STATE OF ENVIRONMENT REPORT AND ACTION PLAN - KARNATAKA

Rural and Urban Drinking Water Supply and Sanitation

Draft Final Report

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2003

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1. Introduction:

It is estimated that poor quality and inadequate quantity of water accounts for about 10 per cent of the total burden of disease in developing countries as much as in Karnataka State (GoK, Task Force on Health 2001)[1]. Apart from health effects, inadequate quantities of water supply and sanitation services leave severe adverse impacts on environment such as blockages in sewerage system resulting in stagnation of sewage, thereby soil and water when it leaches in to them.

1.1. Current Status

The Government of Karnataka, has accorded highest priority to provide drinking water and sanitation services, and implemented various plans and programmes in both rural and urban areas. In order to augment provision of these services a Strategy Paper for rural drinking water supply and sanitation (GoK, RDPR, 2000) and a Master Plan for urban drinking water supply and sanitation have been prepared, respectively by the Rural Development and Panchayat Raj Department (RDPR) and the Karnataka Urban Water Supply and Drainage Board (KUWS&DB), while for Bangalore city the Bangalore Water Supply and Sewerage Board (BWSSB) has prepared a separate Master Plan.

Thrust on Drinking Water Supply at Policy Level

National Water Policy 2002

The National Water Policy of 2002 has clearly stated that "adequate safe drinking water facilities should be provided to the entire population both in urban and in rural areas. Irrigation and multipurpose projects should invariably include a drinking water component, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first charge on any available water" (GoI, Ministry of Water Resources, 2002).

State Water Policy 2002

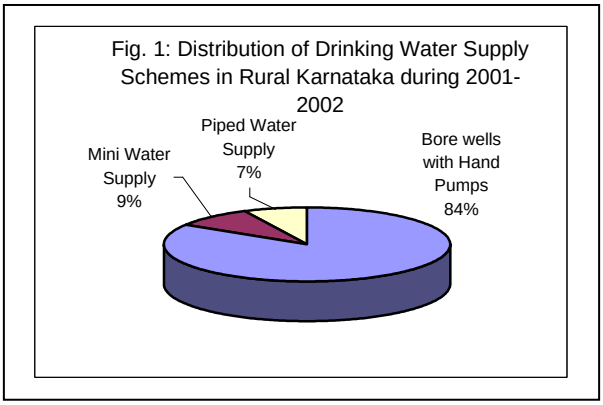
The State Water Policy 2002 also has given high priority to supply drinking water at the accepted norm in rural and urban areas (GoK, Water Resources Department, 2002).

The Rural Development and Panchayat Raj Department has the overall responsibility of meeting the rural drinking water supply needs and maintaining them through the Panchayat Raj institutions (i.e., Zilla Panchayats, Taluka Panchayats and the Gram Panchayats). The RDPR has implemented different programmes sponsored by Central government, State government and external agencies (the World Bank, DANIDA, Netherlands, etc.). Some of the major ones in rural Karnataka are Accelerated Rural Water Supply Programme, Rajiv Gandhi National Drinking Water Mission, Karnataka Integrated Rural Water Supply and Environmental Sanitation Project, Prime Minister Gramodaya Yojana – Rural Drinking Water[2], Jala Samvardhana (specifically for rejuvenation of tanks), watershed development programme, Jala Nirmal (in 11 drought prone districts), Swajal Dhara (at gram panchayat levels), Central Rural Sanitation Programme, Nirmala Grama Yojana, School Sanitation Programme, and Swatch Grama Yojana. During 9th Five Year Plan period (1997-2002) the government has spent about Rs. 1207.84 crores against the approved outlay of Rs. 800 crores for rural water supply and sanitation. During the 10th Five Year Plan (2002-2007) it is proposed to invest over Rs. 2484.07 crores on water supply and sanitation in rural areas of the state.

[1] Waterborne diseases that occur mainly due to lack of safe drinking water and sanitation facilities, have resulted in fifty percent of infant mortality and an estimated 1.5 million deaths under the age of five occur in India every year due to water related diseases; and approximately 1800 million person hours are lost annually, due to the same.

[2] To take up works relating to water harvesting, conservation, recharge in drought prone/desert areas, dark and grey blocks and to tackle quality related problems for providing safe drinking water to non-covered and partially covered habitations

Considering the quantity of water required for drinking, cooking, bathing, washing (utensils, clothes and house), and ablution activities the Government of Karnataka has adopted a norm of 55 liters per capita per day[3] (LPCD) as drinking water requirement in rural areas (GoK, RDPR, 2000). In order to provide drinking water as many as 209098 different drinking water supply schemes, such as Borewells with hand pump schemes (BWS), Mini water supply schemes (MWS) and Piped water supply schemes (PWS) have been created till 2002 (Annexure Table 1). Out of these BWS constitute a major share of 84 per cent, followed by MWS and PWS with 9 and 7 per cent, respectively as shown in Fig. 1 (see Box 1 for criteria of selection of schemes). According to RDPR, about 64 per cent of rural habitations are covered with more than 55 LPCD of water supply.



Box 1: Criteria for Selection of Water Supply Schemes		
1	Habitations with population less than 500 in plains and less than 350 in hilly areas	Bore wells with hand pumps (BWS) One Bore well per 100 population
2	Habitations with population more than 500 and less than 1000 in plains and more than 350 and less than 700 in hilly areas.	Mini Water Supply Schemes (MWS)
3	Habitations with population more than 1000 in plains and more than 700 in hilly areas	Piped Water Supply Schemes (PWS) with provision of individual house service connection

Source: GoK, RDPR, 2000

For urban areas the Karnataka Urban Water Supply & Drainage Board together with city corporations, town councils, and municipalities have the responsibility of providing the above services, and the Bangalore Water Supply and Sewerage Board (BWSSB) is entrusted with the same task exclusively for the city of Bangalore. The State has 226 urban local bodies (ULBs), of which 6 are Municipal Corporations, 39 City Municipal Councils, 83 Town Municipals, 90 Town Panchayats, and 8 Notified Area Committees (according to the Department of Municipal Administration, GoK). The classification of ULBs on population basis is presented in Annexure Table 2.

Karnataka has attained a high rate of urbanisation with about 34 percent of the population (Census 2001) living in urban area (as against 31% at the all India level), having registered an increase from 30.92 percent over 1991.

The KUWS&DB has adopted the norm of drinking water supply stipulated by the Central Public Health Engineering and Environmental Organisation (CPHEEO), ranging from 70 to 135 LPCD depending upon population. At present the KUWS&DB has taken up providing drinking water and sanitation facilities to 208 urban local bodies (ULBs). The KUWS&DB implements different urban drinking water supply schemes, selected on the basis of population and funding pattern. For towns with population less than 20,000 (as per 1991 Census) Piped Water Supply Schemes with the full cost borne by the State Government and Accelerated Urban Water Supply Programmes with cost shared by the Government of India and State Government are implemented. For towns with more than 20,000 population Urban Water Supply Schemes are executed with the Government grant and loan from financial institutions and contribution by Local Bodies. So far 78 per cent of urban population with potable water supply, and about 24 per cent of urban population with 27 different underground drainage systems are covered. Additionally about 55 new water supply and 17 new underground

[3] The Conference of Chief Ministers on Basic Minimum Services held in 1996 resolved to adopt 55 LPCD as the minimum services level for rural areas.

drainage schemes are under commission for the year 2003-04 (KUWS&DB). In order to provide drinking water and sanitation services to urban areas the government has spent a sum of Rs. 1115.82 crores in the 9th Five Year Plan (1997-2002). The government is aiming to invest Rs. 1865 crores for urban drinking water and sanitation in the 10th Five Year Plan (2002-2007).

Bangalore City and the City Municipal Councils situated around Bangalore, are covered by Bangalore Mahanagara Palika and Bangalore Water Supply and Sanitation Board (BWSSB).

Groundwater is the major source of drinking water in the State. In rural area over 90 per cent of the drinking water supply schemes are based on ground water. In urban areas also 40 out of 208 ULBs are exclusively depending upon ground water (Table 1), while it is an additional source to surface water in other ULBs, including Bangalore.

Table 1 : Drinking Water Sources by Class of Towns in Karnataka – 2002

Sl. No	Sources	Type of ULBs				
		Class – I	**Class – II**	**Class – III**	**Class - IV**	**Total**
1	Bore wells (BW)	0	1	21	18	40
2	BW + Tank	1	0	3	1	5
3	River	14	20	53	25	112
4	BW + River	4	2	19	9	34
5	Tank	1	3	0	1	5
6	Open well + BW	0	0	4	2	6
7	Open well	0	0	0	1	1
8	Tank + River	2	0	2	0	4
9	BW + Tank + River	0	0	0	1	1
Total		**22**	**26**	**102**	**58**	**208**

Sources: Karnataka Urban Water Supply and Drainage Board

However, in the provision of drinking water supply and sanitation, from the **supply side**, it all depends upon many factors like availability of water in adequate quantity and quality, sustainability of water resources (e.g., rainfall volatility, surface flows, ground water recharge, surface run-offs etc.), kinds of institutions and establishments (e.g., Zilla, Taluk and Grama Panchayats, Department of Major and Medium Irrigation and Department of Minor Irrigation, Urban Local Bodies, Village Water and Sanitation Committees (VWSCs), and so on), operation and maintenance of water supply schemes, (e.g., by Panchayat Raj Institutions, urban local bodies, user groups, self help groups, NGOs and so on). Apart from adequate quantity of water, quality of water is an important aspect as poor quality of water has repercussions on health and environment. It should be noted that groundwater, which is the major source of drinking water, is of poor quality in around 37 per cent of the rural habitations. The groundwater is contaminated with Fluorosis, Iron, Brackishness, Nitrate, etc. The surface water is also not free from pollution mainly by manmade activities. Another problem is the depletion of drinking water sources. For instance, groundwater level is fast declining in the state (34 taluks are considered as critical) due to over exploitation. Besides to drinking water related problems, lacunae associated with operation and maintenance, distribution system, etc., are also adding to problems. All these environmental pressures limit the quantity of safe drinking water, which is a serious issue being faced by the state. Similarly, sanitation facilities like sewerage system, storm water drain, latrines (public or private), and other community sanitation services are also important in maintaining good hygiene and clean environment. Likewise, on the **demand side**, several factors such as population pressure (the size of population increased from 4.49 crores in 1991 to 5.27 crores in 2001 in Karnataka), use and discharge of water by industries, inefficient use of land, flow of wastewater and fertilizer into water bodies and soils, inappropriate water pricing mechanisms and many others are contributing to the problems of quality deterioration and depletion of water and unhygienic sanitation. All these aggravate the water and sanitation related environmental pressures.

1.2. Government Efforts Towards Sustainable Drinking Water Supply and Sanitation

Considering the increasing problems in drinking water supply and sanitation sector the Central and State governments have initiated various plans and programmes to protect drinking water sources and to promote sanitation facilities. Some of the policy initiatives of the Government are listed below.

- The Karnataka Groundwater (Regulation for Protection of Sources of Drinking Water) Bill, 1999.
- Measures have been taken to recharge ground water, remove silt from surface water bodies like tanks, etc.
- Submission projects are undertaken for providing safe drinking water to the rural habitations facing water quality problems such as Fluorosis, brackishness, nitrate, etc., and for ensuring source sustainability through rainwater harvesting, artificial recharge etc. So far 45 projects covering 632 habitations have been cleared in the state and 22 projects are in progress (Draft 10th Five Year Plan – 2002-07, GoK).
- Water quality testing laboratories have been established by ZP, Directorate of Health and Family Welfare, Department of Mines and Geology, State Pollution Control Board, Karnataka Urban Water Supply and Drainage Board and Bangalore Water Supply and Sewerage Board.
- Swajaldhara, a centrally sponsored programme has been initiated based on community participation to operate drinking water supply schemes.
- The Government is implementing the Nirmala Grama Yojana (NGY) since 1995 to build household latrines in rural areas.
- Swachcha Grama programme has been initiated to promote total village sanitation.
- The KUWS&DB has prepared a Master Plan to provide drinking water and sanitation services to urban areas of the state.
- National River Conservation Plan (NRCP) is being implemented to prevent pollution in the catchment area of river Cauvery and Bhadra caused by towns situated on these basins.

Panchasutras for Total Village Sanitation
(1) paving of internal roads and streets in the village, (2) construction of efficient sullage and storm water drainage, (3) provision of community compost yards and removal of manure pits from the dwelling areas of the village, (4) provision of smokeless chullas/bio-gas for all households, and (5) construction of household latrines/ group latrines with individual ownership, community latrine complexes, and institutional latrines in schools.

- The Slum Clearance Board is implementing drinking water supply and sanitation schemes house construction etc., in slum areas of 21 Class – I ULBs of the State, under the Nirmal Jyothi Yojana.
- The BWSSB has prepared a Master Plan, with the aim of improving the capacity for the delivery of water, sewerage and environmental services to Bangalore, with emphasis on the urban poor and vulnerable groups and within a process of long term Environmental, Economic, Social and Institutional sustainability.

In spite of the progress made so far and other policy initiatives undertaken in Karnataka, the supply and demand factors and pressures mentioned above lead to a number of environmental problems, which have their impacts on health and environment. Therefore, an attempt is made here to examine the key environmental problems, their extent and trends, causes, impacts, prioritization and policy imperatives for rural and urban areas of Karnataka.

2. Rural and Urban Drinking Water Supply

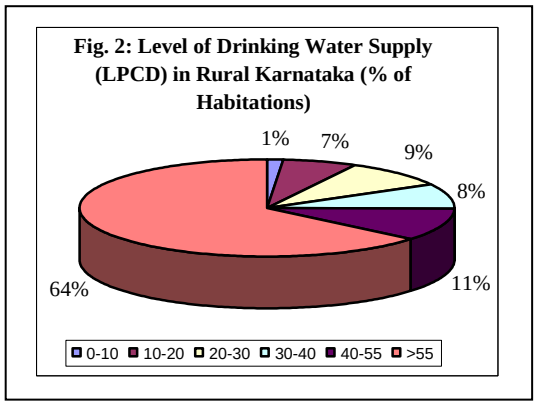
2.1. Key Environmental Problems of Drinking Water Supply

The major environmental problems in drinking water supply are:

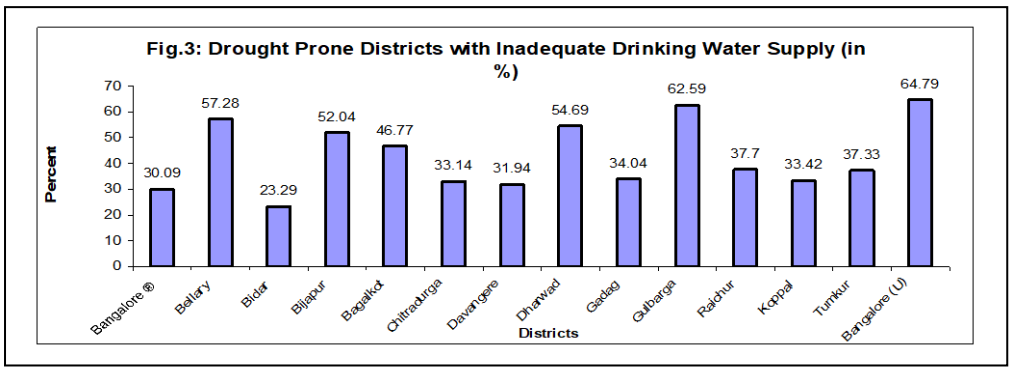
- ***Inadequate quantity*** of drinking water supply, a problem of scarcity and governance
- ***Scarcity of drinking water in summer months***, a problem of natural factors, seasonality, governance and management
- ***Depletion of drinking water sources***, a problem of resource management
- ***Deteriorating quality*** of drinking water, a direct environmental problem

2.1.1. Inadequate Quantity of Drinking Water Supply

Inadequacy of safe drinking water supply is viewed as a starting point for many environmental issues. Because a certain quantity of water is essential for life and maintenance of personal hygiene[4], absence of which leads to health problems like dehydration, skin related diseases etc. Further, maintenance of clean environment becomes increasingly difficult with insufficient use of water, which creates blockages in sewerage system or spread of sanitary waste on surface that can increase pollution of resources like soil, water and even air.



Though there are over 2 lakh drinking water supply schemes in rural Karnataka, more than 36 per cent of 56682 rural habitations do not have access to adequate quantity (of 55 or more LPCD) of drinking water (details in Annexure Table 3), (Data Source: RDPR). Although around 64 percent (Fig. 2) of rural habitations are provided with the norm of 55 LPCD of water supply, the villages with inadequate water supply are still high. It is pertinent to note that more than 50 per cent of rural habitations in eight districts namely Belgaum (64.44 per cent), Bellary (57.28 per cent), Dharwad (54.69 per cent), Gulbarga (62.59 per cent), Kodagu (82.94 per cent)[5], Chamarajnagar (75.18 per cent) and Bangalore Urban (64.79 per cent) have less than 55 LPCD of water supply. The problem of inadequate drinking water supply is more acute in drought prone districts (Figure 3) like Bellary, Bijapur, Bidar, Baglkot, Dharwad, Gulbarga, Banglaore Urban, Chitraduga, Davanagere,



[4] WHO, World Bank propose 40 LPCD of water supply

[5] Few districts like Kodagu, Dakshina Kannada, Udupi also show higher percent of habitations with inadequate water supply as per the data of RDPR. But this needs to be looked carefully considering the ground level situation i.e., large number of households having their own drinking water sources, which might not have been accounted for by the RDPR.

Tumkur, Koppal, Raichur, Gadag and Bangalore Rural. In all these districts more than 30 per cent of the rural habitations do not have access to adequate water supply of 55 LPCD.

Apart from lack of coverage of habitations for safe drinking water, it is essential to see whether the stipulated norm of adequacy is actually realized or not and the water supply schemes created are functioning or not. Generally, the claim of having covered the habitations with adequate water supply appears to relate to the pumping and distribution capacity created under various water supply schemes rather than the actual service provided to the villagers (GoK, HPC Report, 2002). A study conducted by the Directorate of Economics and Statistics showed majority of habitations surveyed had less than 55 LPCD of drinking water supply, which is indicative of lacunae in engineering plan, capacity installation and the satisfaction derived by people (Box 2). According to the Department of Rural Development and Panchayat Raj (2001) as many as 21 per cent of drinking water borewells, 7 per cent of mini water schemes and another 7 per cent of piped water supply schemes are found defunct.

Box: 2. Actual Level of Drinking Water Supply in Rural Area (Based on sample survey - 2001)

- **Borewell with Handpumps** - 91.7 % of 470 rural habitations had less than 55 LPCD
- **Mini Water Supply Schemes** – Out of 646 schemes surveyed 91.48 % reported less than 55 LPCD
- **Piped Water Supply Schemes** - 86.07 % of 977 rural habitations had inadequate water supply (< 55 LPCD)

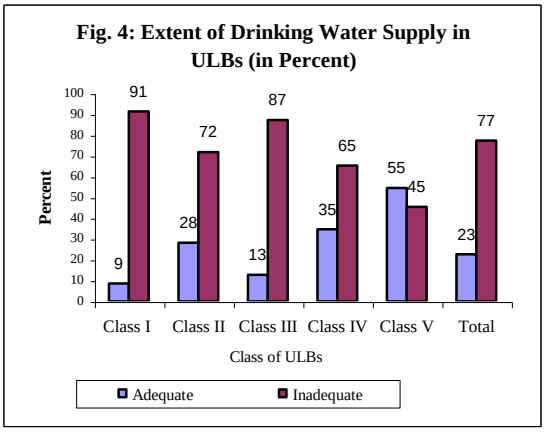
Source: GoK, HPC Report, 2002

The problem of inadequate drinking water supply is also observed in urban areas of the State. In many areas drinking water supply is much less than the norms adopted by KUWS&DB (shown in Table 2). Out of 208 urban local bodies, in 161 ULBs (77 per cent) the drinking water supply is inadequate (Figure 4). In all towns of Bangalore Urban, Kolar, Tumkur, Udupi, Chitradurga, Dharwad, Gadag, Haveri, and Raichur drinking water supply is less than the accepted norms (Annexure Table 4).

Table 2: Norm of Per Capita Water Supply for Urban Areas of Karnataka

Size of Population	Class of ULB	Norm
Above 1 Lakh	Class - I	135 LPCD
20000 - 1 Lakh	Class - II and Class - III	100 LPCD
Upto 20000	Class - IV, V, VI	70 LPCD

Source: KUWS&DB



As against provisioning, the actual levels of drinking water supply in the Municipal Corporation areas of Gulbarga, Belgaum and Hubli-Dharwad are inadequate (see Annexure Table 5). It should be noted that only in Mysore and Mangalore the level of water supply is higher than the norm adopted by the KUWS&DB.

2.1.2. Scarcity of Drinking Water in Summer Season

Fluctuations and irregularity in supply, particularly during summer months is a related inadequacy problem. Variations in the supply of drinking water lead to health and environmental problems, due to reduced quantity of water supplied and unexpected contamination of water in

distributional network attributable to development of rustiness in pipes. According to the 'Study on Rapid Sector Assessment in Karnataka' (GoK, RDPR, 2001), supply level of rural drinking water scheme goes down by 50 to 75 per cent of the intended level of the scheme during summer months. Another study by the High Power Committee reveals that 13 per cent of the 470 villages based on borewell water supply scheme, 15 per cent of the 646 villages based on mini water supply schemes, and 19 per cent of 977 villages based on piped water supply schemes had irregular water supply (Box 3) (GoK, HPC Report 2002). A district wise comparison (shown in Annexure Table 6) reveals that in 15 districts more than 20 per cent of the bore well based water supply schemes were not functioning. The percent of bore well schemes not functioning was found to be quite high in districts such as Dharwad (59 percent), Haveri (43 percent), Gadag (40 percent) and Davanagere (39 percent). Likewise, the irregular functioning of borewell schemes is found to be high in Dakshina Kannada (93 percent), Hassan (39 per cent), Bangalore Urban (33 per cent), Kolar (33 per cent), Bidar (29 per cent), and Haveri (27 per cent). Between 20 to 56 per cent of mini water supply schemes in districts like Chamarajnagar, Hassan, Shimoga, Kodagu, Bijapur, Haveri, Dakshina Kannada, Koppal are not functioning regularly. Majority of the above mentioned districts fall in the drought prone region of the state, which indicates that the problem of access to water is more severe in these areas.

Box 3: Functioning of Drinking Water Schemes (Based on sample villages)

Schemes	Regular Water Supply	Irregular Water Supply	Total
Bore Well with Hand Pump Scheme	409 (87)	61 (13)	470
Mini Water Supply Scheme	599 (93)	47 (7)	646
Piped Water Supply Scheme	793 (81)	184 (19)	977

Source: GoK, HPC Report, (2001)
Note: Figures in parenthesis are percentages to total

2.1.3. Depletion of Groundwater

Depletion of drinking water sources, be they the ground or surface water, adds to further environmental problems, via shortage and deterioration of quality, as experienced by more than 95% of rural habitations. A study by the Department of Mines and Geology on fluctuations in ground water tables during 1978 to 1997 (Rajamarthanda, 1998), showed both fluctuations and depletion in the ground water level up to 7 meters in several districts (Annexure Table 7). In the districts such as Bangalore, Chitradurga, Kolar and Tumkur the problems are acute. Another study by the Department of Mines and Geology on the ground water level across the watersheds during 1999 depicted 56 watersheds as over exploited and critical, attributed to over extraction of ground water. These 56 watersheds fall in 34 taluks shown in Table 3. Kolar, Tumkur, Bangalore Rural, Banglaore Urban, Chitradurga districts have more number of over exploited and critical taluks. The drastic decline in the ground water has adversely affected over 50 per cent of villages in majority of taluks presented in the Table 3. This clearly indicates that depletion of groundwater, the major source of drinking water, would affect the availability of drinking water.

2.1.4. Deteriorating Quality of Drinking Water

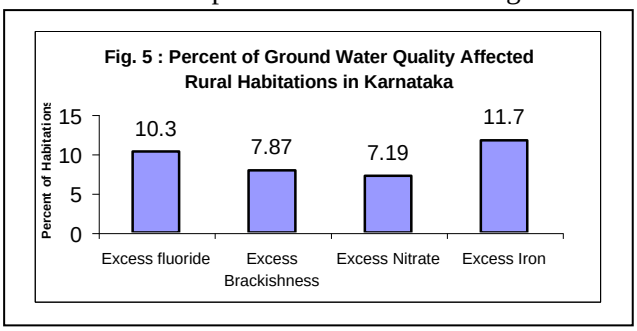
Generally, water, which is sweet and free from odour, colour and organic and inorganic contamination, is considered as safe drinking water. The drinking water quality is determined by the presence of certain organic and inorganic substances in excess of tolerance limits shown in Annexure Table 8. Unsafe and poor quality water adversely affects health status of people. For instance, presence of chemicals like fluoride in excess quantity (more than 1.5 PPM) causes dental and bone hazards, while skin rashes result by consuming water with excess brackishness. Similarly, biological or organic contamination of water may give rise to water borne diseases.

Table 3: Overdeveloped (Groundwater) Taluks in Karnataka

Sl. No	Districts	Taluks	No. of overdeveloped taluks	% of villages affected
1	Bangalore (U)	Anekal, Bangalore (N), Bangalore (S)	3	75
2	Bangalore ®	Devanahalli, Hosakote, Doddaballapur, Ramanagar, Magadi, Nelamangala	6	79
3	Bellary	H B Hally	1	82
4	Chitradurga	Hiriyur, Holalkere, Hosadurga	3	52
5	Kolar	Chikkaballapura, Kolar, Malur, Chintamani, Gouribidanur, Mulbagal, Sidlaghatta, Srinivaspura, Bagepalli, Bangarpet, Gudibande	11	76
6	CR Nagar	Kollegal	1	28
7	Tumkur	Koratagere, Gubbi, Madhugiri, Tiptur, Tumkur, Chikkanayakanahalli	6	70
8	Gulbarga	Afzalpur	1	57
9	Haveri	Ranebennur	1	55
10	Davangere	Channagiri	1	52
	Total		34	63

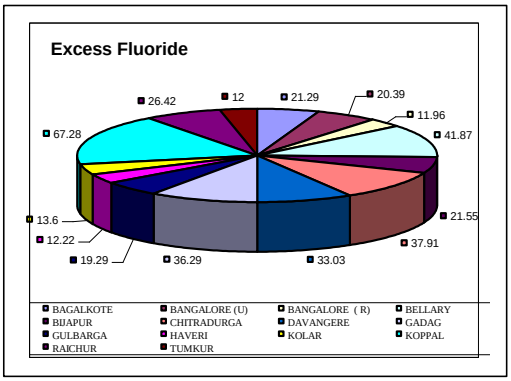
Source: Department of Mines and Geology

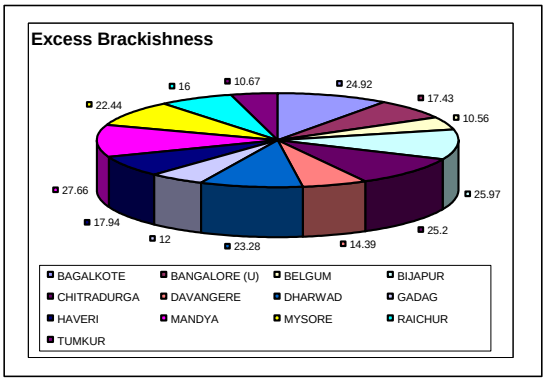
In Karnataka, ground water in more than 37 per cent of rural habitations (Fig. 5 and Annexure Table 9) and surface water in some rivers are contaminated at the points of effluent discharge and also around urban areas. As can be seen from Fig.6, habitations in Bagalkot, Bangalore Urban, Bijapur, Chamarajnagar, Chitradurga, Haveri, Mandya, Tumkur, Bellary, Davanagere, Kodagu, Kolar, Raichur and Koppal districts have serious ground water quality problems, ranging from 50 to 79 percent. More specifically, excess Fluoride in ground water is a major problem in 14 districts, ranging from 10 to 67 per cent of the total habitations of each district, as can be seen from the same figure. Similarly, excess Brackishness in 13 districts (in the range of 10 to 27 % of the habitations), excess Nitrate in 8 districts (10 to 51% of habitations) and excess Iron in 12 districts (10 to 63 % of habitations) is adversely affecting drinking water quality.The spread of groundwater contaminated area of fluoride in the State is shown in Map 1.

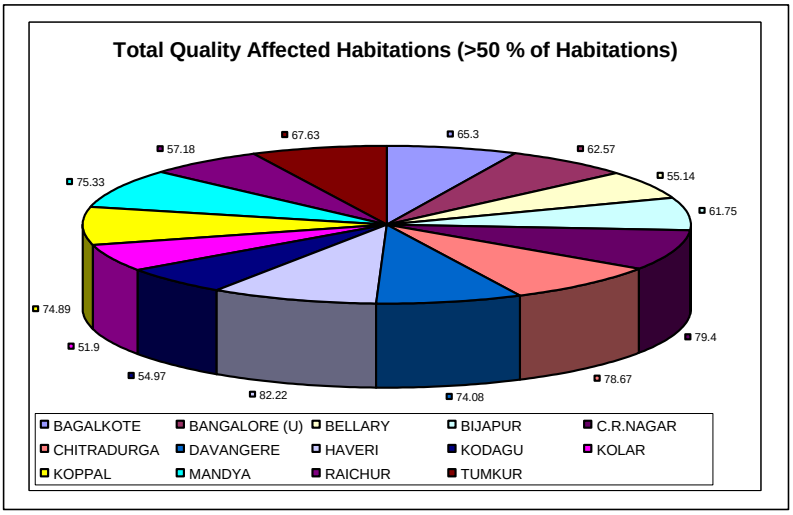


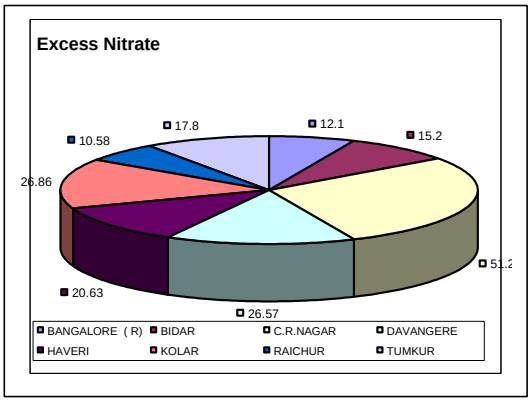
The drinking water quality problem is not just restricted to rural area. Majority of urban areas also are suffering with poor drinking water quality. The quality of drinking water supplied is low due to contamination of ground and surface water and also pollution caused in transmission and distribution system of drinking water. The survey conducted by the High Power Committee (GoK, HPC Report, 2002) reiterates the same. Out of 76 towns surveyed for borewell based water supply scheme, 16 per cent reported of unfitness for drinking purpose; 5 per cent of towns reported saltishness, 5 per cent hardness and 3 per cent contamination. Among the districts surveyed by the HPC, saltishness is a major problem in 33 per cent of towns in Raichur, 20 per cent in Bangalore Rural, 15 per cent of towns in Kolar, while hardness in water was reported in 50 per cent of towns in Shimoga, 40 per cent in Bangalore Rural and 17 per cent in Haveri districts. In Davanagere and Tumkur water was contaminated, respectively in 33 and 12 per cent of towns. Similarly the water quality test for tank based drinking water schemes showed that in 8 per cent of 28 towns surveyed, the quality of water was low with high salt and hardness in water.

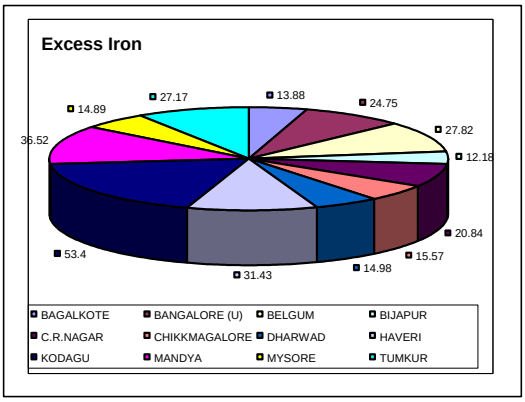
Fig. 6: Percent of Groundwater Quality Affected Rural Habitations



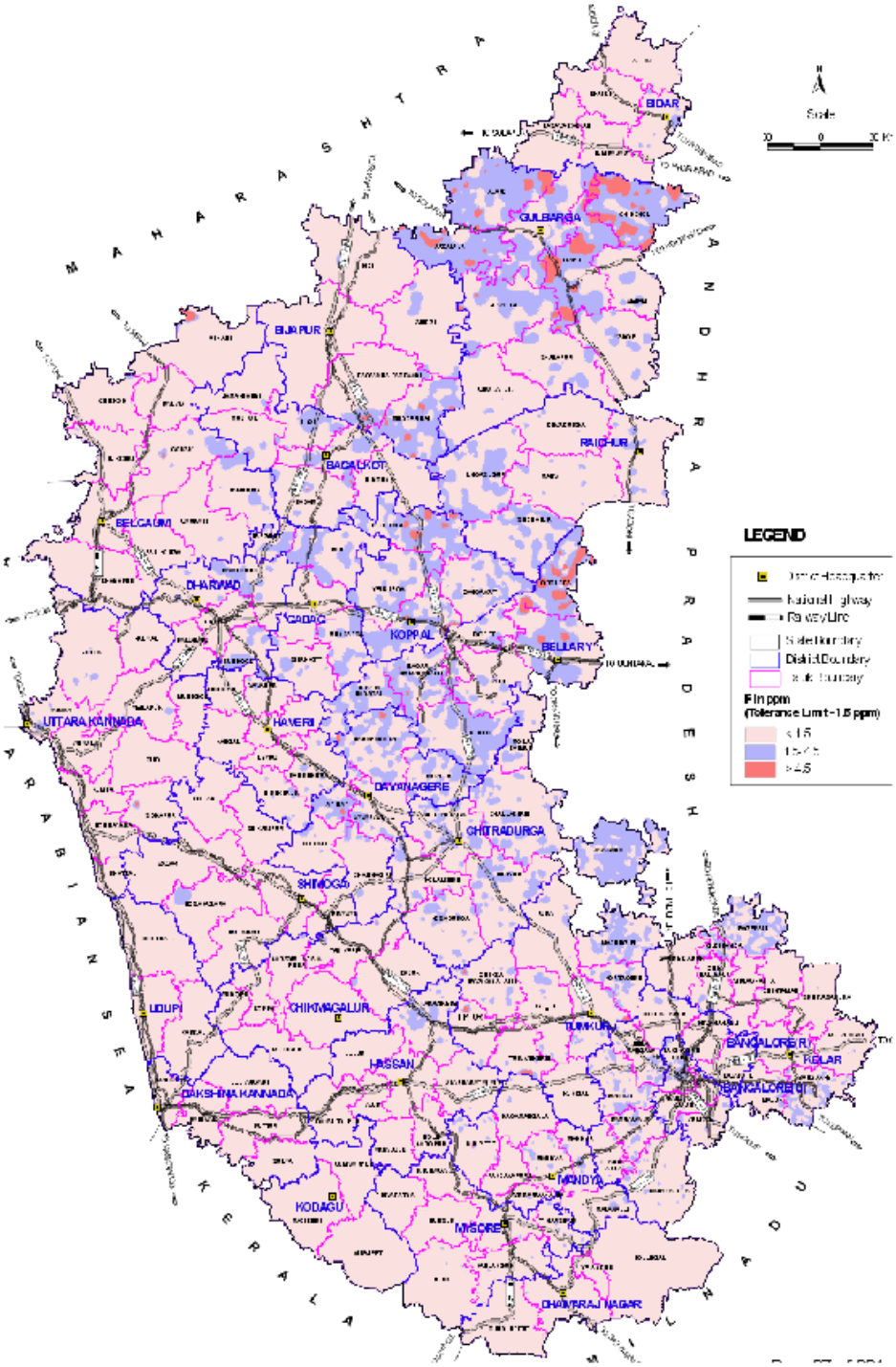








Map. 1: Concentration of Fluoride in Karnataka - 2001



The surface water contamination is yet another environmental problem in the State as water at certain pockets of some rivers and other water bodies is polluted. For instance, water in river Bhadra at the point of effluents discharge by the Mysore Paper Mills and Vishweshvaraiah Iron and Steel Limited, is turbid and contaminated with effluents; in rivers Kabini and Cauvery water is polluted around the townships situated on the banks of these rivers (reported in Deccan Herald, 24 February 2001). NEERI (2002) reported that in intensive mining areas of Bellary district surface water quality is characterized by neutral pH, high turbidity and suspended solids. All these evidences indicate that the quality of surface water is also depleting fast in the state.

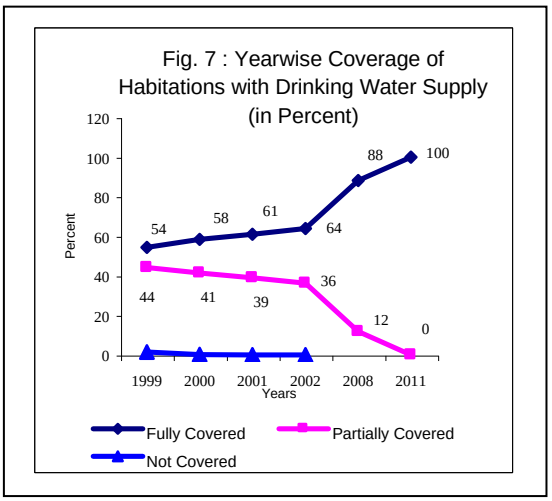
As observed above, there is an increasing pressure on drinking water sources both ground and surface water in terms of quantity and quality in the state. The problems of depletion and deterioration of water quality can result in either sub-optimal or non-functioning of drinking water supply systems, which ultimately aggravate the problem of meeting adequate safe drinking water requirements.

2.2. Trends and Projections of Environmental Problems in Drinking Water Supply

Constant efforts are on to improve both the adequacy and quality of water supply in the state. Therefore, it is useful to track some indications of the trends and projections in the coverage of habitations with adequate drinking water supply and also the trend of changes in the associated environmental problems.

2.2.1. Coverage with Adequate Drinking Water Supply

Rural Water Supply: The year wise coverage of rural habitations with adequate water supply in recent past is graphically presented in Fig. 7, which shows percent of fully covered (i.e., 55 LPCD and above), partially covered (i.e., less than 55 LPCD) and not covered habitations (details in Annexure Table 10). There is a gradual increase in the coverage of habitations with adequate drinking water supply, from 54 per cent in 1999 to 64 percent during 2002, showing a growth rate of 5.5%. But still over 36 % of the habitations have to be covered to reach the 55 LPCD norm in all rural habitations.



Going by the same trend rate of increase of habitations (with full coverage), requirement of around 50000 rural habitations can be met by the end of 10th Five Year Plan (2003-2008) and all habitations by middle of 11th Five Year Plan (2008-2013) with adequate drinking water supply.

Urban Water Supply: Although the KUWS&DB is attempting to provide adequate drinking water to urban areas, the achievement in terms of coverage of ULBs is not sufficient. The KUWS&DB has provided adequate drinking water to only 47 ULBs as on May 2003. It should be noted that the number of towns covered with adequate water supply increased from 24 to 47 between 1998 and 2003; and the state still has 161 ULBs with inadequate water supply. This indicates that in Karnataka, providing adequate quantity of drinking water to urban people still remains as an important issue.

Fulfillment of the coverage of ULBs with adequate water supply depends upon the availability of resources. One can only make guesses, to say that with the proposed North Karnataka Water Supply Board, the coverage of urban towns in north Karnataka would improve. By the year 2018, hopefully all the urban areas would be covered by adequate drinking water supply.

2.2.2. Increase in Groundwater Quality Affected Habitations

Coverage apart, reducing the trend in water quality deterioration is important, which is being addressed by the state government. As reported in HPC Report during 2001 about 20929 habitations (i.e., about 36.92%) were affected by bad water quality (GoK, HPC Report, 2002) and the same increased to 21008 habitations in the next year (Data Source: RDPR), amounting to an annual rate of 0.18 percent. At this rate of increase in the number of water quality affected habitations about 21235 habitations (37.46 per cent) at the end of 10th Five Year Plan, 21427 habitations (37.80 per cent) by the end of 11th Five Year Plan, and about 21621 habitations (38.14 per cent) by the end of 12th Five Year Plan may still remain affected by bad ground water quality[6].

2.3 Hotspots in Drinking Water Supply

From the above analysis the following districts (shown in Map 2) have been identified as critical areas (hotspots) in terms of environmental problems in drinking water supply (Reasons are shown in Annexure Table 11).

Hotspots: Belgaum, Bellary, Chamarajnagar, Bangalore urban, Gulbarga, Dharwad, Bijapur, Tumkur, Kolar, Bangalore rural, Bagalkot, Chitradurga, Haveri, Mandya, Koppal, Gadag and Davanagere.

2.4 Underlying Causes for Environmental Problems in Drinking Water Supply

While environmental problems associated with drinking water supply are many, the root causes can be fewer, but they are required to be identified for prioritising strategies and policy actions.

2.4.1. Causes for Inadequate Coverage and Depletion of Groundwater

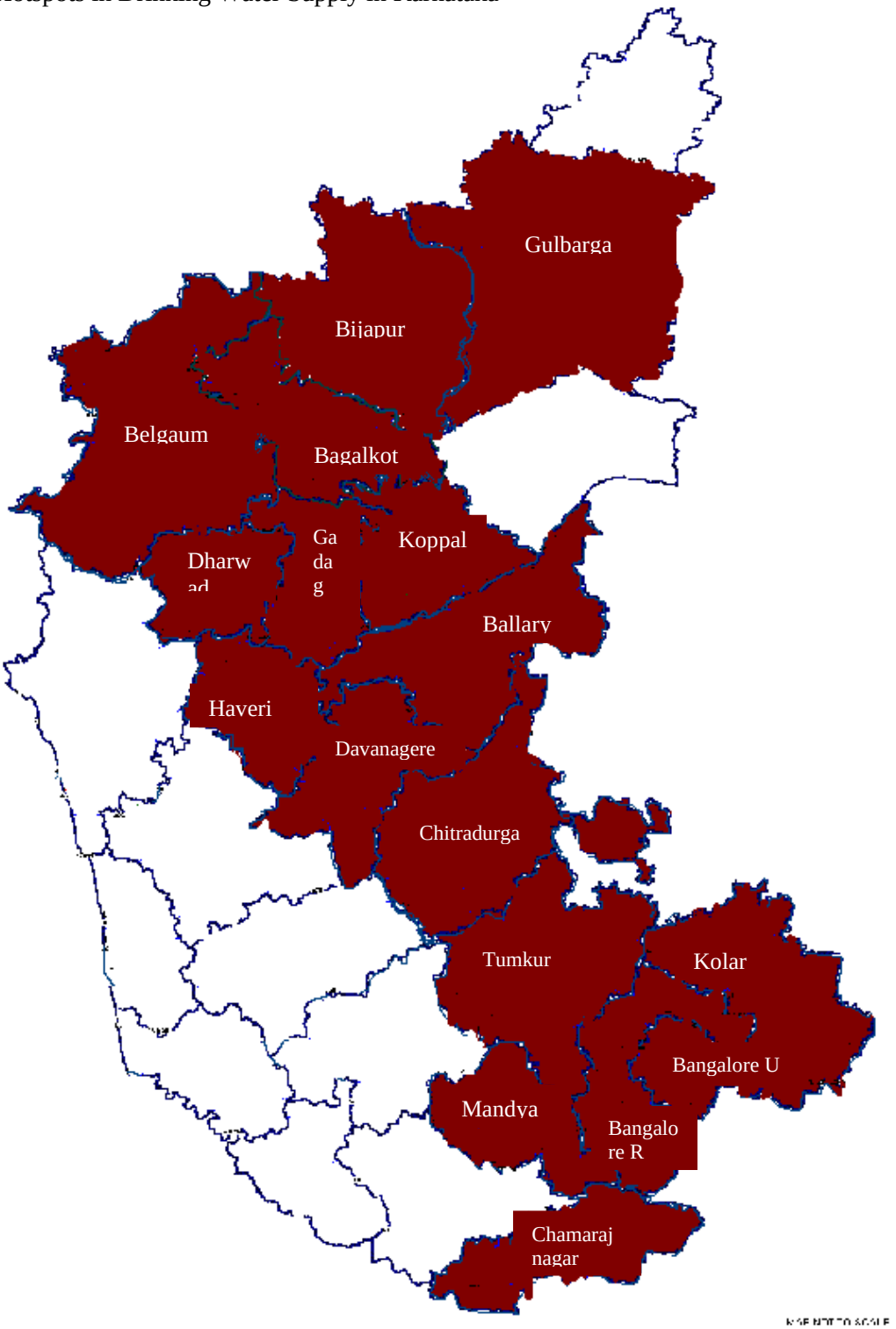
Both supply and demand side factors are causing problems in rural and urban drinking water supply. Two major supply factors are depletion and deterioration in the quantity and quality of water. The major environmental factors causing inadequate supply of drinking water are non-availability of perennial water sources, high dependency on ground water, depletion of ground water, etc. Ground water is experiencing wide fluctuations and cyclically declining in many districts. The major causes are seasonality, geographical and geological conditions, rainfall fluctuations, low recharging rate, etc. It is important to note that as much as depletion of ground water (a supply factor) over extraction (a demand factor) is also a factor causing this depletion. The rapid and accelerated drawal of ground water to meet competing demands from various sectors like agriculture, industry, etc., are leading to decline in ground water table.

Another related cause is decline in the availability of surface water particularly during summer season, which results in inadequate drinking water supply. The supply capacity of surface sources like rivers, lakes, reservoir and tanks also has come down due to another set of causes. The notable ones are: forest degradation and siltation, uncertainty and fluctuations in rainfall (refer Chapter on Water Resources). The general neglect in conserving rainwater has resulted in waste of rainfall by way of run-off and evaporation. Finally, manmade factors like discharging untreated waste, sewage flow, etc., to water bodies also lead to depletion and deterioration of water resources.

Increasing demand and hence over-exploitation are the other demand based causal factors leading to inadequate drinking water availability. There is an increasing population pressure on ground water extraction, since it is not only used for drinking purpose but also for irrigation. This can be noticed from the increased number of wells in the state from 78503 in 1987-88 to 885814

[6] It should be noted the actual increase in the number of quality affected habitations might be more than these projections considering the pressure on water resources due to increasing population, which can deteriorate both quantity and quality of water.

Map 2: Hotspots in Drinking Water Supply in Karnataka



during 1999, which is the major source of drafting ground water. All these factors have reduced the quantum of ground water availability in aquifers, particularly during summer season, which results in fluctuations in the supply of drinking water.

Apart from the above (supply and demand driven) factors, lack of operation and maintenance of water supply schemes (a matter of management and governance) is another major cause for inadequate drinking water supply as rightly pointed out by the Strategy Paper of RDPR (GoK, RDPR 2000). Other management related causes, which can be attributed to variations in supply of water are leakage in distribution network, and power fluctuations, making water supply schemes sub-optimal (GoK, HPC, 2002). Leakage and unaccounted use of water cause disparity in the distribution network, all of which lead to reduction in the actual quantity of drinking water supplied. In urban areas loss of water through leakage is a major cause reducing the quantity of water supplied, but precise information on the quantity of water lost in the distribution network in the state is not available[7].

Out of 161 ULBs with inadequate water supply, 40 ULBs have adequate supply at bulk level, but faulty distribution system has caused leakage and thus reduction in the quantity supplied at consumer end.
Source: KUWS&DB

2.4.2. Causes for Deterioration in Drinking Water Quality

The major causes identified here are, natural factors, man-made (or demand driven) factors and institutional factors (such as lack of monitoring system).

Quality of ground and surface drinking water is affected by factors like (1) Natural factors such as geological and geographical characteristics leading to inorganic contamination of water resulting in excess Fluoride, Iron, Nitrate, etc. and (2) Manmade factors like over extraction of ground water, discharging pollutants to surface and ground water bodies, inadequate and improper drainage and sewerage systems, etc. The common practice of using open places for defecation, activities like washing, bathing around water bodies, inadequate and improperly designed sanitation facilities pollute the water bodies. Discharging of industrial effluents is one of the major causes for decline in the water quality. Studies conducted by Department of Mines and Geology on the quality of water in the vicinity of major industrial locations[8] revealed that in 93 per cent of the stations the ground water quality had exceeded the IS:10500-1991 (drinking water standards) permissible limits for Total Dissolved Solids (500 mg/l). Surface water quality is also adversely affected at several places due to discharge of industrial effluents, urban wastes, etc., as observed earlier.

A study conducted by a team of Bangalore University – Civil Engineering Department, in Chikkaballapur and Mandya showed that ground water was contaminated with Nitrates and Chlorides above the permissible limits, because of inadequate and improper design of sanitation facilities (reported in Indian Express, Dec. 22, 1998). Another study by the Central Ground Water Board showed the Nitrate level between 147 mg/liter to 550 mg/liter in some rural habitations of Bangalore Rural district. The experts state that improper sanitation system is one of the causes for high level of Nitrate in ground water (reported in Deccan Herald, 14th March 2003).

Apart from the source level pollution, drinking water is also likely to get contaminated in the distribution network when the sewage or other waste materials get mixed with drinking water at the broken or leaking pipes. There is a major cause for contamination of water in urban areas due to inadequate sanitation system. Improper siting of water points particularly in low lying areas,

[7] A nationwide study conducted by National Environmental Engineering Research Institute (NEERI) showed that about 17 to 44 per cent of the total flow in the distribution system is lost through leakages in main, communication and service pipes and leaking valves (quoted in Suresh Website).

[8] Attibele and Jigani (Bangalore Urban) Devanahalli and Bidadi (Bangalore Rural), Malur (Kolar), Nanjanagud (Mysore), Aurad (Bidar), Chennagiri (Davanagere) and Machenahalli and Bhadravathi (Shimoga).

unhygienic practice of collecting water by households from pits dug in the ground due to inadequate residual pressure in the distribution pipe, etc., also adversely affect the water quality.

Referring to institutional factors, lack of drinking water quality monitoring system is another major cause for quality deterioration. In the State even now there is no agency with a well-defined mandate for routine water quality monitoring, particularly in rural areas. Various institutions like Department of Health and Family Welfare, Department of Mines and Geology, District Level Laboratories of ZP, Pollution Control Board, etc., are all involved in testing water quality. But, many of these institutions lack either adequate equipment for testing of chemical and bacteriological contamination of water, trained staff, etc., or there are serious coordination problem among all these facilities. It should be noted that out of 18 District Level Laboratories of ZP 11 are not functioning (GoK, RDPR 2001). All these factors add problems to water quality monitoring.

3. Rural and Urban Sanitation

Sanitation facilities play a pivotal role in maintaining hygiene and clean environment. The household and community/public sanitation facilities like latrines, drainage and sewerage system, non-existence of stagnant water pools and distantly placed compost pits, etc., are essential to control several diseases and also to avoid pollution of soil and water bodies. The following section discusses the environmental problems, their extent, causes and impacts related to rural and urban sanitation in the State.

3.1. Key Environmental Problems

3.1.1. Lack of Household Sanitation in Rural Areas

By and large, the household sanitation facilities are very minimal in the State. According to RDPR during 2001 the state had only 15 per cent coverage of sanitation system in rural areas. The concerted efforts made by the Government through programmes like Nirmala Grama Yojana[9] resulted in the construction of a total of 753464 units of latrines in rural areas during the period 1994 to 2000. In addition, the externally aided projects (from the World Bank, DANIDA, Netherlands) have enabled to add 96449 units of latrines in rural areas. But, still a large number of rural households do not have latrine facilities, resulting in open air defecation and thus leading to contamination of soil and water bodies.

When it comes to latrine facility, utilization is as important as construction to keep hygiene and safe environment. It is distressing to note that in rural area many households do not use even the existing latrine facilities for various reasons. According to a study by the Directorate of Economics and Statistics (1998), out of 8634 latrines constructed under NGY, 13 per cent were misutilised and 3 per cent non-utilised (Annexure Table 12). It is significant to note that misutilization of latrines was more in Bijapur (69 %), Gulbarga (56 %) and Raichur (51 %). While in Raichur around 40 percent of the latrines were found to be in use as bathrooms, in Gulbarga 34 per cent were used for other uses. All these indicate that people have not given much importance to proper use of latrines.

3.1.2. Lack of Community Sanitation and Poor Infrastructure Facilities in Villages

Lack of or inadequate community sanitation is another major environmental problem in rural areas. Several habitations suffer from inadequate and improper community sanitation facilities like drainage/sewerage system, community toilets, and *sulabh shouchalayas*. Additionally there are village level problems of presence of stagnant water pools in and around village, compost pits near household or village, poor school sanitation system or lack of it, etc. The Strategy Paper states that there is a lack of network of sullage and storm water drains along the streets and also paving of internal roads in

[9] Started on 2nd October 1995. A subsidy of Rs. 2000 for BPL and Rs. 1200 for non-BPL households was given.

rural habitations, which make the streets slushy in monsoon and dirty during summer season (GoK, RDPR, 2000).

3.1.3. Inadequate Coverage of Sanitation Services in Urban Areas

Lack of and inadequate provision of sanitation facilities is a major problem in urban Karnataka also. This is evident from the fact that only 36 urban local bodies, excepting Bangalore and the City Municipal Councils around Bangalore have been covered with underground drainage (UGD) facilities. Even in those towns where the UGD system is being provided the percentage coverage of area is relatively less. At the state level 182 ULBs are yet to be provided with underground drainage system (Annexure Table 13). The information on provision of under ground drainage system in 5 Municipal Corporations, apart from Bangalore, presented in Box 4, shows that none of the 5 municipal corporations are provided with full coverage of UGD system. Lack of proper sanitation facilities increases the environmental problems particularly during rainy season due to overflow of soakpits and contaminating water and soil and also affecting the health of people. The problem gets worsened in low lying areas, where usually poor people live.

Only in 4 urban areas more than 75 percent of the area is covered with UGD system. It should be noted that 19 Class – II ULBs, 105 Class – III ULBs and all ULBs in Class – IV, V and VI have to be provided with UGD system.

Apart from lack of UGD system, majority of ULBs do not have public sanitation facilities like public toilets or latrines, particularly around common places like busstops, markets etc. Absence of these public sanitation facilities adds to the sanitation related health and environmental pressures. Non-availability of information on number of public toilet/latrines in ULBs, and related impacts makes one difficult in assessing the enormity of the problem.

Box 4 : Level of Under Ground Drainage System in Five Municipal Corporation Areas (as on 2001)

Name of Municipal Corporation	Apprx. % of Area covered with UGD	Avg. Per Capita Contribution of Sewage	STP provided/Not provided
Gulbarga	60	90	Provided
Belgaum	80	100	Not provided
Mysore	80	130	Provided
Mangalore	80	135	Primary Treatment provided
Hubli-Dharwad	50	100	Not provided

Source: KUWS&DB

Note: STP- Sewage Treatment Plant

Another significant problem in urban areas is the large quantity of waste water generated. In 10 towns the average per capita sewage flow is more than 100 liters per capita per day (Annexure Table 13). Mangalore and Bellary ULBs generate the highest per capita of sewage around 135 liters per capita per day. This clearly suggests the need for adequate and urgent provision of UGD system to carry the large quantity of sewage out of urban areas. Majority of ULBs lack place for diversion of waste water or sewage and hence sewage usually flows to water bodies like tanks and lakes. This is a major problem in urban areas, which is contaminating both ground and surface water sources.

The sewage generated in ULBs needs to be treated before it is let to natural drainage. But, most of the ULBs do not have sewage treatment plants (STPs) to treat the wastewater. For instance, out of 36 ULBs, where UGD system is provided, 9 ULBs do not have treatment plants (Annexure Table 13). Even among other urban bodies where STPs are provided, they are either oxidation plants (in 16 towns) or primary treatment plants (in 6 towns) and in none of the towns secondary and tertiary

Considering the heavy pressure on water resource and demand for drinking water, the recycled waste water can be used for non-drinking purposes like industries, gardening, etc. This increases the availability of drinking water and reduces the cost involved in bringing water from distant sources and also pressure on water sources.

treatment plants are established**.** Worst of all, even in majority of the municipal corporations STPs are not provided. For instance, Belgaum and Hubli-Dharwad, which produce an average of 100 LPCD of sewage, do not have treatment plants. Among those ULBs where treatment plants are provided in 4 ULBs, i.e., in Jamkhandi, Bhatkal, Chikmagalur and Ilkal, they are not functioning.

3.1.4. Large Number of Slums in Urban Areas

Slum is an area being low-lying, having ill-sanitary conditions, over crowded population, and hence a source of danger to public health. In urban areas of Karnataka there were 2428 slums (Annexure Table 14) during 2002, which shows the magnitude of the problem. Among the districts, Bangalore Urban has maximum number of slums (366) followed by Gulbarga (179), Shimoga (153) and Bellary (136). All other districts, except Dakshina Kannada, Udupi and Kodagu, have on average more than 50 slums each. The problem of slums is too severe in class – I cities with 998 slums as on 3-5-2003 according to the Karnataka Slum Clearance Board. Presence of large number of slums in almost all districts indicates the magnitude of additional sanitation, drinking water supply and health problems in urban areas. In all these slums to a larger extent the drinking water facilities, drainage system, community toilets, roads etc., are not available. Lack of these basic facilities contributes to the high morbidity of people living in slums and also to bad environment.

3.2. Trends and Projections in Sanitation

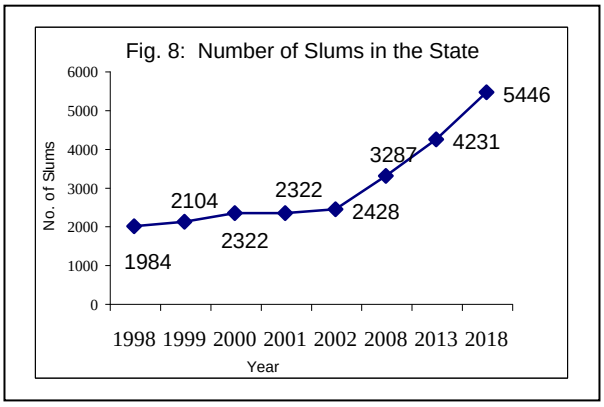
3.2.1. Household Sanitation in Rural Areas

Under the Central Rural Sanitation Programme (CRSP) just about 1.19 lakh households were provided during the period from 1985-1986 to 1994-95 in the State. But, under the Nirmal Grama Yojana launched recently, the State government has been able to provide additionally 753464 households with latrine facilities within six years during 1994-2000. Besides, the World Bank supported Integrated Rural Water Supply and Environmental Sanitation project has created about 89000 latrines between 1993 to mid 2000.

With the above achievements at an average rate of 125577 households per year by the NGY and about 12714 households under externally aided projects, if the same progress is continued, an additional 7 lakh households can receive the benefits of latrine facility during each of the 10th, 11th and 12th Five Year Plans all together adding to another 21 lakh households by the year 2018. This is still away from covering all the 60 lakh households (Census, 2001). Clearly, the present rate of covering sanitation facilities is grossly inadequate.

3.2.2. Increasing Number of Slums

Over the years, there is a significant increase in the number of slums in the state (Fig.8). During 1998 there were 1984 slums in the state, which increased to 2428 in 2002.The number of slums increased at a compound growth rate of 5.17 per cent between 1998 and 2002. At this rate the state may end up with as many as 3287, 4231 and 5446 slums by the end of 10th, 11th and 12th Five Year Plans, respectively, if not more.



3.3 Underlying Causes for Lack of Environmental Sanitation

The causes for problems in sanitation are both demand and supply factors. The notable ones are:

- Ignorance among rural people about the pollution caused by open-air defecation
- Low priority among the rural households for having latrines nearby households
- Lack of space near the house for construction of latrines

- Non utilization of existing latrines facility
- Insufficient water supply in both rural and urban areas
- Lack of resources like land or earmarked space for manure pits outside habitations
- Lack of knowledge of scientific composting method among people
- Low priority assigned by local government organizations such as Grama Panchayat, Regional Development Boards (GoK, HPC Report, 2002) for creation of adequate sanitation facilities like drainage and sullage system in rural habitation
- Improper design and implementation of drainage and sewerage system, lack of or inadequate place for diverting the drainage in both rural and urban areas
- Lack of public toilets/latrine facilities in urban areas
- Non-existence of wastewater treatment plant in several towns
- Factors responsible for increase in the number of slums are:
  - rural-urban migration
  - settling down of migrated people on open lands
  - non-affordability of migrant people for proper accommodation
  - temporary or casual employment opportunities with industrial development, construction activities in urban areas, etc.

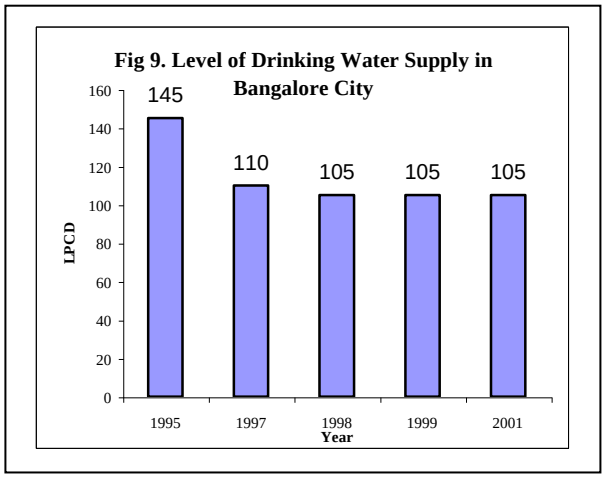
4. Drinking Water Supply and Sanitation in Bangalore City

Bangalore, the capital city of Karnataka State, is one of the fastest growing cities, with the decadal growth of 41.36 per cent (Annual Report 2001-2002, BWSSB). There is a rapid increase in population from 4.13 million in 1991 to 6 million in 2001, for which provision of basic amenities of life like adequate drinking water, sanitation facilities, etc., are necessary. The responsibility of providing drinking water and sanitation facilities to Bangalore city lies with the Bangalore Water Supply and Sewerage Board (BWSSB), established in 1964. Bangalore City is provided with the services of filtered water for over 100 years and with sewerage system since 1922. Yet, pertaining to supply of adequate drinking water and sanitation facilities, the city has certain environment related problems like inadequate drinking water supply, increasing pressure on drinking water sources and insufficient provision of sanitation facilities, which are discussed below.

4.1. Environmental Problems

4.1.1. Inadequate Drinking Water Supply in Bangalore City

Providing adequate drinking water supply to Bangalore City is one of the important emerging issues at present. The level of drinking water supply in Bangalore city lies in the range of 105 LPCD (Fig. 9) (Annual Report 2001-2002, BWSSB). But, this level of water supply is far less than the norm of 150 - 200 LPCD recommended for a city of this size by the CPHEEO (BWSSB Website). Apart from low level of water supply, even that rate is on the decline.



During 1995 Bangalore people were receiving about 145 LPCD of water, but it declined to 105 in the later years, although it is maintained at this level since past 3 years. Hence, inadequate supply of drinking water is an important issue for a large metropolitan city like Bangalore.

4.1.2. More Dependency on Cauvery River and Groundwater

The sources of drinking water for Bangalore are Cauvery and Arkavathi rivers, and ground water. Among these, river Cauvery occupies the major place as it provides over 87 per cent of drinking water drawn from river sources (Table 4). The dependency on Cauvery is growing with the increased number of water supply schemes based on Cauvery water (already three schemes i.e., CWSS I, II and III are completed and CWSS IV is in progress). The increased dependency has its own demerits of high cost, and others due to the long distance from the source. Arkavathy river is another source, which is contributing about 12 per cent of water to Bangalore. But, Arkavathy is a rain-based river, which dries up during deficient rainfall years. In recent years the frequency of drying up of the T. G. Halli Reservoir on river Arkavathy has increased due to drought situations. Hence, the dependency on Cauvery has increased.

Table 4: Present Supplies of Water for Bangalore

Sources	Million Litres Per Day
Cauvery Stage I	135
Cauvery Stage II	135
Cauvery Stage III	300
Cauvery Stage IV	270
Cauvery Total	840 (87.5)
T. G. Halli (Arkavathi)	120 (12.5)
Total	**960**

Source: BWSSB
Note: Figures in bracket are percentages to total

In addition to rivers, ground water is another major source of drinking water in Bangalore. There are over 7000 borewells maintained by the BWSSB, apart from over 80000 borewells maintained by private people. An Estimation by the BWSSB shows that over 103000 million liters of water per year is extracted from groundwater source, which is about 28 per cent of the total drinking water supply during 2001-02. As a result the ground water level is fast declining in Bangalore. According to engineers from the BWSSB, the ground water level has drastically declined in north, north-east, and west part of Bangalore City. Absence of recharging measures of groundwater and conserving rainwater, etc., have added to the problem.

Apart from decline in ground water level, deterioration of ground water quality is another major problem in Bangalore. It should be noted that the Nitrate concentration in ground water is above 45 mg/L as revealed by tests conducted by BWSSB. All these indicate that there is a heavy pressure on drinking water sources of Bangalore, which needs to be addressed immediately.

4.2. Trends in Drinking Water Supply in Bangalore

The quantity of water supplied in Bangalore City has experienced decline over the period. People of Bangalore were receiving about 145 LPCD of water during 1995, but it declined to 105 LPCD in later years (Figure 9), at a rate of 6.56 per cent. At this declining trend rate, the level of water supply in Bangalore City would be reduced to 66 LPCD by the end of 10^{th}, 48 LPCD at the end of 11^{th} and 35 LPCD by the end of 12^{th} Five Year Plans.

4.3 Causes for Drinking Water Problems in Bangalore

Various factors, apart from financial have been contributing to the inadequate quantity of drinking water supply in Bangalore City. There is a drastic increase in population size, number of industrial units, etc., all of which have increased the demand for water. Added to this is the problem of leakage in the distribution system, which reduces the amount of water received by people.

According to BWSSB engineers the leakage of water is estimated at 35 per cent of the flow of water. The leakage is caused mainly due to corroded pipes in the distribution network, damages caused during road widening and repair works and use of inadequate quality pipes in majority of household connections.

4.4. Inadequate Sanitation Facilities in Bangalore City

Inadequate sanitation facility is another issue, which is causing serious environmental problems in Bangalore city. The rapid increase in population and industrialization generates more wastewater in the city, which needs to be carried through proper sewerage system to avoid health and environmental effects. According to BWSSB, about 80 per cent of the water supplied in the city gets reduced as wastewater, which amounts to about 528 MLD. This wastewater needs to be collected and treated before it is let to the natural drainage system. At present about 38.6 per cent of the geographical area of Bangalore City is covered with sewerage system. This shows that the provision of sewerage system in Bangalore is highly inadequate, as nearly 61 per cent of the total geographical area of 593 Sq. Kms. is yet to be provided with sewerage system (Source: BWSSB). It should be noted that the present sewerage system exists in core area of the city, while peripheral areas are being slowly covered. The existing sewerage system of Bangalore City is divided in to 3 drainage zones, namely Vrishabhavathi, Koramanagala & Challaghatta and Hebbal. In addition there are three minor valleys namely Kethamaranahalli and Arkavathi, Tavarekere and Kathriguppe. But, the sewers in these valleys are inadequate and their capacity to carry the sewage is also low, which contribute to wastewater stagnation and other related problems.

Wastewater treatment is another requirement in the provision of sanitation facilities to avoid the problems like contamination of water bodies and soil. There are 5 sewage treatment plants in Bangalore to treat the huge of amount of wastewater, i.e., 528 MLD. Out of this about 408 MLD of wastewater is treated in the 5 existing treatment plants (Table 5).

Table 5: Sewage Treatment Plants in Bangalore

Sl. No.	Sewage Treatment Plants located at	Capacity in Million Liters per Day
1	Koramangala and Challaghatta Valley	163
2	Vrishabhavathy Valley	180
3	Hebbal	60
4	Madivala	4
5	Kempambhudhi	1

Source: BWSSB

But, the rest of about 120 MLD of wastewater is not currently treated. Besides according to study conducted by TCE Consulting Engineers Limited (BWSSB, 2001), the treatment plants work below their capacity.

At the Koramangala and Challaghatta Valley Sewage Treatment Plant the average inflow is about 80 MLD to 100 MLD against the capacity of 163 MLD. Similarly, in the Vrishabhavathy Valley Sewage Treatment Plant during 2000 the sewage inflow was 103 MLD, which is much below the capacity of the plant i.e., 180 MLD. This shows that the STPs are performing less than their capacity.

4.5. Causes for Problems in Sanitation Services in Bangalore City

The inadequate sanitation facilities in Bangalore City are due to several reasons. While the financial problems have caused delay in implementation of sanitation facilities in the city, other factors, shown below have added to the problems related to sanitation in Bangalore City (Source: BWSSB, 2001).

- The sewers at many places are in bad condition, due to siltation or blocking of solid waste or damage in the system.
- The sewage is left to open places at many places creating unhygienic conditions in the nearby area.
- Non-functioning of sewage pumping stations, e.g. Hennur, Halgevadayarahalli
- Dumping of solid waste in manholes
- Discontinuity in sewer lines, crown corrosion and reverse gradient
- Absence of sewers in slum and isolated areas.

These problems in the existing sewerage system add to the problems of inadequate sewerage system in Bangalore City.

4.6. Hotspots in Sanitation

Identification of hotspots in terms of inadequate sanitation facilities like household latrines, community sanitation, drainage and sewerage system, public toilets/latrines, etc., is a difficult task. Because, while over 85 percent of rural households do not have household latrine facility, around 81 per cent of ULBs do not have UGD system. Further, in rural area, one can observe lack of community sanitation. Considering this fact on sanitation service level, it can be said that all rural and urban habitations are hotspots.

5. Impacts of Environmental Problems in Drinking Water Supply and Sanitation

The problems and pressures in drinking water supply and sanitation sector lead to different types of impacts (both environmental and others). Two major impacts that are discernible are on the status of health (see Box 5) and the other impacting the surroundings of the habitations including aesthetic beauty and bounty of nature.

Box 5 : Diseases Transmitted through Water
1. Water Washed Diseases – scabies, trachoma, with inadequate water for personal hygiene causing spread to occur through water used for bathing **2. Water Based Diseases** – infections transmitted through aquatic invertebrate animals e.g., Leptosopirosis and guinea worm **3. Water Related Vector Borne Diseases** – infections spread by insects that depend on water through vector breeding in water – malaria, filariasis, dengue fever, Japanese encephalitis. **4. Water Borne Diseases** – through faecal contamination – gastroenteritis, cholera, typhoid, Hepatitis A, etc.

Source: Adopted from Gleik (1998)

5.1. Impacts of Inadequate Water Supply

Consumption water less than required quantity causes 'water washed diseases' like scabies, fungal infections, trachoma, etc. In many rural habitations of Karnataka health problems due to inadequate water are observed. Further, inadequate water use creates blocks in sewage flow, which contaminates water sources as shown earlier. Irregular water supply contaminates water in distributional network due to rusting of pipes, etc., and insufficient water flow creates back syphonage of water due to low pressure in the distribution system leading to contamination of water and health problems.

> In some villages of Jagalur Taluk in Davanagere district skin diseases were reported as people stopped bathing due to shortage of water (reported in Deccan Herald, March 12, 2003).

Apart from health effects, inadequate water supply increases the hardship on women and children, as they have to spend more time and energy in collection of water. Loss of water in distribution system adversely affects the poor and vulnerable people and those who live in outlying areas, as they will be compelled to buy water from private people or go to distant place for collecting drinking water.

5.2. Impacts of Depleting Drinking Water Sources

Depleting water resources, i.e., unsustainable drinking water sources results in shortage of water availability. This is already being witnessed in many parts of the state with the continued spell of drought during the last four years. For instance, in many villages of Raichur, Dharwad, Belgaum and some other districts drinking water sources are dried up, causing serious drinking water problems

to people. The decline in the ground water table causes geo-chemical changes resulting in wide spread chemical contamination of ground water (e.g. excess of Fluoride, Brackishness, Iron, Nitrate) which has its adverse effects on health of population.

5.3. Impacts of Poor Water Quality

Poor quality water has serious implications on health and environment. For instance, contaminated water has adverse impacts on health like disorder of teeth, bones, skin allergies, birth defects and premature infant death, water borne diseases, etc. Contamination of river water has led to no aquatic life like fish up to 2 Kms. range in river Bhadra from the point of effluents discharge by Mysore Paper Mills. This indicates that in general river and tank aquatic life is severely affected due to low quality water.

Ground water with excess fluoride has caused fluorosis to 1.29 lakh people in Gulgarga and Tumkur (reported in The Hindu, 5 April 2002) and to more than 25000 people in Kolar (reported in Vijaya Karnataka, Kannada Daily, 2 October 2000)

Polluted ground water around Bangalore peri-urban areas is causing health problems like skin irritation, throat infection, vomiting, jaundice for children, etc., and this has resulted in an increased health expenditure of about Rs. 3000 per year per family (Diwakar and Nagaraj, 2002)

5.4. Impacts of Inadequate Sanitation

- Lack of or inadequate sanitation facilities either at household or community level causes unhygienic rural environment
- Absence of drains results in slushy streets during rainy season and creates dust in summer season, both of which can lead to health problems
- Inadequate and improper drainage system results in stagnant water pools, which are breeding sources of flies, mosquitoes and other insects causing health hazards like malaria
- Practices of washing and bathing around water sources, lack of latrine, drainage and sewerage facilities can contaminate ground and surface water bodies due to leaching
- Inadequate sewerage, toilet and other community sanitation facilities or lack of them leads to stagnated wastewater pools, thus becoming the source of worms and mosquitoes, posing danger to public health
- Stagnated sewage pollutes groundwater when it is leached in. Studies conducted by experts from Bangalore University have already shown that ground water around the urban area of Chikkaballapur and Mandya is contaminated, caused by leaching of sewage water into the groundwater
- All these in turn can lead to water borne diseases. But, there is lack of information system to indicate the number of people suffered from diseases related to inadequate sanitation system
- It should be noted that it is the poor people who suffer most due to ill health caused by lack of sanitation system

6. Health Impacts of Inadequate and Unsafe Drinking Water Supply and Sanitation Services

The above sections dealt with environmental problems, their trend, causes and impacts relating to rural and urban drinking water supply and sanitation services in Karnataka. Since drinking water and sanitation services are major inputs for maintenance of health and hygiene, lack of and inadequate provision of these services creates health and environmental problems. But, due to non-availability of actual data on different health problems separately for rural and urban area, incidence and mortality of certain diseases related to water at the state level alone are discussed here.

The major diseases occurring due to unsafe drinking water and lack of sanitation services are gastroenteritis, malaria, cholera, typhoid and others, some details of these are presented in Table 6. Even these are gross underestimates as the data on incidence of water borne diseases is from the

Department of Health and Family Welfare and this does not include the incidence reported in private health centers.

Gastroenteritis is the major disease with nearly 24 thousands of incidences and claiming about 200 lives during 2001. It should be noted that Viral Hepatitis is increasing rapidly in the state from 1714 cases in 1997 to 5438 cases in 2001. Malaria also has its sway as more than 93 thousand cases were proved positive during 1999.

Table 6 : Incidence of Water-Borne Diseases and Deaths

Year	Gastroenteritis		Cholera		Malaria		Viral Hepatitis		Typhoid	
	Cases	Deaths	Cases	Deaths	A	B	Cases	Deaths	Cases	Deaths
1997	23665	307	741	10	7726512	181450	1714	4	2880	5
1998	26832	501	434	2	7568155	26776	3824	2	8242	4
1999	17743	126	134	3	7405711	93651	4792	2	23946	2
2000	31132	265	354	3	131	NA	3077	10	8	NA
2001	23893	198	342	1	NA	NA	5438	28	33346	6

Source: Department of Health and family Welfare, GoK

A: Total Blood smear collected and examined B: total positive cases

Information on diseases at District-level during 2001 is presented in Annexure Table 15. It is important to note here that Dharwad district has reported the highest number of gastroenteritis i.e., 3483 cases, followed by Gulbarga (2309 cases), and Bellary (2098 cases). Among all the districts Kolar has reported more number of incidences of Cholera (62), Viral Hepatitis (1358) and Typhoid (8712).

7. Prioritization of Environmental Problems in Drinking Water Supply and Sanitation

The following section presents the prioritization of environmental problems discussed in respect of drinking water and sanitation sector of Karnataka. The prioritization matrix has been worked out at the State level and four geographical zones and Bangalore City (presented in Annexure Table 16). Wherever necessary and appropriate scores are specified for rural and urban separately. After prioritization the problems have been ranked on the basis of scores obtained and is summarised in Table 7.

Table 7: Ranking of Sectoral Environmental Problems in Drinking Water and Sanitation

Problems	Socio-Economic/Ecological Impacts										
	Rural					Urban					
	Coastal	Western Ghats	Northern Plateau	Southern Plateau	Karnataka	Coastal	Western Ghats	Northern Plateau	Southern Plateau	Karnataka	Bangalore City
1. Inadequate Drinking Water Supply	I	I	II	II	II	I	I	II	II	III	I
2. Depletion of Groundwater	III	II	I	I	I	III	IV	I	I	I	NA
3. Deteriorating Drinking water quality	IV	III	II	I	II	IV	III	III	I	III	NA
4. Lack of Household Toilet Facility	II	III	II	II	II	II	II	II	IV	V	NA
5. Lack of Sewerage System and Disposal Facilities	II	III	II	II	II	II	II	II	I	III	NA
6. Lack of Community Sanitation	II	III	II	II	III	II	II	II	III	II	I
7. Increasing Number of Slums	NA	NA	NA	NA	NA	V	V	IV	V	IV	II
8. Increasing Pressure on Drinking Water Sources											
a) Ground Water Sources	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	I
b) Surface Water Source	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	II

Note: NA = Not Applicable

The outcome of prioritization exercise suggests the following priority issues in the State and across regions:

⇒ Inadequate drinking water supply is the
  First priority issue in both rural and urban areas of Coastal and Western Ghats region and Bangalore City
  Second priority problem in rural and urban areas of Northern and Southern regions and in rural areas at the state level

⇒ Depletion of groundwater assumes
  First priority in Northern and Southern Plateaus; and at the State level
  Second priority in rural areas of Western Ghats

⇒ Deteriorating drinking water quality is the
  First priority problem in both rural and urban areas of Southern Plateau
  Second priority issue at the State level and Northern Plateau (in rural areas)

⇒ Lack of household toilet facilities is the
  Second priority issue in rural areas of Coastal, Northern, Southern Plateau and at State level; and in urban areas of Coastal, Western Ghats and Northern regions

⇒ Lack of sewerage system and disposal facilities is the
  First priority problem in urban areas of Southern Plateau, while is Second priority issue in rural and urban areas of Coastal, Northern regions, rural areas of Southern Plateau and State level and urban areas of Western Ghats

⇒ Lack of Community Sanitation emerges as the
  Second priority aspect in both rural and urban areas of Coastal and Northern Plateau; and in rural areas of Southern Plateau and also in the urban areas at State level.

⇒ Increasing number of slums assumes
  Second rank in Bangalore City

⇒ Increasing pressure on drinking water sources in Bangalore City is the
  First priority issue on groundwater source
  Second priority issue on surface water source

7.1 Sectors Impacting Drinking Water Supply and Sanitation Facilities

Sectors Impacting on Water Supply and Sanitation

Problems	Sectors				
	Household	Agriculture	Urban Planning	Mining and Quarying	Industry
1. Inadequate Drinking Water Supply	High	High	High	Medium	Medium
2. Depletion of Ground Water	High	Medium	High	Medium	Low
3. Deteriorating Drinking Water Quality	High	High	High	High	High
4. Lack of Household Toilet Facility	High	Low	High	NA	NA
5. Lack of Sewerage system and Disposal Facilities	High	Low	High	NA	High
6. Lack of Community Sanitation	High	Medium	High	NA	NA
7. Increasing Number of Slums	High	NA	High	NA	NA
Total	High	High	High	Medium	High

Note: NA – Not Applicable

Mainly household, agriculture, urban planning and industrial sectors adversely affect the drinking water supply and sanitation sector. Increased demand for drinking water and sanitation services due to high growth in population, urbanization, economic activities (irrigation, industry), etc., has lead to more pressure on availability of drinking water, its quality and sanitation facilities. Although, drinking water constitutes a small portion (around 4 per cent) of water resources, problems lie with availability of potable water at all habitations, dependency on ground water, etc., which have resulted in several problems in drinking water supply. Similarly, the problem of inadequate sanitation facilities has got aggravated with rise in demand from the above sectors.

8. Institutional Arrangement in Drinking Water Supply and Sanitation

In the provision of drinking water supply and sanitation services different institutions are involved, in both rural and urban areas, in activities ranging from creation of infrastructure to operation and maintenance; water quality testing and monitoring, etc. It may be useful to take a close look at them with a view to evolve strategies and actions to deal with the environmental problems. See Annexure Tables 17-19 for summary of the institutional structures.

8.1. Rural Drinking Water Supply and Sanitation

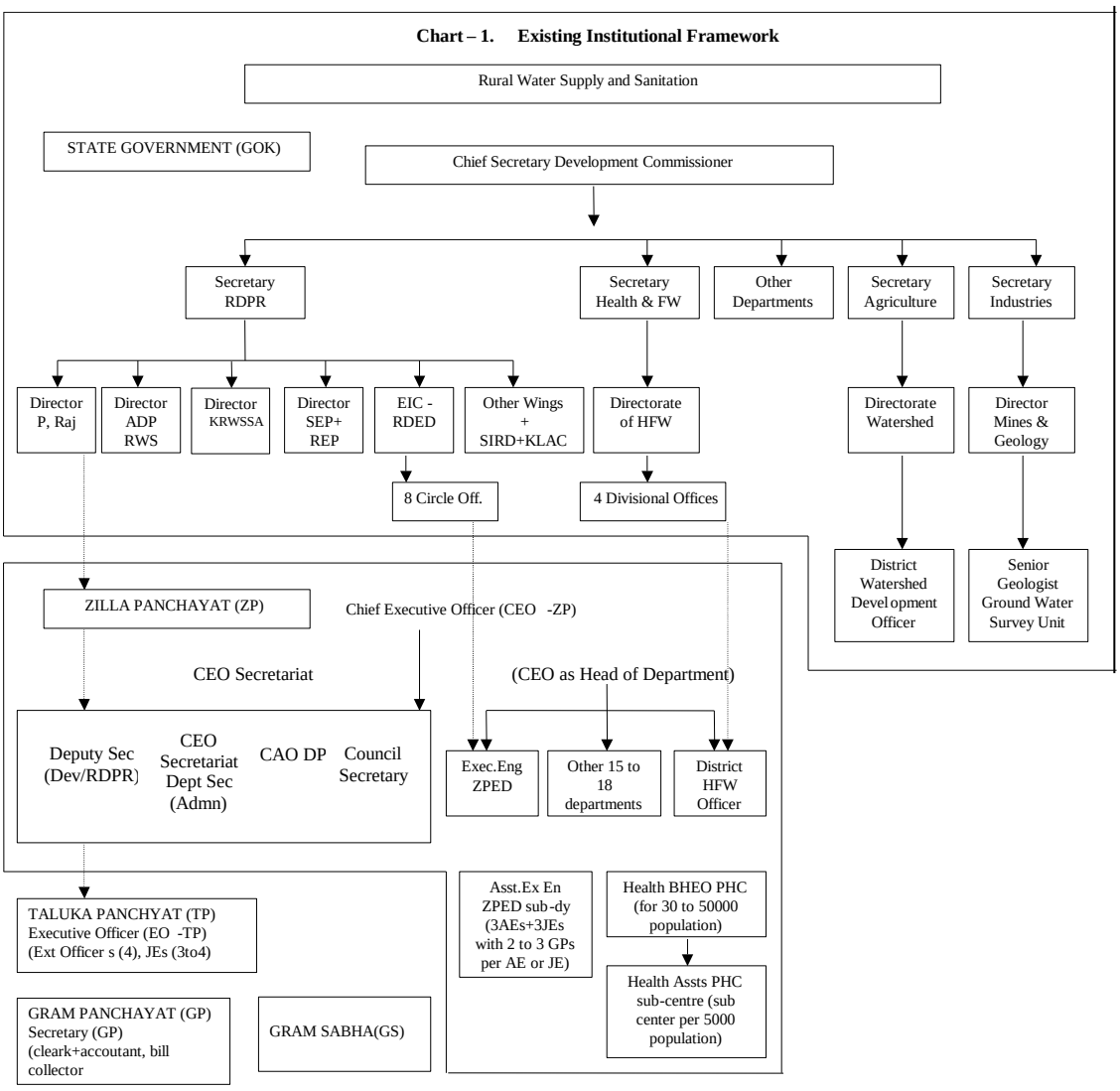
8.1.1. Institutional Arrangement at State Level

The **Rural Development and Panchayat Raj Department** (RDPR), the nodal agency in planning, implementing, monitoring and evaluating all the rural development activities in the State, is responsible for providing drinking water and sanitation services in rural areas. The RDPR has different wings to carry its programmes, which are shown in Chart 1 (GoK, RDPR, 2001), and briefly explained in Box 6.

Box 6: State Level Institutions

RDPR Wings	Matters Related to Drinking Water & Sanitation
1. Area Development Programme Wing	Implementation and monitoring several programmes among which Integrated Watershed Development Programme is included.
2. Rural Water Supply Wing	This wing has two sub wings – one for External Aided Projects of Rural Water Supply and Sanitation and the other for the regular Rural Water Supply and Sanitation. The Rural Development Engineering Department implements and monitors all programmes related to rural water supply and sanitation.
3. Karnataka Rural Water Supply and Sanitation Agency	Established by the GoK as a society under Karnataka Societies Registration Act. Implementing the World Bank aided Jal Nirmal Project
4. Panchayat Raj Wing	This wing deals with all the matters including implementation of the Zilla Panchayat, Taluk Panchayat, and Grama Panchayat.
5. a) Special Economic Programme Wing b) Finance Wing c) Plan Monitoring and Evaluation Cell d) Administrative Wing	Implement and monitors the Swarna Jayanthi Rozgar Yojana, Swavalambana, etc. Over-viewing all activities including drinking water and Sanitation.

Chart – 1. Existing Institutional Framework



RDPR	: Rural Development & Panchyat Raj	ZP	: Zilla Panchayat
RDED	: Rural Development Engg.Department	TP	: Taluk Panchayat
RWS	: Rural Water Supply	GP	: Gram Panchayat
KRWSSA	Karnataka Rural Water Supply & Sanitation Agency	ZPED	: Zilla Panchayat Engg. Division
KLAC	: Karnataka Land Army Corporation	PHC	: Primary Health Centre
HFW	: Health and Family Welfare	BHED	: Block Health Education Officer
SIRD	: State Institute of Rural Development	PR	: Panchayat Raj
EIC	: Engineer-in-Chief	GS	: Gram Sabha

Planning & Moniroting linkage

Technical linkage

Administrative linkage

8.1.2. Institutions at District and Lower Levels

At the district level there are three Panchayat Raj Institutions responsible in implementing the programmes, including those on drinking water supply and sanitation.

Zilla Panchayat: ZP, the first tier in Panchayat Raj institutions, is responsible for planning, implementing and monitoring all the developmental programmes in the district which are being carried out by the departments such as PWD.

District Project Monitoring Unit is formed at district level under Project Planning and Monitoring Unit of ZP and responsible to oversee the activities at district level. It has technical, administrative personnel and also a social scientist.

Taluk Panchayat: Taluk Panchayat liaisons between ZP and Grama Panchayat, and responsible for implementing and monitoring developmental works at taluk level.

Grama Panchayat: *As* the lowest tier of Panchayat Raj institution it prepares its own plan and implements after getting approval from Taluk Panchayat. It is also responsible for collecting water charges, operations and maintenance of water supply schemes.

Village Water and Sanitation Committee (VWSC)**:** VWSCs are developed to involve the local community participation in the project villages of the World Bank assisted Integrated Rural Water Supply and Sanitation. VWSCs play a crucial role in planning, implementation and operation and maintenance of the assets created.

8.1.3. Other Institutions

Department of Mines and Geology
This department has two main divisions, 1. Mineral Investigation and Administration and 2. Groundwater Investigation and Administration. The Groundwater division conducts the activities of

a) Assessment of ground water resources in all the taluks
b) Periodic monitoring of groundwater levels
c) Monitoring of the ground water quality for various purposes
d) Determination of aquifer characteristics
e) Selection of sites and construction of artificial recharge structures
f) Selection of suitable sites for drilling borewells
g) Issue of feasibility reports/certificates
h) Regulate development of groundwater resources in a systematic and scientific manner

Directorate of Health and Family Welfare: This department apart from implementing various health programmes, conducts water quality testing for bacteriological contents with its District Surveillance Unit. A district level coordination committee headed by the Deputy Commissioner of the district coordinates with all departments and reviews the surveillance of the communicable diseases including water borne diseases.

Directorate of Watershed Development: This department is concerned with carrying out activities like recharging ground water, along with several other activities like soil conservation, etc.

Irrigation Department: The irrigation department is the nodal agency for major and minor irrigation projects. Although major portion of water is used for agriculture purpose, it is also used for drinking purpose hence the irrigation department is also involved in the provision of drinking water supply.

NGOs and Community Based Organisations (CBOs): NGOs and CBOs play a crucial role in creating awareness among the communities to involve in planning, implementation and monitoring activities of drinking water projects.

8.1.4. Institutions in Operation and Maintenance of Rural Water Supply

In Karnataka, with the introduction of Panchayat Raj institutions, the responsibility of operation and maintenance of drinking water supply schemes is entrusted to Grama Panchayats. The GPs appoint pump operator and other personnel for the operation of the systems from the local villages. The maintenance of the schemes is carried out by fixing some amount of tariff for the users on adhoc basis. Taking into account the inadequate attention given by the ZPs in maintenance activities of drinking water supply schemes, and to create a sense of ownership among the GPs and users, the Government has transferred the operation and maintenance of all Piped Water Schemes and Mini Water Schemes to the GPs. Although the government is partially meeting the operation and maintenance expenditure, it is proposing to transfer the full responsibility to GPs in the coming years.

8.1.5. Institutions in Water Quality Monitoring

At present there is no well defined and conceived agency with a mandate for water quality monitoring in rural areas. The water quality in rural areas is supposed to be tested by the RDED. The RDED tests the quality of water in the newly dug borewells and if the standard (BIS) is met then the water will be supplied for use. But, after the initial testing, no regular monitoring of water quality is done.

Apart from RDED, few other institutions have the facility of testing water quality. They are:

1. Public Health Institute and District level Public Health Laboratories of the Health and Family Welfare Department has 28 laboratories
    i. Public Health Institute at Bangalore, conducts test for chemical and bacteriological contamination
    ii. Three Divisional Laboratories at Gulbarga, Mysore and Belgaum: Five Regional Laboratories at Mangalore, Chikkamaglur, Chitradurga, Raichur, and Dharwad – these laboratories mainly conduct food testing and cannot be used water quality testing.
    iii. Nineteen District Health Laboratories (before formation of new districts), one at each district – 19 laboratories do not have necessary equipment and trained staff for chemical examination of water, 6 do not have the facility for bacteriological testing of water.

2. Department of Mines and Geology has district or regional laboratories for collection and testing of ground water samples twice a year from its observation wells. But it does not contain facility of testing for bacteriological contents.

3. Zilla Panchayats - District level water quality monitoring laboratories have been set up under ZP in each district. But these labs have inadequate staff to conduct tests. According to RDED out of 18 District Level Laboratories 11 are not functioning.

4. State Pollution Control Board has laboratories at Mysore, Davanagere and Dharwad, and Bangalore; these laboratories collect and test ambient water quality.

8.2. Institutions in Urban Drinking Water Supply and Sanitation Services

The responsibility of providing drinking water and sanitation services in urban local bodies, except Bangalore City and 8 City Municipal Councils situated around Bangalore, lies with the Karnataka Urban Water Supply and Drainage Board (KUWS&DB). The Board executes water supply and drainage schemes, and transfers it to local bodies for operation and maintenance by providing technical guidance. While it adopts population base as a norm in selecting different water supply schemes for urban local bodies, for implementing under ground drainage services all urban local bodies irrespective of population size are covered.

The Karnataka Urban Infrastructure Development and Finance Corporation (KUIDFC) is also involved in implementing urban water supply and sanitation projects through KUWS&DB.

8.2.1. Operation and Maintenance

The urban local bodies are responsible for operation and maintenance activities of water supply and sanitation schemes created by KUWS&DB. As per the Government order (G. O. No. UDD 204 UMS 95 dated 15-11-1996) the Board has to hand over the completed projects to ULBs for operation and maintenance activities (Annual Report, KUWS&DB, 1999-2000).

8.2.2. Water Quality Monitoring

The KUWS&DB has the facility of testing for water quality at four places viz., Mysore, Belgaum, Hubli-Dharwad and Mangalore and also two laboratories in Bangalore.

8.2.3. The Slum Clearance Board

The Slum Clearance Board, established in 1973, has the responsibility of enabling the slum dwellers to live in hygienic condition by providing basic amenities like drinking water, roads, drains, community bathrooms, storm water drains, street lights, etc. At present the Board is implementing its programmes in 21 Class – I cities of the State.

8.3. Institutional Arrangement of BWSSB

The Bangalore Water Supply and Sewerage Board is responsible for providing water supply, sewerage system and sewage disposal services to the Bangalore Metropolitan area. The BWSSB has the following responsibilities:

i. Providing water supply and making adequate provision for sewage and disposal of the sewage in the existing and developing areas
ii. Preparation and implementation of plans and water supply schemes to meet the increasing demand
iii. Preparation and implementation of plans and schemes for providing proper water supply, sewerage and disposal of sewage
iv. Remodeling the distribution system to supply the available water
v. Mobilizing the finances required
vi. Improvement to the existing system
vii. Revenue collection for the water supply, sewerage and sewage disposal system

Operation and Maintenance

A separate engineering section headed by a Chief Engineer is responsible for maintenance of water supply and sewerage system. Another engineering section carries out the work of wastewater management

8.4. Problems or Gaps in the Institutional Structure of Drinking Water and Sanitation

- There is an overlapping between state government programmes and those implemented by the externally aided agencies in the provision of drinking water and sanitation services (as shown by an ongoing project of the World Bank 'Roles of Rural Local Organizations' at Institute for Social and Economic Change, Bangalore).
- Inadequate importance given to operation and maintenance activities of drinking water supply and sanitation schemes by local organizations, due to paucity of resources.
- Lack of an integrated system of water quality testing and monitoring.
- Involvement of multiple institutions in water quality testing.
- The water quality testing facilities of ZP and State Health and Family Welfare Department could only be used for monitoring the quality of rural water supply. But

the possibility of availing the laboratory facilities of other institutions is limited for various reasons like administrative, co-ordination, etc.

- Further, many of the existing water quality monitoring systems have limited infrastructure for carrying tests.
- At present the KUWS&DB has taken up providing drinking water and sanitation facilities to 208 ULBs, and for the rest plans and programmes are yet to be prepared.
- There is the problem of inefficiency in management of water and sanitation schemes including inadequate staff.
- The urban local bodies are responsible for operation and maintenance of water supply schemes. As per the Government order (G.O. No. UDD 204 UMS 95 dated 15-11-1996, Annual Report – 1999-2000) the Board has to hand over the completed projects to urban local bodies for operation and maintenance. But some local bodies have not taken this responsibility from the Board, which shows lack of coordination in responsibility sharing among the organizations.
- Involvement of various institutions in undertaking groundwater recharging measures, in the absence of an integrated agency to plan and implement programmes for rejuvenating groundwater and tanks.
- It seems there is no coordination between water users - public, private (for drinking water provision, agriculture, industry, etc) and agencies involved in undertaking groundwater recharging activities.
- Lack of an institution to promote rainwater harvesting particularly in urban areas as most of the agencies are concentrating on rural areas.
- Majority of ULBs have accorded low priority for construction and also operation and maintenance of public sanitation facilities like public toilets, latrines etc.
- There is inadequate information/data base on problems related to water quality at source, distribution network, and consumer point, sanitation facilities – UGD, community sanitation, public toilets, etc., and information on health and environmental impacts.

9. Policy Recommendations / Priority Action Plan

In order to resolve the problem of depletion of drinking water sources and deterioration in water quality, and inadequate sanitation facilities the following actions need to be considered immediately.

- Integrated institutional system for groundwater conservation and recharging measures
- Institutional initiatives need to be promoted for rainwater harvesting in both urban and rural areas.
- It is necessary to avoid overlapping of various programmes of water supply and sanitation and to spread them equally across the state to bring partially covered habitations under full coverage.
- Drought prone districts should be given high priority to resolve the problem of inadequate water supply
- Drinking water can be made as a matter of right. In any case about 4% of water resource is sufficient for drinking purpose, hence it will not bring in any hardship to water resources. But, it will enable GPs and ULBs to budget for it on a priority basis.
- Measures need to be initiated and implemented against water polluting industries and ULBs for treating wastewater before discharging.
- Drinking water quality affected habitations should be taken on first priority basis to provide safe drinking water, through alternative sources or by treating water.
- Attention may be given towards dual water supply system in water quality affected areas (i) one for drinking (ii) another for washing, bathing and cleaning purposes.
- An integrated water quality testing and monitoring system for both rural and urban area together should be developed to avoid multiple agencies involved in the system. Either State Pollution Control Board, Department of Mines and Geology or Zilla Panchayat Laboratories can be made responsible for testing of both organic and inorganic contamination of water.

- A single water quality testing agency should be promoted for both ground and surface water, and it should be informed to people on a transparent basis.
- A vigilance group has to be created to report on quantity and quality of water supplied functioning of the system, etc., for regular and efficient functioning of the system.
- Transparency law should be implemented and clearcut announcement of water quality level should be made to public, as done by Central Pollution Control Board in Delhi and other major cities.
- Water quality awareness camps should be promoted, particularly in rural areas, where groundwater quality is a serious problem.
- Operation and maintenance is a major problem in both water supply and sanitation system. Hence importance needs to be given to operation and maintenance activities for efficient working of the system.
- Grama Panchayats and ULBs should pass a resolution to use part of the revenue collected from water supply and sanitation services for operation and maintenance activities instead of sending it to general funds.
- Waterman should be a trained /qualified personnel also for maintenance of water supply system (both quantity/quality).
- Immediate attention needs to be given towards constructing sewerage system in non-covered ULBs to avoid adverse impact on health and environment.
- Sewage Treatment Plants (STPs) are an integral part of sewerage system. Hence, STPs should be provided immediately to those ULBs which are generating large quantity of wastewater on priority basis.
- Utilisation of treated waste water needs to be promoted for purposes like industrial and gardening activities, for which incentives in terms of subsidized price may be given.
- Slum development programmes should be given high priority to provide basic facilities like drinking water and sanitation to slum dwellers covering all ULBs.
- In urban planning provision should be given for sewerage system, public toilets/latrines, garbage disposal place, site for sewage / wastewater diversion, STPs, etc.
- GIS facility can be made use to model drainage and sewerage system based on run-off and altitude of the locations.
- Beneficiary involvement and participation is essential in the success of any programme. Hence government, community, NGOs based initiatives should be promoted for efficient functioning of water supply and sanitation system in both rural and urban areas. The model of Bangalore Agenda Task Force (BATF) and Infosys in establishing 'pay and use' toilets at public places in Bangalore City may be considered for developing suitable system of government, community based organisations and NGOs participation. This approach can result in reducing the burden on service providers and increase the accountability and responsibility among users.
- ULBs can consider privatisation of operation and maintenance of water supply schemes, but by protecting poor and vulnerable groups.
- In villages, Village Water Supply and Sanitation Committees (VWSCs) can be established to supervise the operation and maintenance activities of water supply and sanitation schemes by GPs.
- Involvement of slum dwellers in terms of cash, kind and planning in providing sanitation and water supply may be considered.

Annexure Tables

Annexure Table 1: Year- wise Number of Schemes for Drinking Water in Rural Karnataka

Year	Bore wells with Hand Pumps	% of Total	Mini Water Supply	% of Total	Piped Water Supply	% of Total	Total
1996-97	150949	**87.24**	11273	**6.52**	10807	**6.25**	173029
1997-98	158041	**86.54**	12851	**7.04**	11732	**6.42**	182624
1998-99	163384	**85.78**	14268	**7.49**	12812	**6.73**	190464
1999-2000	166660	**85.28**	15533	**7.95**	13237	**6.77**	195430
2000-01	171725	**84.66**	17022	**8.39**	14095	**6.95**	202843
2001-02	175645	**84.00**	18418	**8.81**	15035	**7.19**	209098

Source: Department of Rural Development and Panchayat Raj, GoK.

Annexure Table 2: Classification of Urban Local Bodies in Karnataka

Sl. No.	Class	Number of Urban Local Bodies
1	Class I (Population more than 1 lakh)	28
2	Class II (Population between 50,000 to 99,999)	30
3	Class III (Population between 20,000 to 49,000)	101
4	Class IV (Population between 10,000 to 19,999)	50
5	Class V (Population between 5000 to 9999)	16
6	Class VI (Population less than 5000)	1
Total		226

Source: Department of Municipal Administration, GoK

Annexure Table 3: Status of Rural Water Supply in Karnataka State – 2002

Sl. No.	District	No. of Habitations with LPCD								
							< 55 LPCD		55 LPCD and above	Total
		0-10	10-20	20-30	30-40	40-55	No.	% to Total		
1	Bangalore ®	54	9	128	134	631	956	30.09	2221	3177
2	Belgaum	5	100	376	242	272	995	64.44	549	1544
3	Bellary	3	58	134	112	283	590	57.28	440	1030
4	Bidar	19	14	80	56	42	211	23.29	695	906
5	Bijapur	0	125	156	78	165	524	52.04	483	1007
6	Bagalkot	17	35	69	87	125	333	46.77	379	712
7	Chikkamagalore	234	22	194	121	134	705	19.79	2857	3562
8	Chitradurga	0	70	191	111	132	504	33.14	1017	1521
9	Davangere	0	24	101	121	145	391	31.94	833	1224
10	Dakshina Kannada	0	696	318	221	235	1470	47.88	1600	3070
11	Udupi	57	364	285	350	346	1402	41.38	1986	3388
12	Dharwad	15	46	70	65	49	245	54.69	203	448
13	Haveri	0	8	70	85	176	339	48.85	355	694
14	Gadag	27	10	23	30	38	128	34.04	248	376
15	Gulbarga	0	220	355	259	374	1208	62.59	722	1930
16	Hassan	0	92	597	702	532	1923	44.53	2395	4318
17	Kodagu	142	98	80	72	60	452	82.94	93	545
18	Kolar	35	59	218	176	217	705	18.29	3149	3854
19	Mandya	0	27	195	160	204	586	29.43	1405	1991
20	Mysore	3	0	97	137	303	540	26.77	1477	2017
21	Chamarajanagara	0	84	120	140	165	509	75.18	168	677
22	Raichur	48	154	113	83	131	529	37.7	874	1403
23	Koppal	0	14	46	72	133	265	33.42	528	793
24	Shimoga	4	301	297	288	178	1068	23.39	3498	4566
25	Tumkur	30	614	467	408	399	1918	37.33	3220	5138
26	Uttara Kannada	18	192	154	340	594	1298	22.74	4411	5709
27	Bangalore (U)	0	330	120	101	150	701	64.79	381	1082
Total		**711**	**3766**	**5054**	**4751**	**6213**	**20495**		**36187**	**56682**
Per cent to total no. of Villages		**1.25**	**6.64**	**8.92**	**8.38**	**10.96**	**36.16**		**63.84**	**100.00**

Source: Department of Rural Development and Panchayat Raj

Annexure Table 4: Distribution of Towns by Level of Water Supply during 2001

Sl. No	District	Class I		Class II		Class III		Class IV		Class V		Class VI		Adequate (Total No. of Towns)	Inadequate (Total No. of Towns)	% of Towns with Inadequate Water Supply	Total No. of Towns
		Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate				
1	**Bangalore (U)**						1							0	1	100	1
2	**Bangalore ®**			2	3		6							2	7	78	9
3	**Kolar**		2		2		7				1			0	12	100	12
4	**Tumkur**		1		2		4		3					0	10	100	10
5	**C R Nagar**			1	1		1				1			1	3	75	4
6	**Mysore**	1	1				4	1	1		1			2	6	75	8
7	**Mandya**		1				4	1	1					1	6	86	7
8	**Hassan**		1			1	4		1		1			1	7	88	8
9	**Chikkamagalur**		1				3		2	2	1			2	6	75	8
10	**Kodagu**						1	1	1	1				2	2	50	4
11	**D Kannada**	1				1	3	1	1	1				4	4	50	8
12	**Udupi**		1				2		1					0	4	100	4
13	**Shimoga**		2	1		1		2		2				6	2	25	8
14	**Davanagere**		1		1		1	2	2					2	4	67	6
15	**Chitradurga**		1				3		2					0	6	100	6
16	**Dharwad**		1				2		3					0	6	100	6
17	**Gadag**		1				6		2					0	9	100	9
18	**Haveri**				2		4	2	1					0	7	100	7
19	**U Kannada**			2	1	1	2	3	3					5	6	55	11
20	**Belgaum**		1	1	1	2	6		2					6	10	63	16
21	**Bijapur**		1			2	5	1						2	4	67	6
22	**Bagalkot**				4		5	3	2					1	11	92	12
23	**Gulbarga**		1	1	2		5		1					4	8	67	12
24	**Bidar**		1		2	2	3		1					2	4	67	6
25	**Bellary**		2			3	3							3	7	70	10
26	**Raichur**		1		1		3		1					0	6	100	6
27	**Koppal**			1	1		1		1					1	3	75	4
	Total	**2**	**21**	**9**	**23**	**13**	**89**	**17**	**32**	**6**	**5**	**0**	**0**	**47**	**161**	77	**208**

Source: Karnataka Urban Water Supply and Drainage Board

Annexure Table 5: Level of Water Supply in Different Municipal Corporation Areas in Karnataka

Name of the Municipal Corporations	Level of Water Supply (in LPCD)	Adequate / Inadequate
Hubli-Dharwad	100	Inadequate
Gulbarga	86	Inadequate
Belgaum	85	Inadequate
Mysore	141	Adequate
Mangalore	152	Adequate

Source: KUWS&DB

Note: The Norms fixed for Class I towns is 135 LPCD

Annexure Table 6: Percentage of Rural Water Supply Schemes which are not functioning / Functioning Irregularly

Sl. No	District	P. W. S		M. W. S		B. H. P	
		Not Functioning	Not Regular	Not Functioning	Not Regular	Not Functioning	Not Regular
1	Bangalore (U)	2	17	3	15	30	33
2	Bangalore (R)	7	30	14	9	20	8
3	Chitradurga	1	7	2	0	14	0
4	Davanagere	6	4	10	8	39	0
5	Kolar	2	6	3	6	27	33
6	Shimoga	6	27	4	25	9	0
7	Tumkur	3	12	5	14	17	3
8	Chamarajanagar	10	12	7	20	15	0
9	Chikkamagalur	2	39	4	18	5	7
10	D. Kannada	8	49	9	55	17	93
11	Hassan	9	71	9	23	12	39
12	Kodagu	9	15	11	31	5	5
13	Mandya	4	22	3	17	12	0
14	Mysore	3	29	6	0	8	0
15	Udupi	2	19	8	0	9	0
16	Bellary	25	11	3	13	28	12
17	Bidar	10	3	5	4	21	29
18	Gulbarga	-	14	10	11	21	8
19	Koppal	19	10	3	56	34	0
20	Raichur	19	7	18	6	33	0
21	Bagalkot	7	14	16	11	29	-
22	Belgaum	10	25	14	11	20	0
23	Bijapur	-	21	14	43	20	0
24	Dharwad	4	41	-	11	59	0
25	Gadag	0.6	33	11	0	40	0
26	Haveri	6	19	8	24	43	27
27	U. Kannada	-	100	9	17	7	47

Source: GoK, High Power Committee Report (2002)

Note: PWS - Piped Water Supply
MWS – Mini Water Supply
BHP - Borewell with Handpumps

Annexure Table 7: District-wise Water Level Fluctuations (Meters) in Karnataka

Districts	Years											
	1978	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Bangalore	9.47	10.2	10.3	9.84	10.6	11.9	10.3	12.6	12.5	14	14.9	15.4
Belgaum	10	9.3	9.8	9.07	10.1	11.9	10.5	11	9.85	17.2	12.3	11.6
Bellary	7.37	7.4	7.97	7.19	8.12	9.42	10.4	11	10.1	12.1	13.3	10.9
Bidar	10.9	12.9	11.3	10.8	9.63	10	12.7	12.4	12.6	13.6	11.4	10.7
Bijapur	7.97	9.07	8.15	7.57	7.14	9.69	8.62	9.35	9.93	11.1	11	10.5
Chikkamagalur	8.95	9.22	8.54	8.69	8.48	9.7	9.01	8.16	8.82	9.87	10.4	9.95
Chitradurga	8.06	10.4	8.85	9.25	10.7	13	13.1	12.4	12.5	16.5	16.5	13.3
D.Kannada	8.72	8.84	8.4	9.01	8.8	9	9.01	8.7	8.78	8.87	8.95	9.06
Dharwad	12.2	13.5	11.2	14	15.8	12.7	15.9	13.4	14.2	16.7	17.6	13.9
Gulbarga	7.26	8.1	6.98	7.74	6.81	6.35	8.04	8.57	8.59	9.39	7.4	7.13
Hassan	9.26	9.46	7.77	9.64	10.1	11	9.68	8.85	8.5	8.84	10.7	9.86
Kodagu	9.8	9.19	8.34	9.92	9.86	9.8	9.28	7.35	9.29	8.5	9.14	7.88
Kolar	8.68	9.48	9.52	10.4	11.6	13.4	10.4	13.5	13	13.5	14.3	13.4
Mandya	9.14	8.72	7.55	8.03	8.15	9.49	7.89	8.11	7.85	8.59	9.66	9.46
Mysore	10.2	10.4	9.72	11.1	12	13	11	10.4	10.5	10.1	11.8	11.3
Raichur	5.96	7.03	6.21	6.1	6.42	6.99	8.1	7.81	7.39	7.99	8.04	6.58
Shimoga	9.23	9.03	8.9	9.31	9.19	8.62	8.97	8.23	8.49	8.56	9.8	9.76
Tumkur	8.04	9.53	8.5	8.21	9.17	10.9	9.65	11.1	11.3	13.2	14	14.7
U.Kannada	7.83	8.7	8.79	8.59	8.76	8.27	8.35	7.98	7.8	8.02	8.24	8.12

Source: Behaviuor of Depth to Water level between 1978-97 in Karnataka State, D.Rajamarthanda, Department of Mines and Geology, GOK, 1998.

Annexure Table 8: Standards Prescribed for Drinking Water in India

Sl. No.	Substance / Characteristics	Desirable/ Essential	Highest desirable Limit (ppm)	Maximum Permissible limit in Absence of Alternative source (ppm)
1	Calcium	Desirable	75	200
2	Magnesium	Desirable	30	100
3	Iron	Essential	0.3	1
4	Chloride	Essential	250	1000
5	Sulphate	Desirable	200	400
6	Nitrate	Desirable	45	100
7	Fluoride	Desirable	1	1.5
8	Total Dissolved Solids	Desirable	500	2000
9	PH	Essential	6.5-8.5	No relaxation
10	Total Hardness	Essential	300	600

Source: Bureau of Indian Standards: IS 10500:1991

Annexure Table 9: Status of Water Quality by Habitations in Karnataka State – 2002												
Sl No	District	No. of habitations affected by								Total No. of habitations affected	% of Affected habitations	Total No. of Habitations
		Excess fluoride	Percent	Brackishness	Percent	Excess Nitrate	Percent	Excess Iron	Percent			
1	BAGALKOTE	135	21.29	158	24.92	33	5.21	88	13.88	414	65.30	624
2	BANGALORE (U)	262	20.39	224	17.43	0	0.00	318	24.75	804	62.57	1285
3	BANGALORE (R)	406	11.96	148	4.36	411	12.1	189	5.57	1154	34.00	3394
4	BELGAUM	134	8.9	159	10.56	1	0.07	419	27.82	713	47.34	1506
5	BELLARY	489	41.87	91	7.79	38	3.25	26	2.23	644	55.14	1168
6	BIDAR	37	4.56	56	6.90	123	15.2	1	0.12	217	26.72	812
7	BIJAPUR	200	21.55	241	25.97	19	2.05	113	12.18	573	61.75	928
8	C.R.NAGAR	34	4.10	27	3.25	425	51.20	173	20.84	659	79.40	830
9	CHIKKMAGALORE	51	1.52	77	2.29	136	4.04	524	15.57	788	23.41	3366
10	CHITRADURGA	519	37.91	345	25.20	126	9.20	87	6.36	1077	78.67	1369
11	D.KANNADA	2	0.06	4	0.13	0	0.00	294	9.37	300	9.56	3137
12	DAVANGERE	358	33.03	156	14.39	288	26.57	1	0.09	803	74.08	1084
13	DHARWAD	49	9.92	115	23.28	1	0.20	74	14.98	239	48.38	494
14	GADAG	127	36.29	42	12.00	0	0.00	0	0.00	169	48.29	350
15	GULBARGA	443	19.29	59	2.57	3	0.13	148	6.45	653	28.44	2296
16	HASSAN	159	4.08	181	4.64	39	1.00	323	8.28	702	18.00	3900
17	HAVERI	77	12.22	113	17.94	130	20.63	198	31.43	518	82.22	630
18	KODAGU	3	0.52	0	0.00	6	1.05	306	53.40	315	54.97	573
19	KOLAR	509	13.60	319	8.52	1005	26.86	109	2.91	1942	51.90	3742
20	KOPPAL	477	67.28	50	7.05	0	0.00	4	0.56	531	74.89	709
21	MANDYA	158	8.44	518	27.66	51	2.72	684	36.52	1411	75.33	1873
22	MYSORE	105	5.43	434	22.44	121	6.26	288	14.89	948	49.02	1934
23	RAICHUR	322	26.42	195	16.00	129	10.58	51	4.18	697	57.18	1219
24	SHIMOGA	89	2.01	87	1.97	2	0.05	362	8.18	540	12.21	4424
25	TUMKUR	658	12.00	585	10.67	976	17.80	1490	27.17	3709	67.63	5484
26	UDUPI	11	0.20	2	0.04	1	0.02	218	3.87	232	4.11	5640
27	UTTAR KANNADA	24	0.62	74	1.90	13	0.33	145	3.72	256	6.56	3901
	TOTAL	**5838**	**10.30**	**4460**	**7.87**	**4077**	**7.19**	**6633**	**11.70**	**21008**	**37.06**	**56682**

Note: Percent is to Total Number of Habitations

Source: Rural Development and Engineering Department

Annexure Table 10: Year- wise Coverage of Habitations for Drinking Water Supply in Rural Karnataka

Year	FC	% to total	PC	% to total	NC	% to total	Total
1999	30800	54.34	25037	44.17	845	1.49	56682
2000	33135	58.46	23482	41.43	65	0.11	56682
2001	34562	60.98	22120	39.02	0	0.00	56682
2002	36187	63.84	20495	36.16	0	0.00	56682

Note: FC= Fully covered, PC = Partially covered, NC = Not covered
Source: Department of Rural Development and Panchayat Raj

Annexure Table11: Hotspots and Reasons in Drinking Water Supply

Inadequate Quantity of Drinking Water Supply in Rural area

Hotspots - Belgaum, Bellary, Chamarajanagar, Bangalore Urban, Gulbarga, Dharwad, Bijapur and Kodagu

Reason- More than 50 per cent (between 54 to 82.94 per cent) of the rural habitations of these districts have less than 55 LPCD of water supply

Depletion of Drinking Ground Water Sources

Hotspots -Bangalore, Chitradurga, Kolar and Tumkur

Reason- There is a drastic decline in the ground water level in these districts. Since ground water is the major source of drinking water these districts fall in the category of critical areas.

Deterioration of Drinking Water Quality

Hotspots - Bagalkot, Bangalore Urban, Bijapur, Chamarajanagar, Chitradurga, Haveri, Mandya, Tumkur, Koppal, Bellary, Gadag, Gulbarga and Davanagere.

Reasons- In these districts between 50 to 79 per cent of the habitations have been affected with excess Fluoride, brackishness, Iron. etc.

It is significant to note that in Koppal, Bellary, Gadag, Gulbarga, Chitradurga and Davanagere between 30 to 68 per cent of the habitations are affected with excess Fluoride.

Annexure Table 12: Number of beneficiaries of Toilets by Nature of Utilisation

District	Utilisation						Misutilisation						Non-Utilisation								Total (A+B+C)	%
	Regularly	%	Occasionally	%	Total (A)	%	As bath room	%	Other uses*	%	Total (B)	%	Water Scarcity	%	Social Prohibition	%	Dilapidated Toilet	%	Total (C)	%		
Bangalore (U)	164	86	13	7	177	93	0	0	5	3	5	3	7	3	1	1	0	0	8	4	190	100
Bangalore (R)	291	85	35	10	326	95	1	neg	7	2	8	2	9	3	1	neg	0	0	10	3	344	100
Belgaum	585	87	8	1	583	88	52	8	16	2	68	10	7	1	7	1	0	0	14	2	665	100
Bellary	176	65	34	12	210	77	26	10	36	13	62	23	0	0	1	neg	0	0	1	neg	273	100
Bidar	176	91	9	5	185	96	3	2	1	neg	4	2	1	1	3	1	0	0	4	2	193	100
Bijapur	112	20	22	4	134	24	200	35	191	34	391	69	7	1	28	5	8	1	43	7	568	100
Chikkamagalur	521	94	22	4	543	98	1	neg	1	neg	2	neg	6	1	3	1	0	0	9	2	554	100
Chitradurga	258	83	8	2	266	85	21	7	21	7	42	14	0	0	2	1	0	0	2	1	310	100
D.Kannada	688	89	50	6	738	95	2	neg	11	1	13	2	19	2	4	1	1	neg	24	3	775	100
Dharwad	538	74	25	3	563	77	50	7	77	11	127	18	6	1	31	4	0	0	37	5	727	100
Gulbarga	60	30	4	2	64	32	48	24	65	32	113	56	19	10	4	2	0	0	23	12	200	100
Hassan	403	91	23	5	426	96	2	neg	9	2	11	2	5	1	1	neg	1	neg	7	2	444	100
Kodagu	193	94	9	5	202	99	0	0	0	0	0	0	3	1	0	0	0	0	3	1	205	100
Kolar	332	91	14	4	346	95	3	1	6	2	9	3	3	1	5	1	0	0	8	2	363	100
Mandya	390	85	13	3	403	88	48	11	6	1	54	12	1	neg	0	0	0	0	1	neg	458	100
Mysore	209	73	15	5	224	78	11	4	42	15	53	19	6	2	2	1	0	0	8	3	285	100
Raichur	111	46	3	1	114	47	99	40	26	11	125	51	5	2	1	neg	0	0	6	2	245	100
Shimoga	936	94	31	3	967	97	1	neg	6	1	7	1	7	1	14	1	0	0	21	2	995	100
Tumkur	270	84	21	7	291	91	3	1	24	7	27	8	2	1	1	neg	0	0	3	1	321	100
U.Kannada	446	86	31	6	477	92	1	neg	10	2	11	2	6	1	25	5	0	0	31	6	519	100
Total	6849	79	390	5	7239	84	572	7	560	6	1132	13	119	1	134	2	0	0	263	3	8634	100

Source: Directorate of Economics and Statistics, GoK (1998)

Note: Figures in brackets are per cent to Total

* Other uses refers to Store room, godown etc.

Annexure Table 13: Status of UGD system in Different ULBs – as on May 2003

Sl. No	Name of the town	Approx. % area covered	Average per capita contribution in LPCD	Sewage flow in MLD	Remarks
	Class I Cities				
1	Gulbarga	60	90	16.74	Sewage Treatment plant provided
2	Davanagere	75	100	21.53	Treatment plant not provided. To be provided under NRCP programme
3	Belgaum	80	100	31.39	Treatment plant not provided
4	Mysore	80	130	67.83	Treatment plant provided
5	Mangalore	80	135	30.31	Primary treatment provided
6	Hubli-Dharwad	50	100	32.38	Treatment plant not provided
7	Bijapur	40	90	6.95	Oxidation pond provided
8	Bellary	60	135	19.91	Oxidation pond provided
9	Hospet	60	90	6.17	No STP provided
10	Raichur	60	90	9.21	Oxidation pond provided
11	Shimoga	70	100	13.49	Oxidation pond provided
12	Chitradurga	40	90	3.72	Primary treatment provided
13	Chikkamagalur	60	90	3.28	Aerated lagoons provided, but not working
14	Hassan	60	110	7.16	Oxidation pond provided
15	Kolar	60	90	4.49	Primary treatment provided
16	Mandya	60	100	7.2	STP now proposed
17	Bidar	40	75	3.92	No STP provided
18	Udupi	60	100	7.06	Oxidation pond provided
	Class II Cities				
1	Jamkahandi	60	90	2.6	Oxidation pond provided, but not working
2	Harihar	30	90	1.8	Treatment plant to be provided under NRCP programme
3	Sirsi	50	90	2.29	Treatment plant not provided
4	Kollegal	60	90	2.29	Oxidation pond provided
5	Ranebennur	60	75	3.03	Oxidation pond provided
	Class III Cities				
1	Bhatkal	60	90	1.7	Oxidation pond provided but not connected from the wet well, and not functioning
2	Karkala	30	90	0.65	Oxidation pond provided
3	Belur	40	75	0.5	Primary Treatment provided
4	Guledgud	30	70	0.71	Oxidation pond provided
5	Ilkal	25	70	0.7	Primary treatment provided, but not working
6	Arasikere	50	90	1.78	Oxidation pond provided
7	Holenarasipura	50	90	1.06	Oxidation pond provided
8	Channarayapatna	25	90	0.53	Oxidation pond provided
9	Chintamani	40	90	1.8	Treatment plant not provided
10	Bailhongal	40	70	0.95	Primary treatment provided
11	Hunsur	50	90	1.56	Oxidation pond provided
12	K R Nagar	50	90	1.17	Treatment plant provided under NRCP programme
13	Vijayapura	60	90	1.3	STP proposed

Source: Karnataka Urban Water Supply & Drainage Board

Annexure Table 14: Distribution of slums in different ULBs in Karnataka

Districts	Number of slums in Towns						
	Class-I	**Class-II**	**Class-III**	**Class-IV**	**Class-V**	**Class-VI**	**Total No. of slums**
Bangalore (U)	366(100.00)	-	-	-	-	-	366
Bangalore (R)	-	28 (39.44)	43 (60.56)	-	-	-	71
Tumkur	26 (23.01)	30 (26.55)	44 (38.94)	13 (11.50)	-	-	113
Kolar	15 (21.43)	20 (28.57)	34 (48.57)	-	1 (1.43)	-	70
Mysore	52 (48.15)	-	45 (41.67)	7 (6.48)	4 (3.70)	-	108
D Kannada	13 (76.47)	-	1 (5.88)	3 (17.65)	-	-	17
Udupi	-	-	18 (66.67)	9 (33.33)	-	-	27
Mandya	24 (38.71)	-	20 (32.26)	18 (29.03)	-	-	62
C R Nagar	-	35 (64.81)	8 (14.81)	-	11 (20.37)	-	54
Chikkmagalur	13 (21.67)	-	43 (71.67)	-	3 (5.00)	1 (1.67)	60
Hassan	24 (20.69)	-	64 (55.17)	21 (18.10)	7 (6.03)	-	116
Davanagere	38 (46.34)	9 (10.98)	14 (17.07)	21 (25.61)	-	-	82
Chitradurga	22 (53.66)	-	18 (43.90)	1 (2.44)	-	-	41
Shimoga	88 (57.52)	21 (13.73)	14 (9.15)	12 (7.84)	18 (11.76)	-	153
Kodagu	-	-	-	3 (75.00)	1 (25.00)	-	4
Dharwad	61 (76.25)	-	8 (10.00)	11 (13.75)	-	-	80
Haveri	-	17 (26.98)	40 (63.49)	6 (9.52)	-	-	63
Gadag	13 (27.08)	-	30 (62.50)	5 (10.42)	-	-	48
U Kannada	-	19 (27.94)	27 (39.71)	22 (32.35)	-	-	68
Belgaum	18 (16.36)	14 (12.73)	43 (39.09)	35 (31.82)	-	-	110
Bijapur	50 (64.10)	-	28 (35.90)	-	-	-	78
Bellary	76 (55.88)	-	60 (44.12)	-	-	-	136
Bagalkot	-	51 (45.13)	44 (38.94)	18 (15.93)	-	-	113
Gulbarga	60 (33.52)	33 (18.44)	56 (31.28)	30 (16.76)	-	-	179
Koppal	-	47 (87.04)	3 (5.56)	4 (7.41)	-	-	54
Bidar	23 (27.06)	20 (23.53)	37 (43.53)	5 (5.88)	-	-	85
Raichur*	-	-	-	-	-	-	70
Karnataka	982	344	742	244	45	1	2428
Percent to Total	40.44	14.17	30.56	10.05	1.85	0.04	100.00

Note: * Information on Raichur District pertains for the year 2001

Figures in brackets are percent to total

Source: Karnataka Slum Clearance Board

Annexure Table 15: District-wise Incidence of Various Diseases During the year 2001

Districts	Gastroenteritis		Cholera		Viral hepatitis		Typhoid	
	Cases	**Death**	**Cases**	**Death**	**Cases**	**Death**	**Cases**	**Death**
Bangalore city	2227	1	28	0	148	0	0	0
Bangalore (U)	162	3	10	1	58	0	0	0
Bangalore (R)	1221	3	0	0	109	0	627	0
Chitradurga	1299	5	3	0	821	3	1806	0
Davanagere	800	7	4	0	133	18	733	1
Kolar	795	27	62	0	1358	0	8712	0
Shimoga	777	0	0	0	379	0	1352	0
Tumkur	840	11	1	0	8	3	0	0
Belgum	361	3	2	0	40	0	1882	4
Bijapur	365	9	1	0	128	0	3892	0
Bagalkot	327	1	0	0	375	2	2230	1
Dharwad	3483	4	57	0	26	0	95	0
Gadag	353	0	0	0	67	0	170	0
Haveri	104	0	2	0	68	0	1501	0
U Kannada	188	1	3	0	26	0	108	0
Bellary	2098	24	37	0	115	0	2123	0
Bidar	286	1	4	0	7	1	0	0
Gulbarga	2309	29	23	0	519	0	4928	0
Koppal	738	14	0	0	175	0	708	0
Raichur	759	18	0	0	50	0	209	0
Chikkamagalur	249	1	11	0	200	0	1000	0
D Kannada	46	0	1	0	0	0	0	0
Udupi	46	0	0	0	21	0	304	0
Hassan	238	1	3	0	565	1	654	0
Kodagu	189	6	2	0	0	0	0	0
Mandya	307	11	18	0	0	0	0	0
Mysore city	620	0	24	0	0	0	0	0
Mysore	614	0	35	0	4	0	234	0
Chamarajnagar	342	18	12	0	21	0	78	0

Source: Department of Health and family Welfare, GoK

Annexure Table 16: Prioritization of Environmental Problems in Drinking Water Supply and Sanitation (Matrix I to VI)

Matrix I : Karnataka

Problems	Socio-Economic/Ecological Impacts															
	Impact on Public Health		Loss of Biodiversity		Impact on Vulnerable groups		Productivity loss		Impact on critical Ecosystem		Irreversibility/ reversibility		Urgency of the problem		Total	
	R	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**
1. Inadequate Drinking Water Supply	H	H	M	L	H	H	H	H	M	L	H	M	H	H	31	25
2. Depletion of Ground Water	H	H	H	M	H	H	H	H	H	M	M	M	H	H	33	29
3. Deteriorating Drinking Water Quality	H	H	M	L	H	H	H	M	M	M	H	M	H	H	31	25
4. Lack of Household Toilet Facility	H	M	M	L	H	H	H	H	M	L	H	M	H	H	31	23
5. Lack of Sewerage system and Disposal Facilities	H	H	M	L	H	H	H	H	M	L	H	M	H	H	31	25
6. Lack of Community Sanitation	H	H	M	L	H	H	M	H	H	M	M	M	H	H	29	27
7. Increasing Number of Slums	NA	H	NA	NA	NA	H	NA	H	NA	L	NA	M	NA	H	NA	24
Total	30	33	20	8	30	35	28	33	22	13	26	21	30	35	186	178

Note: R = Rural U = Urban H=High-5, M=Medium-3, L=Low-1 NA = Not Applicable

Matrix II : Coastal Regions

Problems	Socio-Economic/Ecological Impacts															
	Impact on Public Health		Loss of Biodiversity		Impact on Vulnerable groups		Productivity loss		Impact on critical Ecosystem		Irreversibility/ reversibility		Urgency of the problem		Total	
	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U
1. Inadequate Drinking Water Supply	H	H	L	L	H	H	H	H	L	L	M	M	H	H	25	25
2. Depletion of Ground Water	M	M	M	M	M	M	M	M	L	L	L	L	M	M	17	17
3. Deteriorating Drinking water quality	M	M	L	L	M	M	M	M	L	L	L	L	M	M	15	15
4. Lack of Household Toilet Facility	H	H	L	L	H	H	H	H	L	L	L	L	H	H	23	23
5. Lack of Sewerage System and Disposal Facilities	H	H	L	L	H	H	H	H	L	L	L	L	H	H	23	23
6. Lack of Community Sanitation	H	H	L	L	H	H	H	H	L	L	L	L	H	H	23	23
7. Increasing Number of Slums	NA	M	NA	NA	NA	M	NA	M	NA	L	NA	L	NA	M	NA	14
Total	26	29	8	8	26	29	26	29	6	7	8	9	26	29	126	140

Note: R = Rural U = Urban H=High-5, M=Medium-3, L=Low-1 NA = Not Applicable

Matrix III : Western Ghats

Problems	Socio-Economic/Ecological Impacts															
	Impact on Public Health		Loss of Biodiversity		Impact on Vulnerable groups		Productivity loss		Impact on critical Ecosystem		Irreversibility/ reversibility		Urgency of the problem		Total	
	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U
1. Inadequate Drinking Water Supply	H	H	M	L	H	H	M	H	M	L	H	M	H	H	29	25
2. Depletion of ground Water	H	M	M	L	H	H	M	H	M	L	M	L	M	M	25	19
3. Deteriorating Drinking water quality	H	H	L	L	H	H	M	M	L	L	M	L	H	H	23	21
4. Lack of Household Toilet Facility	H	H	L	L	H	H	H	H	L	L	L	L	H	H	23	23
5. Lack of Sewerage System and Disposal Facilities	H	H	L	L	H	H	H	H	L	L	L	L	H	H	23	23
6. Lack of Community Sanitation	H	H	L	L	H	H	M	H	M	L	L	L	H	H	23	23
7. Increasing Number of Slums	NA	M	NA	NA	NA	H	NA	H	NA	NA	NA	L	NA	L	NA	15
Total	30	31	10	6	30	35	22	33	12	6	14	9	28	29	146	149

Note: R = Rural U = Urban H=High-5, M=Medium-3, L=Low-1 NA = Not Applicable

Matrix IV : Northern Plateau

Problems	Socio-Economic/Ecological Impacts															
	Impact on Public Health		Loss of Biodiversity		Impact on Vulnerable groups		Productivity loss		Impact on critical Ecosystem		Irreversibility/ reversibility		Urgency of the problem		Total	
	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U
1. Inadequate Drinking Water Supply	H	H	M	M	H	H	H	H	L	L	M	M	H	H	27	27
2. Depletion of Ground Water	H	H	M	M	H	H	H	H	M	M	H	H	H	H	31	31
3. Deteriorating Drinking water quality	H	H	M	L	H	H	H	H	L	L	M	M	H	H	27	25
4. Lack of Household Toilet Facility	H	H	L	L	H	H	H	H	M	M	M	M	H	H	27	27
5. Lack of Sewerage System and Disposal Facilities	H	H	L	L	H	H	H	H	M	M	M	M	H	H	27	27
5. Lack of Community Sanitation	H	H	L	L	H	H	H	H	M	M	M	M	H	H	27	27
6. Increasing Number of Slums	NA	H	NA	NA	NA	H	NA	H	NA	L	NA	L	NA	H	NA	22
Total	30	35	12	10	30	35	30	35	14	15	20	21	30	35	166	186

Note: R = Rural U = Urban H=High-5, M=Medium-3, L=Low-1 NA = Not Applicable

Matrix V : Southern Plateau

Problems	Socio-Economic/Ecological Impacts															
	Impact on Public Health		Loss of Biodiversity		Impact on Vulnerable groups		Productivity loss		Impact on critical Ecosystem		Irreversibility/reversibility		Urgency of the problem		Total	
	R	U	R	U	R	U	R	U	R	U	R	U	R	U	R	U
1. Inadequate Drinking Water Supply	H	H	M	L	H	H	H	H	L	L	M	M	H	H	27	25
2. Depletion of Ground Water	H	H	M	L	H	H	H	H	M	L	H	H	H	H	31	27
3. Deteriorating Drinking water quality	H	H	M	L	H	H	H	H	M	L	H	H	H	H	31	27
4. Lack of Household Toilet Facilities	H	M	L	L	H	H	H	M	M	L	M	M	H	H	27	21
5. Lack of Sewerage System and Disposal Facilities	H	H	L	L	H	H	H	H	M	M	M	M	H	H	27	27
5. Lack of Community Sanitation	H	H	L	L	H	H	H	H	M	L	M	L	H	H	27	23
6. Increasing Number of Slums	NA	M	NA	NA	NA	H	NA	H	NA	L	NA	L	NA	M	NA	18
Total	30	31	12	6	30	35	30	33	16	9	22	21	30	33	170	168

Note: R = Rural U = Urban H=High-5, M=Medium-3, L=Low-1 NA = Not Applicable

Matrix VI : Bangalore City

Problems	Socio-Economic/Ecological Impacts							
	Impact on Public Health	Loss of Biodiversity	Impact on Vulnerable groups	Productivity loss	Impact on critical Ecosystem	Irreversibility/reversibility	Urgency of the problem	Total
1. Inadequate / Unequal Distribution of Drinking Water Supply	H	L	H	H	L	L	H	23
2. Increasing pressure on Drinking Water Sources								
a). Ground Water	H	M	H	L	M	L	H	23
b). Surface Water	H	L	H	L	M	L	H	21
3. Inadequate Sanitation Services	H	L	H	H	L	L	H	23
4. More number of Slums	H	NA	H	H	NA	L	H	21
Total	25	6	25	17	8	5	25	111

Note: H=High-5, M=Medium-3, L=Low-1
NA = Not Applicable

Annexure Table 17: Institutional Structures in Rural Drinking Water Supply and Sanitation

Institutions	Specified Functions								Suggestions
	Planning	Implementation	Operation & Maintenance	Capacity Building	Co-ordination	Monitoring & Evaluation	Information Sharing	Assessment	
Dept. of Rural Development & Panchayat Raj Area Development Programme wing Rural Water Supply Wing Panchayat Raj	Policy issues	Issue of guidelines & Govt. orders	Fixation of Norms for implementation of programme	Training GP members	Dept. of water Resources Dept. of Health & Family welfare Dept. of Mines & Geology	Report Preparation Monitoring & feedback for policy modifications	Yes	Involvement of multiple institutions in water quality testing	Integrated institutional system for groundwater conservation and recharging measures Integrated water quality monitoring system
Rural Development Engineering Department	Rural water supply & sanitation	Rural Water Supply & Sanitation Water quality testing	Issue of guidelines			Review meetings		No follow up of water quality monitoring	
Karnataka Rural Water Supply and Sanitation Agency	External aided projects of water supply and sanitation	Identifying the implementing agency	Issue guidelines			Review meetings			
Dept. of Mines & Geology	Investigation of ground water sources Regulation of development of ground water resources in a systematic & scientific manner	Identification of ground water source points Ground water recharging measures		Proposed awarenes s camps	RDPR, KUWS&DB, BWSSB, Dept. of watershed	Monitoring ground water quality and level	Yes	Lack of co-ordination - Watershed dept, Soil Conservation and Dept. of M&G – Ground water recharging Inadequate funds for recharging measures	
Directorate of Health & family Welfare	Policy issues related to health programmes – Water – borne diseases	Health programmes Water quality testing	Facilitate the process at district level to maintain health status		No co-ordination with RDPR, KUWS&DB, BWSSB, Dept. of watershed	Review meetings	Data on morbidity status missing		
Zilla Panchayat	Planning & Issue of	Execution of	Through taluk Panchayat &		Seems to be co-ordination	Review meetings		Majority of water	Role of GPs neds to be

	guidelines for water supply & Sanitation	Programmes of water supply & sanitation	Gram Panchayat		between ZP & Dept. of Mines & Geology,. Watershed in execution of works			quality monitoring laboratories not functioning	increased
		Water quality testing			Lack of co-ordination in water quality monitoring between ZP & Dept. of Mines & Geology	Supervision, water quality monitoring not done well		Inadequate staff	Maintenance

Annexure Table 18: Institutional Structure in Urban Drinking Water Supply and Sanitation

Institution	Specified Functions							
	Planning	Implementation	Operation & Maintenance	Capacity Building	Co-ordination	Monitoring & Evaluation	Information Sharing	Assessment
Karnataka Urban water Supply and Drainage Board	For all Urban Local Bodies, except Bangalore City and surrounding CMCs	Executes water supply & Drainage Schemes Water quality testing in urban areas (Laboratories at 4 places – Mysore, Mangalore, Belgaum and Hubli-Dharwad + Two Laboratories in Bangalore	Transfers to urban local bodies		Expected to have better co-ordination between Urban Local Bodies and KUWS&DB	Yes	Yes	Some Urban Local bodies have not taken the responsibilities of operation and maintenance Lack of co-ordination between KUWS&DB and urban local bodies Inadequate staff Inadequate number of laboratories for water quality testing

Annexure Table 19: Institutional Structure in Drinking Water Supply and Sanitation in Bangalore

	Specified Functions						
Institution	Planning	Implementation	Operation & Maintenance	Capacity Building	Coordination	Monitoring & Evaluation	Information Sharing
Bangalore Water Supply and Sewerage Board	For Bangalore Metropolitan area	Water Supply and sewerage Facilities	Yes		Dept. of Mines & Geology for water quality	Yes	Yes

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