Water Environment Partnership in Asia (WEPA) -Nepal Dialogue Kathmandu

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Groundwater Depletion in Kathmandu Valley

Need for Management

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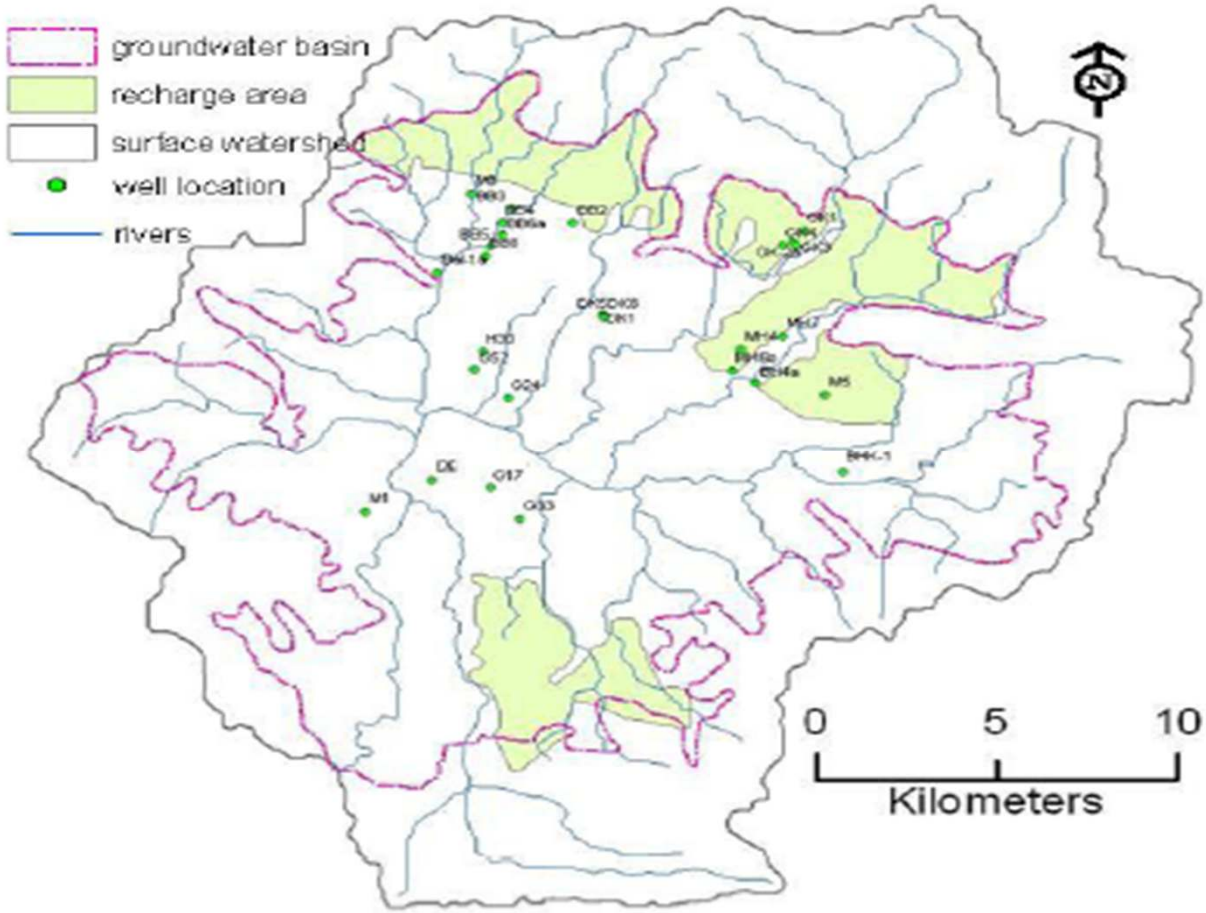
1. Existing Situation of Groundwater

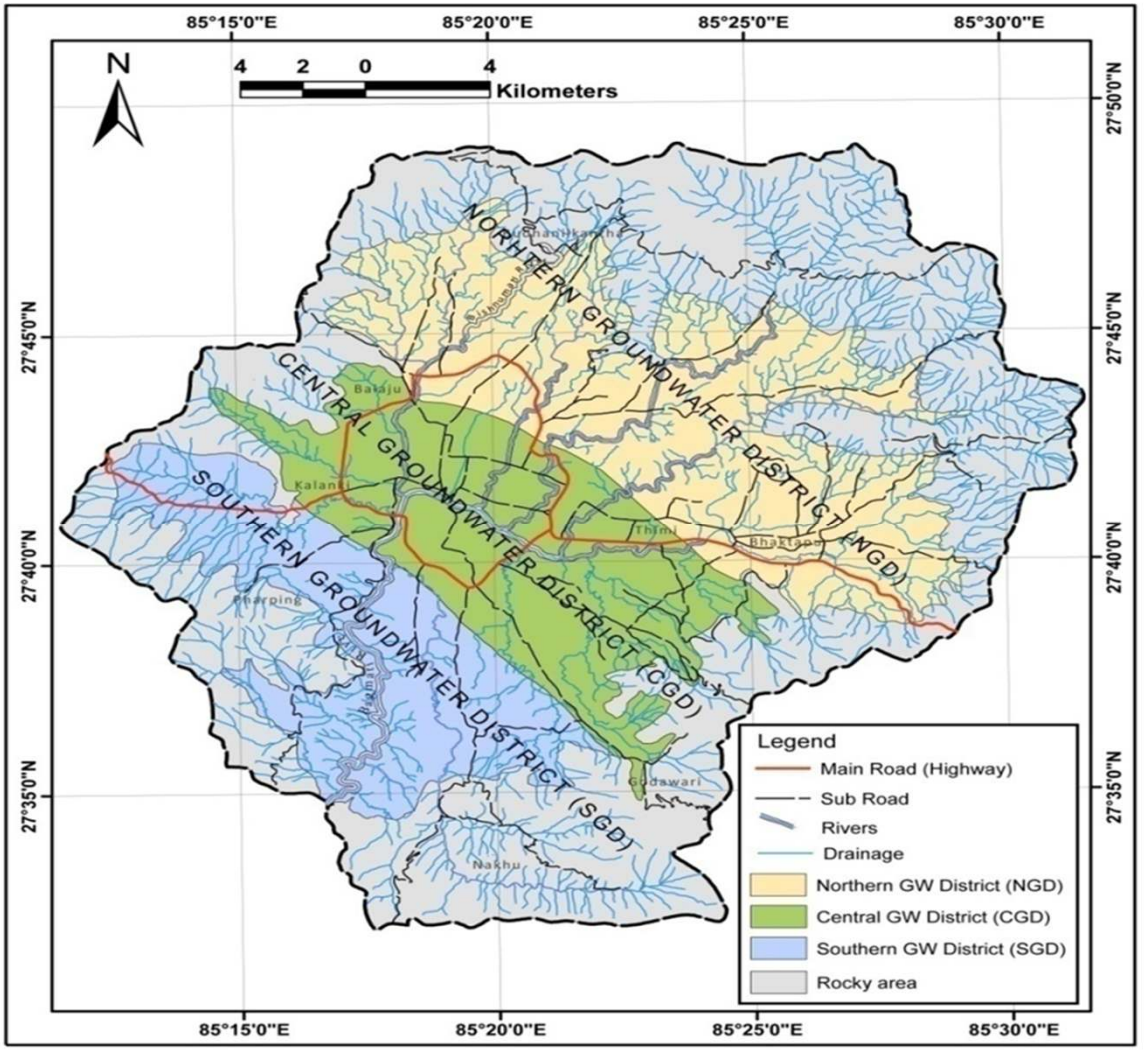
Map of Kathmandu Valley



Groundwater Zones

1	Northern	Rich
2	Central	Medium
3	Southern	Low

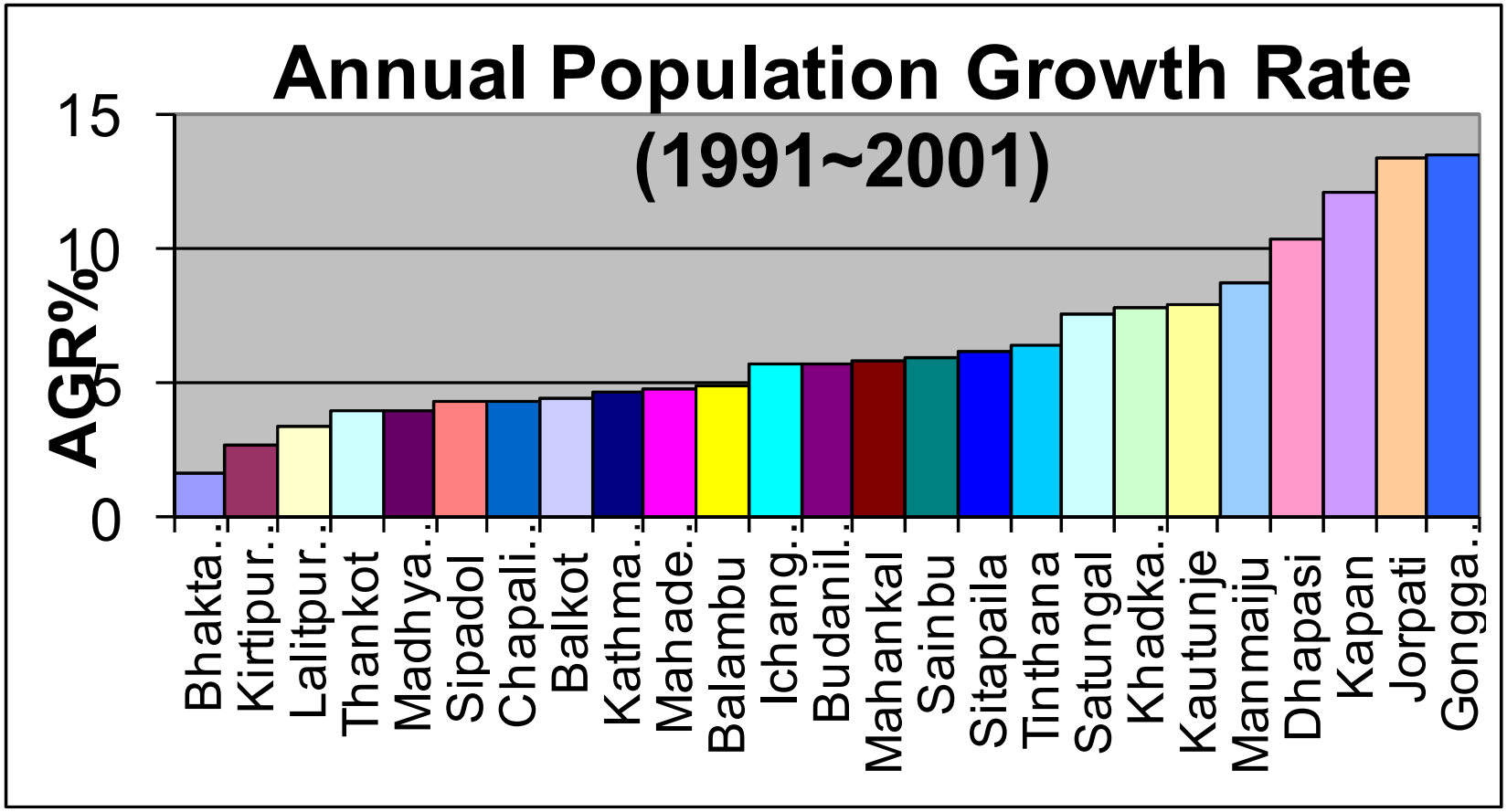
Hydrogeological Division-JICA 1990



Northern Groundwater Zone

- North of Maharajganj, Boudha and west of Gokarna to the western and northern foothills comprises the unconfined aquifers. UDLE
- Coarse to medium sand , thin layer of clay
- Effective thickness of 60m
- Low ele. conductivity (100 to 200 micro-simens/cm)
- Transmissivity of the aquifer ranges from 83 to 1963 m2/day

More Population Growth in North Zone



Groundwater Storage

North Zone

- Q = Aq. Thickness x Area x Sp. Yield
- Thickness = 60m, Area= 156km 2
- Sp. Yield for sand = 28%(Todd,)
- The total volume of groundwater storage = 60m x 156 x 106 m2 x0.28 = **2620.8 x 106 m3**

Central and South Zone = 410.4x106 m3

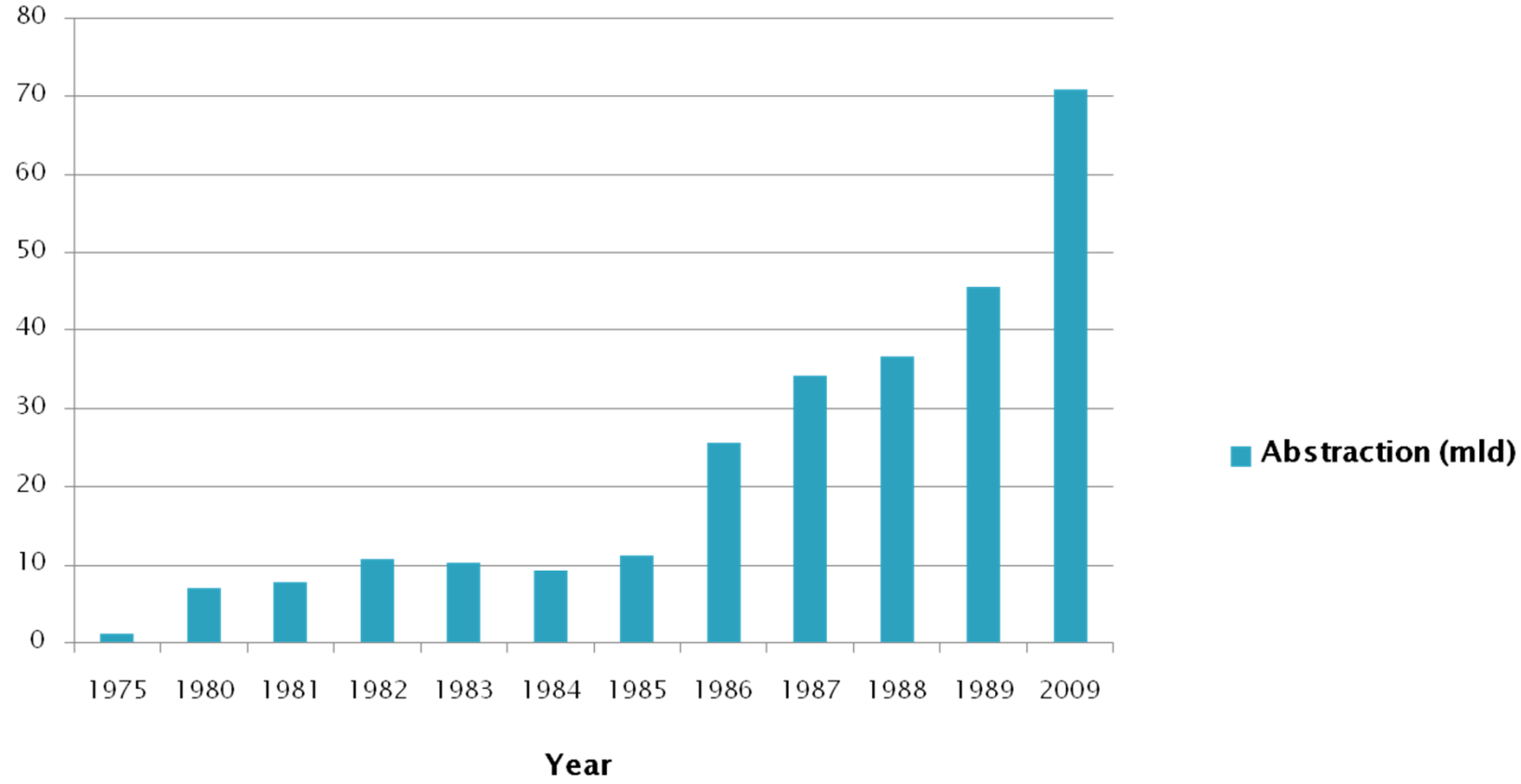
Total = 3031.2x106 m3

Estimated Groundwater Abstraction

Year	Estimated abstraction(mld)			
	NWSC	Private	DMG	Total
1975	0	1.0	0	1.0
1980	3.6	3.24	0	6.84
1981	4.8	2.4	0.4	7.6
1982	6.8	3.4	0.6	10.8
1983	5.8	3.5	1.0	10.3
1984	4.4	3.6	1.2	9.2
1985	5.3	4.5	1.4	11.2
1986	17.6	6.6	1.4	25.6
1987	26.2	6.4	1.6	34.2
1988	28.7	6.3	1.6	36.6
1989	36.4	7.3	1.8	45.5
1999	34.6	21.8	1.8	58.2
2009	22.9	48		70.9

Existing Situation of Groundwater

Trend of Groundwater Abstraction



Existing Situation of Groundwater

Aquifer depletion at selected locations during the dry season

Location	WID	Previous water level (mbgl)		Current water level (mbgl)		Depletion (m)	Remarks
		Base year	SWL	Current year	SWL		
Bansbari WF	Bal - 1a M8	2000 2001	5.27 12.75	2008 2008	10.85 14.52	5.58 1.77	In some areas SGL has gone down by more than 30 meters in the last 30 years and by 20 m in last 10 years
Gorkaran WF	GK- 2a GK4	1999 2000	16.41 16.60	2008 2008	23.91 20.18	7.50 3.58	
Dhobi Khola WF	DKl DK8	1999 2001	28.90 3.89	2008 2008	30.73 5.27	1.83 1.38	
Manohara-Bhaktapur/ Bode WF	BHK-1 M5	1999 2001	37.68 93.33	2006 2008	42.00 98.87	4.32 5.54	
Pharping WF	M1	2001	8.48	2008	8.85	0.37	
Central Area	I 26 G17	2000 2000	7.37 10.68	2008 2008	13.08 11.68	5.71 1.00	

SWL : Static Water Level, WID : Well Identification Number, WF : Well Field, mbgl : meter below the ground level,

Existing Situation of Groundwater

Aquifer depletion between year 2000 and 2005 a scenario of data gap

District	No of Tubewells		Average Draw Down(m)	Average Draw Down considering level downs only(m)	Maximum Draw down(m)	Average Flow Rate (lps)	Number of wells	Av flow (lps)	Av flow (mld)
	Level up	Level down							
Northern GW District	**2**	**6**	**4.74**	**-7.16**	**10.35**	**19.02**	**108**	**2054**	**177**
Central GW District	**2**	**6**	**2.87**	**-4**	**8.58**	**9.18**	**140**	**1285**	**111**
Southern GW District						**5.69**	**12**	**68**	**6**
Unknown						**13.65**	**17**	**232**	**20**

Existing Situation of Groundwater
Capacity of Groundwater

Institution	Extraction Rate (mld)	
	Year 2002	Year 2009
KUKL	42.00	36.00
Hotels	6.53	8.00
Government/Institutions	5.36	10.00
Tankers and others	5.37	30.00
Total	59.26	84.00(includes 13 from spring water)

Water Demand & Supply in Kathmandu

Year 2009-10	GW	SW	Total	Gap
Demand(mld)			320	
Supply-Dry season(mld)	30	70	100	220
Supply-wet season(mld)	25	130	155	165

The gap is met through GW extraction
Individuals, Institutions, Hotels, Business Houses, apartment buildings, industries, tanker supply etc

Groundwater Quality

- Shallow aquifers are polluted by wastewater and leachate from solid waste.
- Shallow aquifers have high fecal coliforms and high oxygen demand.
- Deep aquifers have high content of ammonia, methane, hydrogen sulphide, iron, manganese and hardness, and salts.

Groundwater Quality

- Mineral content is high in deep aquifers in central district and lower in shallow aquifers and springs in the south: ranges from 80-1500 micro S/cm
- High mineral content means that water is not suitable for drinking and needs significant treatment.
- Temperature and pH seems normal in several cases.

Supreme Court Directive

- Recently the Supreme Court has given directive to preserve the GW resources by effectively managing the GW demand and supply.
- They have stressed the need to harvest rain water, recharge, recycle water and quality preservation.

Observation So Far

- Current extraction –unknown
- KUKL total abstraction in 2009- 23 MLD from 49 wells (GWRDB, 2009).
- Static water level has lowered at the rate of 2.5m/yr at some places(MPPW-2002)
- Estimation of no of deep wells - approx 700
- Inventory of only about 513 wells
- Mostly located in northern and central groundwater district.

Observation So Far

- Max of 9 aquifer horizons tapped (Wells MH3 in Mulpani and GK1at Nayapati .
- The single thick aquifer GK3 from the depth of 70-246 mbgl (5% opening)
- Many wells have multiple screens in shallow and deep aquifers .
- The first screen has been placed at the depth of 6m bgl at well BB9 at Budanilkantha.
- Most of the deep wells located in the northern part of the valley.

2. Effects of Groundwater Extraction

Dhungedhara Drying

Number of Stone Spouts

Natural flow	233
Flow from city supply line	43
Not working	68
Disappeared	45
Total	389

Rivers Flowing with Sewage

- All freshwater from rivers used for drinking water.
- All the sewage discharged into the rivers where only the sewage flows.

3. New Policy for Groundwater Management

New Policy for Groundwater Management

Objectives/Goals

- Safeguard the fundamental right of the people to access safe drinking water for livelihood as per Nepal government's water resources act 2002.
- To efficiently manage the scarce resource of groundwater so that maximum benefit can be obtained from the resource and extend the life of the aquifer.
- To design and implement source directed regulatory measures to prevent or minimize the adverse impact of development activities especially with regards to quality and resource potential.

Guiding Principles

- water is a resource common to all and have consistent status in law.
- The ownership lies on the state and individuals only have right to use
- shallow and deep groundwater as separate systems
- First priority to domestic consumption

Policy Framework

- Compulsory licensing of all GW users
- Regulatory and management measures for preservation of GW quality and preventing it from environmental and hazardous effects.
- KVWSMB to implement measures and programs for monitoring and regulation of GW resources.
- Preservation of identified recharge areas or zones either by stopping or discouraging the conversion of such lands into urban settlements.

Policy Framework

- Promoting rainwater harvesting as an alternate to the management of supply side of the water constraint in the Kathmandu Valley.
- Discouraging the extraction of large volume of water from single location or aquifer zone.
- An integrated approach in the management of GW resources with surface water sources encompassing the possible areas of natural recharge, man-made recharge measures/mechanism, extraction and its utilization.

Implementation Measures

Short term measures

- Detail inventory of all existing water sources
- Carry out area wise data collection for hydro-meteorological, hydro-geological parameters, demand supply analysis and potential for groundwater abstraction for local distribution, water quality etc.
- Registration and issue of licenses to all groundwater users

Implementation Measures

Short term measures

- Categorize areas, aquifers in the valley according to their groundwater potential, water quality, vulnerability, recharge etc.
- Identify site specific water resource augmentation measures including rainwater harvesting, recharge potential including immediate potential sites and measures to protect the area for the purpose.
- Carry out research works to identify other water sources in the valley including spring sources, hard rock aquifers etc.

Implementation Measures

Short term measures

- Prepare guidelines on works like drilling, distribution, community supply, abandonment etc
- Carry out study and research on water balance studies, rainwater harvesting, water quality/pollution, conservation measures, GW potential of FAN deposits
- Establish web-based GIS to disseminate information on various aspects of GW
- Carry out mass awareness programs on RWH, water recycle etc

Implementation Measures

Long term measures

- Regulate the existing deep wells with respect to location, spacing, aquifer horizon tapped, purpose etc.
- Categorize tariff according to the use and purpose, aquifer horizon and number tapped and totally restrict haphazard groundwater abstraction and drilling.
- Regularly monitor the wells for efficiency, water level fluctuations, water quality and water management aspects.
- Regulate deep well drillings with respect to aquifer potential, location, requirement and priority basis.

4. Challengers For Groundwater Management

Challenges for GW Management/Monitoring/Licensing

- Generate and collect quality Information on GW potential, Recharge potential, present use & trend of use, use points etc
- Carry out necessary research and study on hydrogeology
- Maintain GW storage and use sustainably
- Provision of alternative source of supply
- Prevent pollution at source, monitor and preserve water quality
- Monitor Extraction against Permission
- Effective implementation of policy measures and secure potential recharge areas from infrastructure development
- Capacity building of KVWSMB
- Explore and acquire necessary funding

5. Recharge-Tool for Groundwater Management

Recharge-Tool for GW Management

- Valley receives about 1.165 billion cubic meter of rain per year
- 80% of this amount comes in 4 months
- Only about 6.6% of it is retained as GW (including flow from springs)
- If additional 6% is retained, demand of drinking water in the valley can be fulfilled

Recharge-Tool for GW Management

- Valley geology not homogeneous
- North zone is potential for GW recharge
- Other pockets may have potential
- **Such potential areas must be identified through research**
- **Suitable recharge technology options must be identified through research**

THANK YOU