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Ground Water Conservation And Management In The Stateof Uttarakhand: A Perspective On Law And Policy

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"Ground Water Is PreciousNational Resource- Preserve It , Protect It, And Don't Pollute It."

1. INTRODUCTION

Ancient Indian mythology believes the human body to have been constituted of five elements including the Earth, the Fire, the sky, water and the wind. Out of these five elements depicting different components of the being, water is believed as representing the faculty of thought and the heart. The same way as the faculty of thought covers and represents the most of a human, water occupies the most of the planet Earth. Both the availability and requirement are high for this resource. Further different needs of water may have different quality demands as well. This means the whole of water available on Earth may not be fit for human consumption. Largely due to this fitness and unfitness for human consumption, water happens to be a non-renewable resource. However, in technical sense, the hydrological cycle makes it renewable, but the experiences from different water resources around the world have confirmed otherwise. In light of the above, management of water becomes important and wise consumption and maintenance of the hydrological cycle become a crucially important instrumentality of human survival. Water is fundamental for supporting all types of creation, financial extension, and for general prosperity. It is difficult to fill in for the greater part of it hard to de-contaminate, costly to ship, and it is really a one of a kind blessing to mankind from nature. Water is additionally one of the most importantof the common assets as it is equipped for preoccupation, transport and reusing. Every one of these properties grant to water its extraordinary utility for individuals. The surface water and the ground water assume significant job in agribusiness, hydropower age, domesticated animals creation, mechanical exercises, ranger service,fisheries and so on. According to the "National Water Policy", the planning and operation of system should be broadly classified as:

(i) drinking water, (ii) irrigation, (iii) hydropower, (iv) water available in the various rivers of the ecology, (v) agro-industries and non-agricultural industry, the groundwater is also an important source of and (vi) navigation.

The State of Uttarakhand

Uttarakhand is endowed with bountiful water resources which are available in abundance. But, at the same time because of uneven distribution, demand is increasing further for various purposes such as drinking & domestic use, irrigation, power (hydro), industry etc. Water scarcity of the contemporary time is apparent and shall get more pronounced with increasing population. There are even limits on utilizable quantities of water owing to uneven distribution over time and space. In addition, challenges of frequent floods, landslides, soil erosion, cloud bursts and droughts in one or other part of the state adds to the woe. Climatic changes also impact the availability of utilizable water that may come under further strain in future with deepening water conflicts among different user groups. Also, due to lack of unified perspective in planning, management & use of water resources, there are inequalities in distribution. Water allocation is difficult due to present demographic and climatic changes. The traditional fragmented approach is no longer viable and a more holistic approach to water management is essential. The water resources' situation, their development, management and availability vary considerably from state to state. In this context, it is highly desirable to develop state specific action plan on water sector. The state specific action plan on water sector essentially consists of state specific present water situation in the form of water budget, identification of key issues and their possible solutions and preparation of detail action plan. About 70% of the land in Uttarakhand is under forests. The Forest Department administers most of this land. The variation in the landscape has fashioned a huge medley of flora and fauna, and consequently, resources. The Department has contributed to these resources via plantation actions. Uttarakhand encompasses upper reaches of Ganga basin and is home of 968 glaciers. The two main rivers of India i.e. Ganga and Yamuna originate within the state. The state high court has declared Ganga and Yamuna rivers as living entities and now, it has also granted similar status to the Gangotri and Yamunotri glaciers.

The Drinking Water Department is the administrative department of UttarakhandPey Jal Nigam (UPJN) and Jal Sansthan (UJS) those ensure water supply, and sewerage & drainage services to the project town. Statewise, around 80% of water is being supplied against the demand. Tehri, Devprayag, U. S. Nagar and Ranikhet towns has less than 70% of the supply against the demand of domestic water. Being a hilly state, most of the urban local bodies are located in the remote hilly area of the state. That is why, Urban Development Planning is a challenging task in the state, and different strategies are required to meet requirements of residents as well as to cater the needs of tourists and pilgrims. The topography and geographical features of the state are additional challenges for planners.

There are in total 11 aquifer systems in the state. CGWB has started a detailed aquifer mapping of 8 states in which Uttarakhand is not included. Central Ground Water Board has target of aquifer mapping of entire country by 2022. Pilot demonstration projects have been launched in 5 states. An area of 41,000 km has been identified for aquifer mapping in the state of Uttarakhand in which 7700 km is targeted under 12th five year plan, while rest of the area will be mapped under 13th five year plan.

Ground Water in Uttarakhand

"Groundwater" means the water, which exists in an aquifer below the surface of the ground at any particular location, regardless of the geological structure in which it is stationary or moving and includes all groundwater reservoirs. Groundwater is water that is found underground in the cracks and spaces in soil, sand and rock. Groundwater is stored in and moves slowly through layers of soil, sand and rocks called aquifers. Aquifers typically consist of gravel, sand, sandstone, or fractured rock, like limestone. These materials are

permeable because they have large connected spaces that allow water to flow through. The speed at which groundwater flows depends on the size of the spaces in the soil or rock and how well the spaces are connected.

Groundwater model can be useful understanding the behaviour and performance of the real field conditions of the groundwater system. Groundwater is one of the main source of water for drinking and other daily use purposes. It is locked up in the ground and extracted with the help of pumping techniques. Groundwater model helps in understanding the changes in the water balance due to bore wells and other modes.“The significance of water in everyone’s life is measured by the fact that since ancient times, the development of human civilization has been taking place along the rivers, keeping in view the availability and need of water. However, it is a limited resource, but despite limited availability, the resource is an important basis for the needs of humans, living beings, along with food security and sustainable development.” Luckily, the vast majority of the geological region of the state is secured by the river-fed plain of Ganga-Yamuna rivers, which also is one of the most densely consumed supply of ground water. In past years, to satisfy the different needs of this express, the reliance on ground water assets has unreasonably expanded. Ground Water is a significant part of 'Water cycle' and yearly recharging of this dynamic asset for the most part happens from downpour water and different assets. In any case, without understanding these logical parts of this normal asset, with the attitude that the asset is boundless, its impromptu and uncontrolled abuse in water system, drinking water and mechanical regions has occurred in past decades. Besides, there is no consolidated arrangement, currently, for effective management and planning of water resource. hese are the principal reasons why the state of regional inequality in ground water resources and environmental imbalance has continued in the state; and as a consequence, the resource is reaching unprecedented poor levels in terms of the resource availability and quality

The main source of replenishable ground water resources is recharge through rainfall, which contributes to nearly 67% of the total annual ground water recharge. India receives about 119cm of rain in a year but it has great spatial variations. Most part of India receives rainfall mainly during south-west Monsoon season. However, main rainfall season in Tamil Nadu is October– December. Jammu and Kashmir, Himachal Pradesh and Uttarakhand receive significant rainfall in all four seasons

Share in the total aquifer area in the state of Uttarakhandis as below presented:

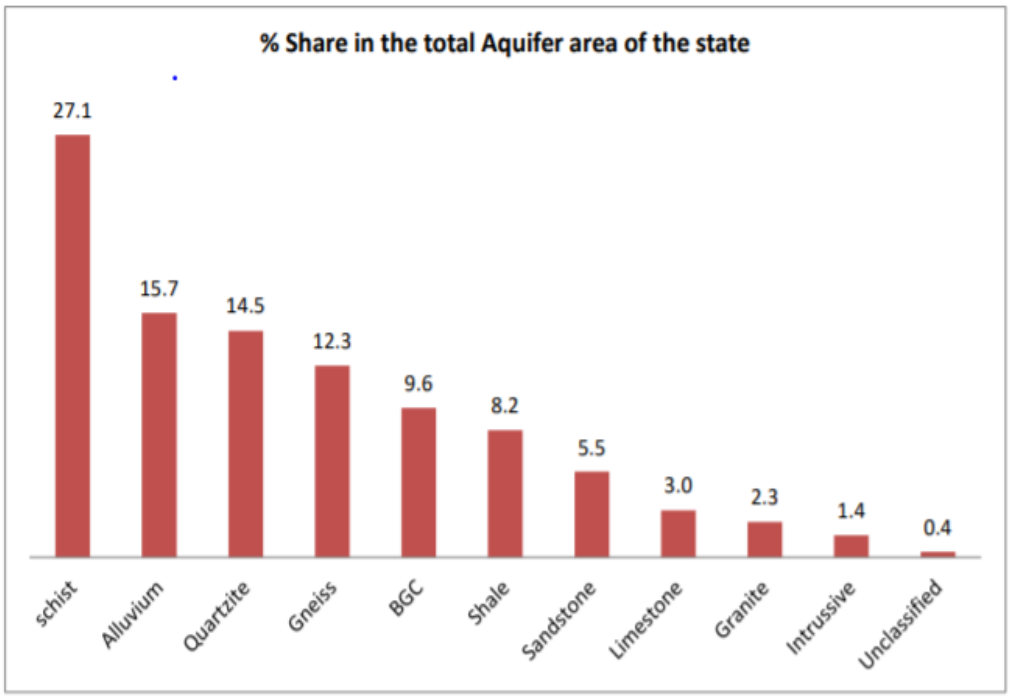

Figure: Distribution of aquifers in the state

The crisis of water resources in the Indian subcontinent

In South Asian countries, a substantial chunk of the population faces the problem of lack of water and the individuals who don't, are affected by financial constraints leading to lack of access to water. Surface irrigation arrangements have deteriorated because of lack of efforts for preservation, which generally is a reflection of varying conditions of farmers that gravity stream water system, can not provide any further.

Crop rotation and shift from rice and wheat implies that gravity irrigation water system structures built remembering grain crops may not promptly adjust to a progressively distinguished pattern that farmers in Asia are currently moving towards. Massive efforts towards recuperation and lately towards upgrading of gravity flow systems have generated less than adequate results. Groundwater boom, despite providing several advantages, also has it's own set of challenges in regarding overexploitation and reduction of groundwater amenities leading to endangering the life of lakhs of cultivators who depend on it. Global opening up of economy, urbanization, changing climate, contending demands for water, changing desires, transformed strain on environmental water demands and the requirement to keep attending lakhs of people in South Asia carry on offering huge challenges to the irrigation and drainage sector.

Groundwater Availability and Dependence in Uttarakhand-

Groundwater availability depends on several factor including the original state of groundwater, rate of consumption, rate of recharge of groundwater levels and some other factors. It is depicted by citing data about replenishable groundwater resource and the stage of groundwater development. As already mentioned, the aquifer areas in the state are not very large. The rate of recharge is also not very high based on the fact of it's height from sea level

and the slopy surfaces. However, the high forest cover throughout the state, is a major contributory factor to the maintenance of groundwater levels.

Ground Water Resources Availability, Utilization and Stage of Development (as in 2009)

Annual Replenishable Ground Water Resource					Natural Discharge during non-monsoon season	Net Annual Ground Water Availability	Annual Ground Water Draft			Projected demand for Domestic and Industrial uses upto 2025	Ground Water Availability for future irrigate on use	Stage of Ground Water Development (%)
Monsoon Season		Non-monsoon Season		Total			Irrigation	Domestic and industrial uses	Total			
Recharge from rainfall	Recharge from other sources	Recharge from rainfall	Recharge from other sources									
1.26	0.24	0.20	0.46	2.17	0.10	2.07	1.01	0.03	1.05	0.08	0.98	51

Uttarakhand, situated in the western Himalayas, is richly endowed with water. Many traditional systems like *Naula* (little depression aquifer), *Dhara* (springs), *Gadhera* (small river tributaries), *Gul* (traditional irrigation canals), *Chal* and *Khal* (artificial ponds on hilltops) to collect and supply water still persist in the villages of Uttarakhand. Among these, *Naula* and *Dhara* are the most important and are still used as the prime source of drinking water in many hilly areas of Uttarakhand, especially in the Kumaon division. Uttarakhand State has a distinct geological attribute with wide variety of rock units ranging in age from Archean to Quaternary. Ground water in the hard rock area is harnessed through the springs and hand pumps tapping the weathered zone. Ground water in this area is developed by open wells, shallow and deep tube wells. Total Annual Groundwater Recharge of the State has been assessed as 3.04bcm and Annual Extractable Ground Water Resource as 2.89bcm. The Annual Ground Water extraction is 1.64bcm and Stage of Ground Water extraction is 57%. Out of the 18 assessment units, 5 are 'Semi-Critical' and 13 are 'Safe'. There are no over-exploited, critical and saline blocks in the state. As compared to 2013 estimate, there is an increase in the Total Annual Ground Water Recharge, Annual Extractable Ground Water Resource and annual ground water extraction in the State. The stage of ground water extraction has increased from 50% to 57%. The reason for the increase in recharge can be attributed to improvement in database (recharge from surface water irrigation-included in current assessment) which has resulted in the refinement of assessment and increased draft due to revision of well census data.
The depth of water level in Uttarakhand is not bad. However, in the high hills it becomes a problem for locals how to retain water. The surface is majorly rocky, so extraction of water is also difficult, expensive and risky. The following table shows the depth and it's general fluctuation in the state:

Rainfalls in Uttarakhand and it's Role in Availability of Water:
Rains are very regular in Uttarakhand. Even at times, they cause calamities. Another factor along with a good amount of rains is that the state is substantially covered by forests. This makes it possible that the rains contribute to water resource recharge. One problem in this is the hilly nature of the surface due to which rainfalls are immediately flown away. The following date depicts the Monthly Rainfall (Actual)inUttarakhand:

Month	2009	2010	2011	2012	2013	2014
January	3.5	8.7	26.2	53.4	73.0	45.9
February	23.1	53.1	73.3	13.4	188.3	99.9
March	2.3	4.3	20.0	30.8	22.0	68.4
April	21.6	12.9	35.0	46.6	24.7	37.6
May	30.3	60.4	89.0	10.7	18.2	52.9
June	68.3	109.2	262.9	48.0	488.9	62.9
July	320.4	538.8	455.4	389.8	413.4	462.7
August	313.5	515.7	564.2	461.2	359.4	264.2
September	195.9	522.3	171.8	223.3	111.3	107.9
October	87.2	12.0	6.0	8.8	29.1	40.8
November	7.7	5.1	2.1	4.6	3.2	0.0
December	2.2	21.8	2.3	19.2	3.8	44.3

Availability and utilizable water in Uttarakhand:

A1. Precipitation (including Snowfall): (MCM)			REMARKS
Basin/Sub-basin (Area in Km^2)	(mm)	(MCM)	
Upper Yamuna (5783)	2371	2371.78	Calculated on the basis of Year 2016 data
Ganga (25422)	7469	21140.50	
Ramganga (11434)	3926	11788.88	
Sharda (11007)	3845	13050.65	
TOTAL		48351.82	

Uttarakhand has a total geographical area of 53,566 km", of which 93% is mountainous and 64% is covered by forest. The state comprises two regions, i.e. Garhwal and Kumaun. Out of 13 districts, 7 districts namely, Chamoli, Pauri, Tehri, Uttarkashi, Dehradun, Haridwar and Rudraprayag lie in Garhwal region; and 6 districts, i.e. Nainital, Almora, Pithoragarh, Udham Singh Nagar, Champawat and Bageshwar lie in the Kumaun region. However, four districts namely Haridwar, Dehradun, Nainital and Udham Singh Nagar occur mainly in plain areas, whereas the other nine districts comprise the hilly region of the state. The hilly parts of the districts are less developed in terms of infrastructure, especially pertaining to availability of water, either for drinking or irrigation purposes. Due to physical, geographical and environmental reasons, a major part of the rural population in the hills either survives on subsistence resources or migrates to other parts of the state or country for better resources. More than three-fourths of the state population depends on agriculture for their livelihood. Water occurs abundantly in the hilly districts of Uttarakhand and this region has great potential to supply this natural resources.

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Ground Water Scenario of Uttarakhand

Area (Sq.km)	53,484
Physiography	Ganga Plain, Siwalik Hills, Lesser Himalayas, Central Himalayas
Drainage	The State is drained by major perennial rivers like Ganga, Yamuna, Ramganga, Sarda and Kali and their tributaries.
Rainfall (mm)	1523
Total Districts / Tehsils	13 districts / 78 Tehsils

Uttarakhand is endowed with bountiful water resources which are available in abundance. But, at the same time because of uneven distribution, demand is increasing further for various purposes such as drinking & domestic use, irrigation, power (hydro), industry etc. Present level water scarcity which is now apparent shall get more pronounced with increasing population. There are even limits on utilizable quantities of water owing to uneven distribution over time and space. In addition, challenges of frequent floods, landslides, soil erosion, cloud bursts and droughts in one or other part of the state adds to the woe. Climatic changes also impact the availability of utilizable water that may come under further strain in future with deepening water conflicts among different user groups.

Dynamic Ground Water Resources	
Annual Replenishable Ground water Resource	2.27 BCM
Net Annual Ground Water Availability	2.10 BCM
Annual Ground Water Draft	1.39 BCM
Stage of Ground Water Development	66 %
Ground Water Development & Management	
Over Exploited	2 blocks
Critical	NIL
Semi- critical	3 blocks
Ground Water User Maps	5 districts
Artificial Recharge to Ground Water (AR)	• Feasible AR structures: 500 spring development, 500 check dams, 500 sub-surface dykes
	AR schemes completed during IX Plan: 1

Development of the law for Ground Water Management, Rain Water Harvesting & Ground Water Recharge in Uttarakhand

One major reason for the depleting groundwater level in the state is the increased irrigated surface. Increasing population makes it desirable to increase the surface under cultivation and the same keeps cascading towards increased consumption load on the groundwater resources. The following table depicts the Irrigation Potential, Flood Control, Ground Water, Distribution of Large Dams and Hydro Potential Status:

Category	Major Medium Irrigation	Minor Irrigation	Total
Ultimate Irrigation Potential ('000ha)	346.00	518.00	864.00
Potential created till and of IX Plan ('000 ha)			
Created	280.30	500.98	781.28
Utilised	185.41	400.80	586.21
Irrigation Potential during X Plan ('000 ha)			
Created	8.68	17.77	26.45
Utilised	5.64	8.04	13.96

As per Central ground water Board Ministry of water resources Depth to Water Level – Pre-monsoon 2018 Uttarakhand state is mainly covered by hilly areas. About 85% of the area is hilly and has no appreciable ground water potential whereas about 15% of the state is plain where ground water is developed. Depth to water level in the range of 0-2 m is observed in 1 % wells, 2-5 m bgl in 25% of the wells analysed, 47% of the wells show water level in the range of 5-10 m bgl and 23% in the range of 10-20 m bgl. Deeper water level of more than 20 m bglwas seen in 3% wells. In Nainital district, maximum water level of 31.75 m bglwas recorded

FREQUENCY TABLE OF DEPTH TO WATER LEVEL (m bgl) , MAY 2019-UTTRANCHAL

No of wells in depth range (May 2019) and its percentage from total number of wells monitored

S No	State	District	No of wells Monitored	Minimum	Maximum	0 to 2	in %	2 to 5	in %	5 to 10	in %	10 to 20	in %	20 to 40	in %	> 40	in %
1	Uttaranchal	Almora	1	10.21	10.21		0%		0%		0%	1	100%		0%		0%
2	Uttaranchal	Champawat	3	9.73	45.04		0%		0%	1	33%	1	33%		0%	1	33%
3	Uttaranchal	Dehradun	47	5.10	89.75		0%		0%	9	19%	20	43%	10	21%	8	17%
4	Uttaranchal	Haridwar	39	3.19	67.70		0%	9	23%	13	33%	13	33%	3	8%	1	3%
5	Uttaranchal	Nainital	11	3.34	73.58		0%	1	9%	2	18%	3	27%	2	18%	3	27%
6	Uttaranchal	Pauri Garhwal	3	25.85	91.10		0%		0%		0%		0%	1	33%	2	67%
7	Uttaranchal	Udham Singh Nagar	45	1.94	18.21	2	4%	20	44%	15	33%	8	18%		0%		0%
8	Uttaranchal	Uttarkashi	7	10.75	45.50		0%		0%		0%	4	57%	2	29%	1	14%
	Uttaranchal Total		156	1.94	91.10	2		30		40		50		18		16	

2. GROUNDWATER RULES AND LEGISLATION

Rules governing control over, and access to, groundwater in India are largely derived from English cases. This simple statement hides a more complex situation due to the fact that the main statutory mention of groundwater rights is found in the Indian Easements Act 1882 The main rules for groundwater allocation were established in the context of disputes related to the use of land for mining or other industrial activities. The first thing that English courts did in the nineteenth century was to assert that groundwater should be treated differently from surface water. This was confirmed in Chasemore v Richards where the court determined that water 'percolating through underground strata, which has no certain course, no defined limits, but which oozes through the soil in every direction in which the rain penetrates' is not subject to the same rules as flowing water in streams or rivers. As per Constitution of India, water, that is to say, water supplies irrigation and canals, drainage and embankments, water storage and water power are items of List II of the Seventh Schedule of the Constitution i.e. the State

List. Accordingly, if/any one of these matters there is need for a legislation, the States in India will be empowered to do so and not the Centre. Even though groundwater management is recognised as a national priority problem and institutions such as the Central Groundwater Board have been set up, yet when it comes to actual regulation the initiative has to come from the States. With natural resources of this kind, where regulation has to be region specific, such decentralisation is necessary

In Subhash Kumar v State of Bihar , , the Supreme Court recognized that 'the right to life includes the right to enjoyment of pollution free water and air full of enjoyment of life'. In the SardarSarovarCase , the Supreme Court went further and directly derived the right to water from Article 21. It stated that 'water is the basic need for the survival of the human beings and is part of right of life and human rights as enshrined in Article 21 of the Constitution of India

Uttarakhand Ground Water (Regulation and Control of Development and Management) Act, 2016 has come into existence with an aim to regulate and control the development and management of ground water and matters connected therewith. It extends to the whole of the State of Uttarakhand.

Uttarakhand Water Management and Regulatory Act, 2013 has been established To provide for the establishment of the Uttarakhand water Management and Regulatory Commission Bill to Regulate water resources within the State, facilitate and ensure judicious, equitable and sustainable management, allocation and optimal utilization of water resources of environmentally, economically sustainable development of the State, fix the rates for water use for agriculture, industrial, drinking, power and other purposes and cess on land benefited by flood protection and drainage works from the owners of lands benefited through appropriate regulatory instruments according to State Water Policy and matters connected therewith or incidental thereto.

Rain water harvesting for ground water recharge. - (1) "To improve the ground water situation, the Authority may identify the recharge worthly areas in the State and issue necessary guidelines for adoption of rain water harvesting for ground water recharge in these areas. In rural areas, watershed management to facilitate ground water recharge may be encouraged through community participation. The Authority may give appropriate directions to the concerned departments of the State Government to include Rain Water Harvesting in all developmental schemes falling under notified areas. In urban areas, falling in notified areas, the Authority may issue directives for constructing appropriate rain water harvesting structures in all residential, commercial and other presmises in manner prescribed within the sitpulated period, failing which the Authority may get such rain water harvesting structure constructed and recover the cost incurred along with a penalty as may be prescribed.

(2) Notwithstanding anything contained in the relevant laws, the Municipal Corporation or any other Local Authority as the case may be, may impose stipulated conditions for providing roof top rain water harvesting structures in the building plan while according approval of construction, and permanent water and electricity connections shall be extended only after compliance of the directions given in this regard.

(3) The Authority shall take steps for promotion of Mass Awareness and Training Programmes on Rain Water Harvesting and Artificial Recharge to Ground Water through Government Agencies/Non-Government Organisations (NGOs)Voluntary Organisations/ Educational Institutions/Industries/Individuals."

Existing Institutional/ Manpower Structure of various Departments related to Water

Central Ground Water Authority has been constituted under Section 3 (3) of the Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources in the country. Central Water Commission (CWC) is headed by a Chairman, with the status of ExOfficio Secretary to the Government of India. The work of the Commission is dividedamong 3 wings namely, Designs and Research Wing (D&R), River Management Wing (RM) and Water Planning and Projects Wing (WP&P). Each wing is placed under the charge of a full-time Member with the status of ExOfficio Additional Secretary to the Government of India and comprising of number of Organizations responsible for the disposal of tasks and duties falling within their assigned scope of functions.

Equitable Use of Ground Water and Planning for a Better Future:

Equitable use of water is the idea to make it available for longer duration and for maximum possible generations. Equitable use of groundwater definitely cover the international commitment for inter-generation equity. At the same time, the state of Uttarakhand has a genuine claim for application of intra-generation equity also. The state has the origin of major rivers like the Ganges and the Yamuna; still not very prosperous in terms of water resources. Since the state has a lot of flowing water resource; it may also help in tapping out the hydropower potential of the state. Smaller plants would help more with risks also being low. The usage of groundwater is not easy in most the state being hilly. Extraction is costly, risky and difficult. The population in the state is concentrated in certain areas; so the consumption of water is also not very equitable within Uttarakhand. The existing water policy in the state must include cess on over-consumption, classification of domestic use, commercial use and industrial use. Consumption ceilings may be decided and taxed accordingly. The data referred to has confirmed that rainfall in the state in regular and good in amount. However, the hilly surfaces are not able to hold it for some time so as to recharge the groundwater. For this, rainwater harvesting wells may be of help. The private premises may take time in implementing the practice; but since the rainwater moves fast, public areas may be quickly be provided with the rainwater harvesting wells which will not only add to the groundwater recharge but also will solve the problem of heavy water flows on the roads causing difficulty. Storage of water in hilly areas is difficult and risky. Construction of dams and reservoirs may lead to environmental risks; so conservation and recharge of groundwater may turn out as a better solution, which needs lots of efforts from state and an increased public participation.