dehra Doon's urban agglomeration (UA) receive their water supply from either the Garhwal Jal Sansthan or the Cantonment Board or private sources. The total amount of water extracted by various sources in the UA is about 125 to 148 Mld, depending on the withdrawal from private tubewells. About 80 per cent of the Jal Sansthan's supply is from tubewells. It is obvious that Dehra Doon's citizens should receive a comfortable amount of water, about 250 to 300 lpcd for a population of 500,000 people.

At present, the Jal Sansthan assumes line (distribution) losses to be about 30 per cent. Even then, more than enough water is available to meet the needs of the city. If the available water in Dehra Doon is properly husbanded, i.e., line losses are reduced, the supply available today should be more than adequate up to 2010 A.D. and may even be sufficient to meet the needs of the subsequent decade.

Despite this abundant availability of water in Dehra Doon, there is a general perception amongst many citizens that water is a scarce resource in the city. This may be partly due to the iniquitous distribution of water. A survey conducted by PSI in 1995-96 showed that while the well-off localities consume an average of 140 lpcd, the poor make do with just 15 lpcd (1 bucket a day). Another cause of the scarcity perception may be the intermittent nature of the daily supply – twice-a-day for a few hours.

The scarcity perception, however, is more due to the shortages that often occur for a few weeks in the summer months. Jal Sansthan engineers and other agencies feed the scarcity perception. For 2001, the Jal Sansthan claims a shortfall of 60.4 Mld between Dehra Doon's daily water demand and supply ! It estimates a daily demand of 127.2 Mld, as follows:

(i) Domestic requirement for 5.61 lakh people @ 200 lpcd = 112.2 Mld

(ii) Industrial demand = 15.0 Mld

It claims that it is only able to supply 66.8 Mld since:

(i) The total production of water from surface and groundwater sources by the JS = 95.4 Mld

(ii) Line losses @ 30% of above = 28.6 Mld

(iii) Net supply = 66.8 Mld

Hence, the daily deficit of 60.4 (127.2-66.8) Mld.

But the analysis of the JS is erroneous on two major counts:

1. The norm of 200 lpcd supply includes industrial demands and losses in distribution as defined earlier. The corresponding 'deficit demand' amounting to about 43.6 Mld is included in 112.2 Mld, by definition of the norm used.
2. Dehra Doon's population receives about 29 to 52 Mld from the Cantonment and private sources. The JS conveniently forgets to add this figure to the amount supplied to the citizens every day. By including a notional 'floating' population of about 50,000 persons – defined as tourists, essentially in the summer season -- for the purposes of calculating daily requirements, but ignoring the extra supply available in the city, the JS is falsifying the numbers.

Shortages of water supply in Dehra Doon occur primarily during the summer, due to the city's over-reliance on groundwater, high distribution losses and iniquitous supply (and use). Almost 80 per cent of the Jal Sansthan's daily water supply is from tubewells. About 42 tubewells are over 100m deep. The groundwater levels drop from about 70m after the rains to about 110m during the summer. This creates water scarcities in many parts of the city. Ironically, it is also the time of the year when the demand goes up – tourist influx and increased household needs. In the summer, power cuts are more frequent. These cuts reduce the groundwater withdrawals. The more densely populated and poorer localities bear the brunt of the summer shortages.

Water Quality: Almost 80 per cent of the city's water supply comes from groundwater, which has been naturally filtered through 100m of soil and gravel. Hence its quality "at source" is good. The waterworks' objective is to reduce the coliform count to less than 10 per 100 ml, but more importantly, to ensure that there are no fecal coliform organisms in the water. The amount of residual chlorine should be within 0.2mg/l to 0.5mg/l.

People's Science Institute (PSI) has been testing Dehra Doon's water quality at specific sites, periodically during the last decade. Its data show that by the drinking water standards (IS10500:1991), most of the water supplied to Dehra Doon is sub-standard, particularly since at no site can the standard, "Throughout any year, 95 per cent of samples should not contain any coliform organisms in 100 ml," be met. At the same time it is clear that at some of the sites, the TC and FC values, though greater than zero, are low. PSI's studies also show that the water quality in the city varies with the seasons. In general, March to September is the period when coliforms in excess of the standards are routinely detected in the water supplied. From October to February the coliform counts are usually within the prescribed standards.

Most of Dehra Doon's water quality problems are linked to leakages in the distribution pipelines, since JS does chlorinate the water. This is also evident from the fact that the quality varies from locality to locality. Thus the problems of Dehra Doon's water supply quantity and quality largely stem from the same source, a distribution system that requires better maintenance.

Meeting Dehra Doon's Future Water Demand*

Water supply resources in Dehra Doon will have to be augmented in the future to meet the needs of a larger population. Where will the water come from ? Where will the money come from? The Jal Sansthan's expenditures usually outstrip its revenues.

The cost of creating additional resource capacity varies from about Rs 560/kl (kilolitre) for surface water, to about Rs 3600-4800/kl for groundwater. Most of these projects are financed by loans from financial institutions, including the World Bank. Institutional loans are available only at substantial interest rates, which a poor state like Uttarakhand can ill-afford.

Perhaps, the cheapest way to augment Dehra Doon's water resources is to reduce the wastage due to leakages in the distribution pipelines. At present, the Jal Sansthan estimates a loss of almost 30 Mld (~30 per cent of the daily supply). While the JS admits, that it can reduce this loss to 20 per cent, the goal should be to bring it down to 10 per cent.

To create new resources, the JS is likely to focus on more tubewells. Tapping groundwater is not only expensive, but it cannot solve the problem of summer shortages. With every new tubewell, the pressure on the city's water table grows, aggravating the supply problem in the summer.

Under these circumstances, rainwater harvesting from the rooftops of buildings becomes a very feasible economic and eco-friendly alternative. A family living on plots of 300 to 400 m^2, can practically harvest about 100,000 litres a year at an estimated rate of Rs. 720 to Rs.1000/kilo litre. At 150 lpcd, for a family of 5 persons, this is a 4.5 months supply. At 100, it is a 200 days supply. The owner will have to incur additional costs for pumping the water out. Purity can be maintained by chlorination with bleaching powder.

Several cities in India have taken initiatives to promote rainwater harvesting. These include Delhi, Chennai and Bhopal. The Jal Sansthan should consider providing incentives for roofwater harvesting installations.

* Extracted from, PSI (2001): WATER, Dehra Doon Factsheets Series, Dehra Doon.

III. Himachal Pradesh

In Himachal Pradesh too, domestic water supply is the responsibility of the state. All the water supply programmes are generally within the national framework. The Centre provides funds through the ARWS and AUWS Programmes. As elsewhere, the programmes adopt a supply side approach rather than being demand-driven. H.P. has raised the target for rural water supply to 70 lpcd. A single Department of Irrigation and Public Health (IPH) looks after irrigation and domestic water supply so that there is administrative integration. A Superintending Engineer heads a circle (district) and is responsible for domestic water supply and irrigation.

III.1 Rural Water Supply

As in Uttarakhand, domestic water supply investments showed sharply stepped up investments during the decades of the 1970s, '80s and '90s, as shown below:[31]

Plan Period	Investments (State + Centre) Rs. in cr	Villages covered
First Three Plans (1951-66)	2.04	1036
Three Annual Plans (1966-69)	1.10	398
Fourth Plan (1969-74)	5.00	1403
Fifth Plan (1974-78)	6.36	931
Two Annual Plans (1978-80)	23.91	2657
Sixth Plan (1980-85)	96.35	6318
Seventh Plan (1985-90)	125.76	2610
Two Annual Plans (1990-92)	108.91	775
Eighth Plan (1992-97)	315.69	777+ 3075 habitats

By 1994, all the 16807 Census villages had been provided at least one source of potable water within 1.6 km.[32] But at the same time, many habitations were either not covered or only partially covered as shown below.

Year	No. of Settlements			
	NC	PC	FC	Total
1994[33]	7157 (16.3)	11644 (26.6)	24980 (57.1)	43781 (100)
1999[34]	3750 (8.3)	13592 (30)	28025 (61.7)	45367 (100)
2001	1593 (3.5)	11658 (25.7)	32116 (70.8)	45367 (100)

[31] SCSTE (2000): State of the Environment Report – Himachal Pradesh, State Council for Science, Technology & Environment, GoHP, Shimla, p.93.
[32] *Ibid*, p.91.
[33] SCSTE (2000): *op.cit*, p.91.
[34] GoHP (2000): Annual Plan 2000-2001, Planning Department, GoHP, Shimla, p.326.

The above data shows under-counting of the habitats in 1994. It also shows that new schemes have been speedily installed to reduce the number of NC habitations by about 78 per cent. But the problem of PC villages appears to be intractable. The district-wise coverage is shown in Table III.5

Table III.5: District-wise rural habitations coverage by domestic water supply schemes in Himachal Pradesh.

Sl. No.	District	1.4.2001				
		NC	PC	FC	Total	% FC/Tot
1	Bilaspur	0	770	1555	2325	66.9
2	Chamba	145	453	7178	7776	92.3
3	Hamirpur	0	1775	745	2520	29.6
4	Kangra	180	3090	2871	6141	46.8
5	Kinnaur	0	0	324	324	100.0
6	Kullu	75	72	3123	3270	95.5
7	Lahaul-Spiti	0	0	346	346	100.0
8	Mandi	112	1107	6139	7358	83.4
9	Shimla	544	3125	3171	6840	46.4
10	Sirmour	400	313	2827	3540	79.9
11	Solan	137	389	2784	3310	84.1
12	Una	0	564	1053	1617	65.1
13	**H.P.**	**1593**	**11658**	**32116**	**45367**	**70.8**

Source: IPH Department, GoHP, Shimla, 2001.

The worst off district is Hamirpur with a full coverage of only 29.6% habitations, even though it has no NC habitat. Kangra, which has the maximum irrigated area in the state and the capital district of Shimla also perform poorly. Kangra's slow progress may be partly due to a part of the district being a drought-prone area – the Changar (wasteland in local parlance) region. But this area has also been the beneficiary of a major eco-development project, the Indo-German Changar Eco-development Programme. Newspaper reports appear routinely highlighting water shortages in the Changar villages. The poor performance of Hamirpur, Kangra and Shimla districts is also surprising for another reason. The last three Chief Ministers of Himachal belonged to these very districts.

A variety of sources are used in Himachal Pradesh to obtain domestic water supply. The results of a state-wide survey of such sources in rural areas, done in 1991-93, are summarized in Table III.6. Traditional sources supplement government supplies to a very significant extent, particularly during the lean times.

Table III.6: Distribution of Water Sources in H.P.

Sl.No.	District	No.of Villages	Types of Sources				
			Ground	Surface	Traditional	Other	Total
1	Bilaspur	950	827	786	461	0	2074
2	Chamba	1144	1717	2433	2598	839	7587
3	Hamirpur	1617	1057	485	231	1	1774
4	Kangra	3620	1602	1317	1369	477	4765
5	Kinnaur	228	76	217	24	2	319
6	Kullu	172	0	3392	0	0	3392
7	Lahaul-Spiti	272	1	290	57	0	348
8	Mandi	2818	833	3924	1483	840	7080
9	Shimla	2311	233	3917	2518	14	6682
10	Sirmour	965	644	2249	535	9	3457
11	Solan	2348	344	1090	1215	316	2965
12	Una	552	832	123	21	117	1093
13	**H.P.**	**16997**	**8166**	**20223**	**10512**	**2615**	**41536**

Source: State of The Environment Report-Himachal Pradesh, 2000.
Note: Others includes location-specific non-conventional methods.

Only three micro-level studies were available for analysis. Their data have been supplemented with information from newspaper reports.

Adequacy: Watershed development plans prepared by implementing agencies in a few districts in the last few years give daily consumption levels averaged over the year. The data are summarized in Table III.7

Table III.7: Water Consumption Levels in Selected Watersheds

Watershed	District	No. of Villages					Survey Agency (Year)
		Water Consumption Levels (lpcd)					
		1-10	11-20	21-30	31-40	>40	
Bhagan Khadd	Kangra	0	0	3	0	0	CTT (2002)
Kotlu Khadd	Mandi	0	5	1	0	0	SKVM (2002)
Jabli	Bilaspur	0	0	1	13	0	MMJ (2001-2002)
Total	**23 villages**	**0**	**5**	**5**	**13**	**0**	
Total	**% all villages**	**0**	**22**	**22**	**56**		

Source: Various watershed development plans.

It is noteworthy that no village had an average consumption of 40 lpcd or more.

Under the Jal Sanskriti Programme, PSI and a group of voluntary organizations surveyed domestic water consumption patterns of over 1100 households in 35 villages of Bilaspur, Hamirpur, Kangra and Solan districts. Almost half the sample was SC (46%) and ST (5%) households. Eighty-three per cent of the families said that they had access to a pipeline installed by the IPH department. The average distance to the IPH source was only 39m. Not only has the IPH succeeded in installing an extensive network of pipelines to the habitations, but it has also equipped a large number of households with taps. In Himachal, private tap connections are available on application and payment of a fee. But newspapers routinely carry stories of no water flowing in the taps.[35] The Jal Sanskriti survey reveals that on an average the IPH sources are able to supply water for only eight months in a year. There is also a public perception that increasing the number of private taps increases the shortages experienced by the non-tap consumers.[36]

When the IPH supplies fail, people routinely fall back on their traditional sources. If there are no built water bodies like *baoris*, *khatris*, *nauns,* wells, tanks, etc. (See previous chapter), people fetch water from natural sources, primarily springs and streams. In summer, however, the flow in the springs is often low or non-existent. When there is no source available the district administrations have to provide water tanker services. *Baoris*, *nauns* and tanks are often not well-maintained. But in the lean season when people are forced to rely on them, they are cleaned sometimes. In fact there is now a growing appreciation of the need to resurrect the traditional sources.[37]

The Jal Sanskriti survey (2003) mentioned above, determined the water consumption patterns in summer and winter. The average water consumption for about 740 reporting families was 45.9 lpcd in summer and 30.5 lpcd in winter. About 64 per cent of the summer season consumption was

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[35] Amar Ujala (2002a): July 3,2002 (in Hindi)
Punjab Kesri (2002): August 25,2002 (in Hindi)
[36] Amar Ujala (2002b): July 12,2002 (in Hindi)
[37] Divya Himachal, July 15, 2002. (in Hindi)

met by the IPH supply and the rest came from traditional or natural sources. In winter the government supply meets about 82 per cent of the average per capita consumption. The reliance on traditional sources in the summer is thus twice that in the winter. A categorization of the sampled households by the number of buckets used per capita daily, for the two seasons is given below.

Consumption	Summer	Winter
Upto 1 bucket (<15 lpcd)	15.2%	21.5%
1 to 2 buckets (15-30 lpcd)	24.7%	42.4%
2 to 3 buckets (30-45 lpcd)	24.0%	15.0%
More than 3 buckets (>45 lpcd)	36.1%	21.1%

Thus in the winter, about two-thirds of the population consumes only two buckets, woefully below the minimum norm. The reduced winter consumption could be related to the demand as well as the ease of access factor. The effect of ease of access can possibly be understood by comparing the difference in consumption levels of those who have taps with adequate water supply in summer and winter and those who do not have private tap connections. Such a survey is yet to be done.

Sustainability: Unlike Uttarakhand, no specific data were available about the performance of the various installed schemes. But there is enough evidence about the nature of the problem.

So far much of the development of water resources in Himachal Pradesh has focused on surface water resources, particularly streams, rivers and springs. But deforestation, land use changes and development activities are leading to reduced year round flows or extinction of springs. When springs and streams fed by them dry up, they affect the government supply systems and the traditional sources. In the summer of 2002 the state's Minister for IPH stated that 25 per cent of Himachal's traditional sources had dried.[38]

The State of the Environment Report produced by the State Council for Science Technology and Environment, observed that often schemes get designed on a source without measurement of its lean season discharge.[39] Such water supply systems yield either little or no water during the summer. Mismatch between water availability at source and the population served by it can make a small reduction in flow lead to serious problems. In 2002-2003 failure of winter rains in the state led to serious domestic water supply problems in many districts.

Till now Himachal Pradesh has tapped only a small fraction of its groundwater resources. Rough estimates indicate the groundwater potential of Himachal Pradesh to be about 500 Mlpd.[40] Handpumps for extracting of groundwater are usually quicker and cheaper to install than tapping surface water sources. The IPH Department has installed over 8800 handpumps throughout the state. But due to irregular maintenance many handpumps become non-functional. Installation of handpumps is being increasingly done in the valleys of the low hills and mid-hills regions, as a quick response to water shortages. But in such cases, the geohydrological investigations are not thoroughly done and the units installed go dry, due to heavy demand on the source.

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[38] Amar Ujala (2002c): June 4,2002. (in Hindi)
[39] SCSTE (2000): *op.cit*., p.102.
[40] SCSTE (2000): *op.cit*., p.102.

Equity: There are occasional reports of dalit bastis being neglected by IPH facilities.[41] But the Jal Sanskriti survey did not reveal any significant difference in the amount of water consumed in summer between the SC and the higher castes households. If anything, the SC families used more water in the winter than the higher castes. The survey, however, revealed that ST families – primarily *Gaddis* who are shepherds -- consumed significantly lower amounts of water. This may be related to their scattered habitats and less sedentary lifestyle compared to the rest of the population. The survey results are given below.

	Consumption (lpcd)		Source Access		Sample Size
Caste	**Summer**	**Winter**	**Government**	**Traditional**	**N**
Brahmin	44.6	29.3	94%	95%	128
Rajput	43.3	27.4	65%	94%	311
SC	44.0	32.5	77%	96%	300
ST	26.4	24.7	77%	91%	57

Water Quality: Typically, a pipeline water supply system is a five-stage operation. Water from the source is brought to a storage tank via an intake chamber. It is then transferred to a sedimentation tank so that suspended solids can settle down. The filtrate is led to a treatment unit for chlorination, usually with bleaching powder, from where it flows to another storage tank and is finally distributed to the people. It has been observed, however, that in many villages the treatment unit is either not built or is not functioning, particularly in the post rainy season. In villages where there is no treatment unit, the second storage tank is also not built.

In the summer of 1996, the Industrial Toxicology Research Centre, Lucknow determined the quality of 111 drinking water samples from different locations in Kangra district. About half the samples had coliform counts within the acceptable limits set by IS: 10500 (1991).[42] Physico-chemical analysis revealed the following violations:

- 17 samples exceeded the Fe-content limit (1.0mg/l)
- 6 samples exceeded the Mn-content limit (0.52 mg/l)
- 52 samples exceeded the Pb-content limit (0.1 mg/l)

A few samples also had excess calcium (20), magnesium (13) and cadmium (2).

Since a number of samples were taken from handpumps, the above study recommended that water quality tests be undertaken while installing these pumps. Lead is a harmful carcinogen.

In times of water shortages people draw water from the nearest available traditional or natural source. PSI has begun a systematic study of such sources in villages, where it has an outreach. The first round of testing was done in April 2003 in 5 streams of 5 micro-watersheds in Hamirpur district. The tests showed that the stream water quality was of class C, i.e., fit for drinking after

[41] Punjab Kesri (2003): January 8,2003. (in Hindi)
[42] BIS (1991): Drinking Water Specification IS 10500:1991, Bureau Of Indian Standards, New Delhi.

treatment. Though coliforms were present, their range was low ($4 \le TC \le 240$, FC values were < 3 in all but two cases) as compared to the stream water quality standard of 2000 per 100ml for C class streams. Water samples from three *baoris* in the district also tested positive for FC counts, but the maximum value was 4 per 100ml.

People should be instructed to either boil the water before drinking or treat it with an adequate dose of bleaching powder (1.0 to 1.5 mg/l) before drinking it. In May 2002, the SDO in Nurpur asked the IPH staff to provide the Panchayat sub-committees with bleaching powder so that they could ensure chlorination of traditional water sources.[43]

Urban Water Supply: Himachal has 55 urban areas with a total population of only 5.95 lakhs.[44] They are classified as below:

Class I	> 100,000 population	1 city
Class III	20,000 < population < 50,000	4 towns
Class IV	10,000 < population < 20,000	7 towns
Class V	5000 < population < 10,000	9 towns
Class VI	<5000 population	34 towns

A survey of six towns – Shimla, Solan, Dharamshala, Mandi, Manali and Chamba highlighted the following features of their water supply:[45]

- More than 80 % households used piped water sources for drinking to the exclusion of other sources. A large majority used piped water for other domestic purposes also.
- About one-third of the population used community taps solely or in addition to household tap supplies for their daily water needs.
- The distance to the source was 50m on an average, well within the specified norm of 100m.
- More than 50% of the households consumed over 100 lpcd.
- About 85% of the respondents spent nearly 30 minutes per day to transport more than 150 liters of water.
- Nearly one-third of the sample tested were contaminated with pathogens. The contamination increased with the distance of the supply line. Households within 1km of the main supply tank had significantly fewer coliforms in the water than those that were further away. Fecal contamination in household taps' water was about half that of the community taps' water.

In many towns of Himachal Pradesh the water supply systems are old. They were designed to serve much smaller populations. Shimla is a classic case (See Box: Why Is The Queen Thirsty?). In old towns like Shimla the distribution networks are ageing. They leak heavily, leading to massive waste of water. Rehabilitation and augmentation of old schemes were given priority in the Ninth Plan. During the Plan period (1997-2002) 16 augmentation projects have been completed and

[43] Divya Himachal, May 5, 2002
[44] GoHP (2000): *op.cit*., p.324.
[45] SCSTE (2000): *op.cit.*, p.109.

another 27 remain to be done. A special grant from the Tenth Finance Commission has been given for upgrading Shimla's water supply system.

Urban population growth leads to urban sprawl. Housing development and road construction destroy the tree cover and catchments in mountain towns, affecting underground seepages and the flow in springs. In recent years the discharge in springs at Rakkad, Mater, Glenmore and the stream at Charaan *Khadd*, that supply water to Dharamshala, has begun to decrease significantly. This creates periodic water shortages, especially when the rains are delayed. To reduce dependence on springs, the IPH unit in Dharamshala has begun to tap groundwater sources by boring tubewells and installing handpumps.[46] If this becomes a widespread practice it will have deleterious effects on traditional sources at lower elevations which are usually fed by underground seepages and springs.

In Mandi, it has been reported that while the sewerage network is being expanded, there has not been a corresponding increase in the amount of water supplied. There have planning for a population of 35,000 people, whereas the actual population is much higher.[47]

[46] *Divya Himachal*, December 15, 2002.
[47] *Divya Himachal*, July 16, 2002.

Why Is The Queen Thirsty?*

Himachalis often refer to Shimla, once the winter capital of British India as the Queen of hill stations. It is spread over almost 20 sq km on seven hills with a mean altitude of about 2100m above sea level. Its present population is over 100,000 making it Himachal's only Class I city.

Till the British made Shimla their summer capital, its water supply came from *baoris* and springs. Its first water reservoir was constructed in 1884 to supply two million gallons, about 9 million liters. Now the IPH department is responsible for planning and creating the water supply infrastructure for the city. The Shimla Municipal Corporation is responsible for the operations and maintenance as well as collection of revenues. By 1995 the city had an installed capacity of 39.34 Mld from four sources. A fifth water supply project from Ashwani *Khadd* was expected to add another 10.8 Mld. Details of the supply sources are given in the Table below.

Water Supply Sources of Shimla.

Source	Year Installed	Lean Period Flow (Mld)	Normal Flow (Mld)	Installed Capacity (Mld)
Upper Gravity	1875	0.23	6.81	6.81
Cherot Nallah	1889	3.86	5.81	6.65
Chair Nallah	1914	2.50	3.00	1.82
Nauti *Khadd*	1923-1982	24.60	34.32	7.72
Ashwani *Khadd*	1992	10.80	-	-
Total		**41.45**	**49.94**	**39.34**

A study done by the National Environmental Engineering Research Institute in April 1986 concluded that the average leakage loss was about 45 per cent. Assuming no change in the situation, the actual supply in 1995 would have been around 22 Mld. The CPHEEO norm of 165 lpcd for designing urban water supply projects in Class I cities was adopted in the Eighth Plan. This norm covers all uses in a Class I city other than heavy industries for which a separate assessment is added. But in 1995 Shimla had only five heavy industries. Thus the available supply should have been adequate for the local population of just over 100,000 people in the Shimla urban agglomeration. In all probability some consumers are using far more than their share of water, at the expense of others. The main trouble arises in the tourist season, which in the summer coincides with the lean flow period. In the summer, the daily tourist traffic rises by several tens of thousand persons and often doubles the local population.

A special grant from the Tenth Finance Commission has been given for rehabilitating and augmenting Shimla's water supply system. Proper management, the addition of 10.8 Mld from Ashwani *Khadd* and repairs of the leaky distribution network should be adequate to meet the needs of a population of almost 300,000 persons. The IPH, however, has projected a future demand of 140 Mld for which it roughly estimates a requirement of Rs 682 cr for installation expenses. Is such an expense necessary? Roof rainwater harvesting in private homes and commercial establishments like hotels is a cheaper, more equitable and environmentally better option.

- Based on AME (1997): Urban Environmental Maps – Shimla, Academy for Mountain Environics, Dehra Doon.

IV. Discussion

Two key features of domestic water supply in Uttarakhand and Himachal Pradesh are discussed in this section.

Adequacy

Rural Areas: The water supply agencies in both the states have installed schemes to partially or fully cover almost all the rural habitations. Consumption data presented earlier show that while the network of pipes may have reached almost all the habitations, they are not able to supply the minimum normative amount of 40 lpcd to a majority of the rural population.

Several causes for the inadequacy of water supply in rural areas have been identified. These include dysfunctional systems, inadequately designed systems, e.g., system design not being based on low flows, FC habitations falling into PC or NC categories due to source failure, or inadequate funds.

Another important reason can be described as 'administrative culture'. One aspect of this administrative culture is the obsession with physical targets. The states' agencies, like in other states of India, appear to be eager to show that the planned targets of coverage have been met. At first glance the coverage figures appear impressive. But now even the Tenth Plan document has officially debunked the coverage data.[48]

A second aspect of present day administrative culture is that many technical staff persons, and sometimes even officials, have a poor knowledge or understanding of the norms. Under such conditions, the goal becomes providing 40 lpcd. In some official documents the range 0 to 10 lpcd is described as NC – as it should be, but 30 to 40 lpcd is described as FC, which it should not be. The supply agencies forget that 40 lpcd is a minimum norm. Even if it is reached it does not leave the users any margins to spare in case of even a partial disruption of supply. In this sense, the Himachal Pradesh government's decision to set a target of 70 lpcd is a welcome one.

The third aspect of administrative culture is its ignorance of tradition. The only way it usually recognizes the value of tradition is to stick an unaesthetic pipe into a *naula* or a *baori* and claim to have provided the people with a source of water supply. Fortunately in recent years, the scientific community has begun to show an appreciation of traditional water harvesting structures. One such initiative has been the recharging of *naulas* in Almora through the use of rainwater harvesting recharge pits.[49]

Gram Panchayats are ideally suited to ensure the renovation, recharge and conservation of traditional structures. They must be inspired, empowered and enabled to do so.

Urban Areas: The location of urban areas is a major determinant of adequacy. Cities like Dehra Doon and Haldwani located in the bhabbar region and hills-station like Shimla, Almora, Mussoorie or Pauri that are located on mountain crests are the most vulnerable. Towns in the *terai* belt like Kashipur are more fortunate since the groundwater table is very shallow. Groundwater resources in the Lower Shivaliks vary, depending on the predominance of clays or sandy soils. The prospects

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[48] GOI (2003): Tenth Five Year Plan 2002-2007, Vol II, Academic Foundation, New Delhi, p.601.

[49] C.S.Mehra (2002): "Water Harvesting Measures to Overcome Drinking Water Problems in Almora City" , Paper presented at the workshop on "Water Supply and Conservation in Uttarakhand: Successful Examples and Future Strategies", Watershed Management Directorate, Dehra Doon.

for towns like Una or Mehatpur in this region of Himachal thus depend on the local or nearby soil conditions. In the Upper Shivaliks, the dependence is more on springs and streams, though in recent years, the states' agencies have begun to install handpumps in these areas too.

The case studies of Dehra Doon and Shimla show that the present amount of water extracted in these cities is more than enough to meet their normative demand. The shortages are due to mismanagement – leakages in the pipelines and preferential treatment of elite area at the expense of others. Here it may be mentioned that the hospitality sector is a major presence in these cities. In a mapping exercise done at PSI, it was noted that the typical water short areas were located in the vicinity of large hotels or where there was a concentration of hotels. Tourist towns like Mussoorie and Naini Tal, where the hotel industry dominates, report similar water problems.

The trend in Dehra Doon for the last few decades has been to extract ground water through deep tubewells. But extracting more groundwater will not solve the problem. It will only aggravate it by increasing the pressure on the underground storage. During the summer when the demand is at its peak, the level of groundwater is at its annual low. Erratic power supply limits the hours of pumping, further reducing the daily withdrawals. The cheapest way to augment water resources is to reduce leakages in the distribution pipes. A highly desirable alternative for urban areas throughout the region is rainwater harvesting from the rooftops of buildings (See box: Meeting Dehra Doon's Future Water Demand).

If the Jal Sansthan or the IPH gave loans on a commercial basis to homeowners for installing rainwater harvesting systems, they could actually make money rather than expend it on installing new water capacity. The maintenance costs would be zero. For new housing, the water supply agency should make rainwater harvesting mandatory. There are reports that the GoU intends to do so. Also, for new housing colonies, the JS and IPH should seriously consider technical measures like reducing the diameter of supply lines, to limit the municipal supply and force households to harvest rainwater from their roofs.

Sustainability

The problem of sustainability revolves around two issues: (i) operation and maintenance of the physical structures and (ii) sustenance of the source of supply.

Operation & Maintenance (O&M): Officials often mourn the lack of involvement of the users in the maintenance of the physical structures. Citizens blame the departments for leaky pipes and department officials blame citizens' apathy when taps are missing or leaking or a handpump's handle is missing. But little effort is made to understand why the people are apathetic.

In the course of the *Jal Sanskriti* Programme a series of consultative workshops were organized with villagers, village-level functionaries like heads of *Mahila Mangal Dals*, *Gram Panchayat* members, *sarpanches, pradhans* and block *pramukhs* among others. The workshops revealed that the *Panchayats* have little faith in the design and quality of the WSS or the sustainability of their sources. Hence they do not want to be responsible for something they consider to be defective or inadequate. In Uttarakhand, some *Panchayat* representatives appear unwilling to even implement rural WSS under the present conditions. They believe that they have neither the funds nor the power to raise funds to plan and implement such schemes.

A major recommendation by village and *Panchayat* functionaries at a series of consultative workshops was that *Panchayati Raj* Institutions should be empowered to prepare development plans for their local areas. The state should allocate a fixed portion of its Plan outlay or its annual budget for the *Panchayats*. The latter should have the freedom to spend the allocation according to the needs of the villages as identified in their local area plans. A similar system exists in Kerala. Under such a system the *Panchayat* functionaries foresee taking on responsibilities for rural water supply.

Some representatives at the consultative workshops expressed apprehension about their technical capabilities. Others felt that under their proposed system *Panchayats* would be free to contract state agencies, technical organizations, professional institutions and individuals or competent VOs for technical support. In summary, it was clear from the deliberations at the consultative workshops that the *Panchayati Raj* and village representatives preferred autonomy in managing their natural resources. This is a major political and policy issue, but one that is in keeping with the spirit of the 73rd Amendment.

Source Failure: The bulk of Uttarakhand and Himachal's population resides in an area which is nourished largely by springs. Snow-fed streams are rare in this region. Hence it is essential to maintain the integrity of the springs in order to ensure the adequacy of supply and the sustainability of the systems. This in turn requires protection of the catchments of the springs and streams from where the supply is being tapped.

Water and forests form an integrated and symbiotic system, as mentioned in rishi Kashyapa's five basic principles of water management.[50] A living practical demonstration of this can be seen at Ufrenkhal, where the work of local villagers and the Doodhatoli Lok Vikas Sansthan has succeeded in reviving a nearly extinct stream with a combination of designing small trenches and afforestation.[51] Here water production has preceeded water consumption. Hence catchment treatment should be the first step in the implementation of a water supply project. Catchment protection by the local people must be a continuing aspect of it. This, however, appears possible either if the people have the right *sanskars* -- that water is sacred, it must be conserved – or if they believe that they will receive direct, tangible benefits in the near or immediate future.

In most water supply programmes there is no concern for catchment treatment. This is a direct fall-out of the modern administrative system introduced by the British and continued by independent India, where natural resource management is divided amongst various departments, in direct contrast to the traditional integrated approach. Consequently, water supply projects are implemented by engineers, strictly as engineering projects. Even in the Swajal Programme in Uttarakhand, though catchment area treatment is a component of the programme, it is usually implemented as the last activity when the project and the enthusiasm of the local people is almost over. Engineers see their task mainly as one of conveying water from where it is available to where it is needed. Sustainability under this set up is impossible.

As a change within the present system of centralized resource management, the first step is to combine the disciplines of forestry, water conservation and water supply engineering in water supply departments or agencies. But catchment protection on a sustainable basis is unlikely without the commitment of the local population to ensure it. This is turn calls for autonomy of local self-government institutions and decentralization of natural resource management.

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[50] V.Paranjpye (1994): "Preliminary Look at ARUN III in the Light of Tehri Experience" ,Water Nepal, 4 (1).
[51] Sheena (1998): Ripples of the Society, P.N.SHARMA (Ed.), Field Document No.14, PWMTA-FAO, Kathmandu.

V. Conclusions

Highly centralized, nationally designed and driven domestic water supply programmes have reached a dead end. They are unable to escape the Sisyphean trap of supplying the normative amount of domestic water in urban and rural habitats. Targets are set, they are almost achieved and they fall back to earlier levels.

The experiences of Uttarakhand and Himachal Pradesh follow the national trends. To ensure adequate supply in rural areas, the administrative culture needs to change by recognizing that 40 lpcd is a minimum norm and in reality the supply must be well above that, as decided recently by the GoHP.

Traditional water harvesting structures in both the states meet a significant amount of the demand for water. They need to be identified, renovated and conserved.

Within the centralized system of natural resource management a serious effort at enhancing sustainability can be made by combining the disciplines of forestry, water conservation and supply engineering in the water supply departments.

But real sustainability will require decentralization of natural resource management and autonomy for local self-government bodies to plan, implement and manage water supply systems.

Until the goal becomes water consumption with water production, sustainability cannot be guaranteed.

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