IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG)
e-ISSN: 2321–0990, p-ISSN: 2321–0982.Volume 2, Issue 1 Ver. I. (Jan. 2014), PP 47-50
www.iosrjournals.org

Augmentation of Groundwater Resources through Watershed Management: An Overview

S.K.Maanju*,K.Saha**,R.K.Verma***
** S.S. in Earth Science, Vikram university, Ujjain (MP)*
***Govt. Dungar college, Bikaner.*
****St.Wilfred's P.G.College,Jaipur.*

Abstract: *There is growing stress on the water resource availability all over the globe. The population rise, unplanned day by day increasing urbanization, multiplicity of Industrial activities, modernizing agriculture and overall inefficient water use practices has further worsened the availability of water resources. Since water mass is constant throughout hydrological cycle, therefore, we should focus on efficient water resource management. The present paper discusses the pattern of water distribution and importance of watershed management.*
Key words: *Watershed, Groundwater, Environment.*

I. Introduction

As per an estimate the total water in the world is 1.5 billion cubic kilometers and 95% of which is in salty areas and thus remaining 5% (75 million cubic km) is fresh water and out of this, 60 million cubic kms. constitute solid form, leaving only 15million cubic km as fresh liquid water for organic world. Only 1% fresh water is surface water and 99% remaining fresh water is stored beneath the surface of the earth at varying depths. About half of ground water is considered to be stored at depths greater than 1000 mts. and accordingly not feasible to pump for human use. In this way only 7 million cubic kms of fresh ground water entrapped at reasonable depths from surface plus 15000 cubic kms surface water is only useable water available in the world. The distribution of world water is tabulated below as table-1 whereas annual water balance is shown in table-2.The precipitation and the run-off relation among all the continents is shown in table-3 as well as annual run-off of world rivers into sea is shown in table-4. The rate of water exchange in hydrologic cycle during the year is shown in table-5 alongwith water carried by ocean currents and intensity of water exchange is shown in table-6

Table-1 (Nace 1960 and Feth 1973)

Content	Volume in 1000 km^3	% of total water
Atmospheric water	13	0.001
Surface water		
Salt water in oceans	1320,000	97.219
Salt water in lakes and Inland seas	104	0.008
Fresh water in Lakes	125	0.009
Fresh water in stream channels	1.25	0.0001
Fresh water in glaciers and Ice caps	29,000	2.136
Water in the Bo-mass	50	0.004
Sub-surface water		
Vadose water	67	0.005
Groundwater within depth of 0.8 km (active exchange)	4,200	0.309
Groundwater between 0.8 and 4km depth	4200	0.309
Total	13,57,760	100

Table-2 Annual water Balance of the World (Lvovich 1973)

Item	Volume (cubic kilometers)	Depth (millimeters)
1.**Periphery of Land Area (116.8 x 10^6 km^2)**		
Precipitation	106,000	910
River discharge	41,000	350
Evaporation	65,000	560
2.**Inland Water Area(32.1 x 10^6 km^2)**		
Precipitation	7,500	238
Evaporation	7,500	238
3. **World Ocean Area(36.1 x 10^6 km^2)**		

Precipitation	411,600	1,140
Inflow of river water	41,000	111
Evaporation	452,600	1,251
4. **World Total Area(510 x 10^6 km^2)**		
Precipitation	525,100	1,030
Evaporation	525,100	1,030

Table-3 Precipitation-Run-off Relation of the Continents (Lvovich 1973)

Continents	Area 10^6 km^2	Annual Precipitation Mm	Annual Precipitation Km^3	Evaporation Km^3	Evaporation % of Precipitation	Overland surface Run-off Km^3	Overland surface Run-off % of Precipitation	Groundwater Flow Km^3	Groundwater Flow % of Precipitation
Asia	45	726	32,690	19,500	59.0	9,780	29.9	3,410	10.5
Europe	9.8	734	7,165	4,055	56.5	2,045	28.6	1,065	14.9
Africa	30.3	686	20,780	16,555	79.7	2,760	13.3	1,465	7.0
North America	20.7	670	13,910	7,950	57.2	4,220	30.3	1,740	12.5
South America	17.8	1640	29,355	18,975	64.6	6,640	22.6	3,740	12.8
Australia	8.7	736	6,405	4,400	69.7	1,500	23.4	465	7.3
All land areas	132.3	834	110,305	71,465	64.7	26,945	24.4	11,885	10.8

Table-4 Annual run-off World Rivers into sea (Lvovich 1973)

Region	Run-off volume km^3	Depth(mm)
1.Asia	13,190	293
2.Europe	3,110	319
3.Africa	4,225	139
4.North America	5,960	287
5.South America	10,380	585
6.Australia	1,965	226
7.Greenland	700	180
8.Antarctica	2,200	250
Total	41,730	280

Table-5 Rate of water Exchange in Hydrologic Cycle during the Year

Hydrologic Arc	Activity	Quantity in Active exchange in km^3
World Ocean	Circulation	452,600
Ground water	Circulation	1,200
Polar glacier	Circulation	2,900
River water	Circulation	41,000

Table-6 Water carried by Ocean currents and Intensity of Water Exchange(Lvovich 1973-p26)

Oceans	Area in million sq.km	Volume in million cu.km	Annual flow in million cu.km	Water exchange intensity ratio of annual flow to ocean volume (No. of years)
Pacific	180	725	6.56	110
Atlantic	93	338	7.30	46
Indian	75	290	7.40	39
Arctic	13	17	0.44	38
World Ocean	363	1,370	21.70	63

India with a geographical area of 328 million ha. received rainfall varying from 100 mm in western Rajasthan and exceeding 11000 mm in Chirapunji in Meghalaya experiences extremes of climate. The average annual rainfall of the country is about 1170 mm which constitute average run off of 1869 cubic km in river systems. During the monsoon period over 90% run off occur in peninsular rivers whereas 80% of the annual run off in the Himalayan rivers.

Average annual rainfall over India is computed as 117cm which is largest anywhere in the world for a country of a comparable size, the global mean being 99cm .the annual rainfall suffers from wide departure from the normal from year to year. Rainfall in India is erratic and Ill-distributed. It varies from place to place and year to year. While western Ghats, Assam and its neighborhood and parts of Himalayas receive more than 200cm annually; in contrast Rajasthan, Kuttch receive rainfall between 10to50cm in a year. Chirapunji records a rainfall of 1142 cm, the highest in the country in a year and recorded as high as 104cm in one day .In major parts of the country almost 85to90 percent of the total rainfall is contributed by the southwest monsoon and is received only in four rainy months of June to September .The balance precipitation occurs during the North-East monsoon period of November and December mostly in the coastal area of Tamilnadu, Andhra Pradesh and parts of Orissa. There is wide departure in rainfall from year to year even in the rainy season. The rainfall in most part of the country is subject to uncertainty of occurrence marked by prolonged dry spell and aberration in time of commencement and with drawl and also the total amount received. Considering the nature of topography of the country, concentration and localized precipitation in the regions only limited extent of surface stream flow could be availed and rest goes into the sea.

Annual average precipitation in India =$370X10^6$ ha.m
Loss in evaporation =$120x10^6$ ha.m
Loss in seepage to soil =$80\ x10^6$ ha.m.(Groundwater $40x10^6$ ha.m)
Annual stream flow in river =$170x10^6$ ha.m.(utilizable flow $77x10^6$ ha.m)
Thus surface water source is about 21% and groundwater source is about 11% of the annual precipitation.

STATUS OF WATER UTILIZATION IN INDIA

In our country the main occupation of the people is agriculture and presently the irrigated area in the country is more than 91.8 million ha including 33.82 million ha from major and medium project. In 1997 total utilization of surface and ground water was about 605 cubic km. It is estimated that by 2025, the total water utilization in the country is projected about 1050 cubic km (700 cubic km from surface and 350 cubic km from ground water). This includes 52 cubic km for domestic use, 770 cubic km from irrigation, 71 cubic km for energy, 120 cubic km for industrial and 37 cubic km for other purposes. Thus, it appears that almost the entire utilizable water resources would be required to be utilized completely by 2025.

The available fresh water source is being depleted day by day which has led rationing of water in urban areas. Inter State and Inter City disputes on the use of water are growing day by day and even International disputes on water are getting space as box items on the first page of leading news papers of the world. The increasing population of India needs more water not only for personal and domestic use but requires more and more for irrigation to cater proportionate food demand.

Per capita average annual availability of water in world is 8500 cubic meters whereas in India annual water resources in the various river basins are estimated to be around 1869 cubic km and per capita annual availability is only 2200 cubic km which is not even uniform in the country. It varies from 18417 cubic mts. in Brahmaputra to as low as 380 cubic mts in some rivers of Tamilnadu. In any situation if availability is less than 1000 cubic mts. then, annually scarcity conditions are considered by International Agencies in that area. Thus, it is emerged that remedial measures are to be taken since water scarcity conditions are already prevailing in our country.

WATERSHED

Watershed Management Programme has to be adopted for conservation of soil and water in order to get optimum results. The term "watershed" indicates a geo- hydrological unit comprising of all land and water within the confines of drainage divide. The size of watershed in increasing order is expressed by terms such as micro-watershed, sub-watershed, watershed catchments and river basin. Watershed Management is an integrated approach to the development of an area with the ultimate aim of improving the quality of the life of the inhabitants of the area.

MAIN OBJECTIVES OF WATERSHED MANAGEMENT

The ultimate aim of watershed management programme is to protect and improve the quality of life of the community. In order to achieve this objective there are several sub objectives which are required to be operated simultaneously as under:

1. Conservation of basic natural resources like soil, water and vegetation.
2. Protection of environment and restoration of geological balance.
3. Sustainable crop yields by adopting improved management and farming practices.
4. Development of land use systems through horticulture, forestry, pasture and animal husbandry.
5. Training programmes are to be conducted from time to time to educate beneficiaries and enhance their capacity and skill.
6. Regular periodical assessment by concerned people of watershed programme is essential for better results.
7. The awareness of people both as participant directly within the watershed area and as a beneficiary from the conservation of soil and water particularly for domestic purposes is essential.

II. Conclusion

Theoretically we know that the water mass transfer takes place through various components of hydrologic cycle with mass balance remaining the constant. However, with intended interventions in the systems, it is possible to beneficially divert several times more water than it is actually in the form of developed water supplies. The hurdle in utilization of rain water is non- availability of storage facilities since major quantity of river water goes in flood flows which is approximately 20% of total precipitation. Another factor of Inter- state water disputes also put difficulties since water is a state subject. Recently Central Ground Water Board has assessed that 432 cubic km of groundwater is available annually through conventional means which could be utilized for replenishing existing water level whereas as per an estimate 690 cubic km water could actually be utilized by constructing water harvesting structure.

International Water Management has indicated that by 2055, 40% of the world population will live in constraint with physical water scarcity and 26% will live in constraint with economic scarcity. In this background it is very timely that we geoscientist should devise, formulate strategies towards finding suitable remedy for the present and the impending water crisis, the degree/intensity of which would go on increasing if timely thinking/measures are not carried out.

It has been found out that in 2055, the world will need at least 27% more developed water supplies for all sectors including 60% more water for irrigation. Although this increase is only about 1% per year, it is still represents 490 cubic km water per year. However, the picture may not be so gloomy if we are able to put our collective efforts and wisdom to resolve the issues. It is possible to have a blue revolution in water after having gone through successfully various similar revolutions such as white, green revolution and so on. The answer is an effective Watershed Management Approach aided with water recycling and precision irrigation as the watershed is the source of all our surface and subsurface water resources.

Reference

[1]. Bouwer, H 1978 Ground water hydrology, Mc Grow Hill, New-York.
[2]. Davis D.N. and Dewiest, R.J.M. 1968 Hydrogeology John Willey & Sons
[3]. Garg, S.K. 1973. Water resources and Hydrology. Khanna publishers Nai Sadak, Delhi.
[4]. Heath R.C. and Frenk W. Trainer 1968. Introduction of ground water hydrology. John Willey & Sons, New-York.
[5]. Jhanwar, M.L., 1998. Hydrology and water Resources. published by Vigyan Prakashan Bapu Nagar, Jodhpur.
[6]. Karanth, K.R., 1989. Hydrogeology. Tata Mc Graw Hill Publishing Company Limited Asaf Ali Road, New Delhi.
[7]. Nagabhushaniah ,H.S.2001.Groundwater In Hydrosphere CBS Publishers & Distribtors ,New Delhi.
[8]. Todd, D.K. 1980. Ground water hydrology, John. Willey & Sons, New- York.
[9]. Walton, W.C. 1970. Ground water resource evaluation Mc Graw Hill, New-York.