Water Management in Hilly Area: Indian Context

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Abstract— Water is the very basis of life and is the foundation for human survival and development. Sustainable and equitable use of water over millennia has been ensured by cultural adaptation to water availability through water conservation technologies, agricultural systems and cropping patterns adapted to different climatic zones, and conservation-based life styles. But in the last few decades the consequences of population growth, industrialisation and urbanisation, and the associated consumerist culture, have interfered with the natural hydrological cycle of rainfall, soil moisture, groundwater, surface water and storage of all sizes. In all the hilly region of India, North –Eastern zone is very poor and undeveloped zone due to lack of facilities. Presently in this region source of water for drinking and irrigation is surface water (Streams and Rainwater). In absence of proper rain water harvesting structures in this region, rain water is hardly available and stream water is available only for the people living close to river banks. So they use their traditional land and water management system such as rain water harvesting, pot chlorinator for water purifying, zabo system, rice and fish culture etc. till now. Beyond these traditional technologies there are some new technologies has been developed for water conservation and filtration for drinking such as life straw, life sack and some other but due to lack of information and knowledge they are unable to use these technologies. With the help of Govt. Organization and Pvt. N.G.O.'s we can introduce and provide these cheap and latest technologies to the poor people of hilly region of India.

Key words: rain water harvesting, slow sand filtration, the pot clronition

I. INTRODUCTION

Water is very important for any living. So human settlements in the world over have grown so long they had enough water for drinking, consumption and irrigation. In hilly region all the water flows down to the bottom of the hill due to terrace and slope, so the people who live at the top and middle of the hill can't use this water properly. So in the hilly and mountainous terrains, the communities have invented some of water tapping and transfer system which is used for generation to provide water for drinking and agriculture base. The NEH region of INDIA is facing problem for storage of sufficient water, especially in summer time, for drinking and irrigation purposes. An attempt is made to study the sustainable water resources management with particular reference to rainwater harvesting, water quality improvement of safe drinking water supply and sanitation with active public participation, training and awareness programs. Water resources for utilization of the country have been assessed at 1123 billion cubic meters, of which 710 bcm is surface water and 433 bcm from ground water sources. The potential of irrigation of the country has been estimated to be near about 141 MH without inter-basin sharing of water and 175 MH with inter-basin sharing. For irrigation, water demand is more in India. However, this limit of storage and transfer of water restricts the potential for irrigation. The potential created and potential utilized up to XIth five year plan are

- Potential created – 118.77 MH
- Potential utilized – 99.04 MH

II. LITERATURE REVIEW

Sustainable development and efficient management of water is an increasingly complex challenge in India. Increasing population, growing urbanization and rapid industrialization combined with the need for raising agricultural production generates competing claims for water. There is a growing perception of a since of an impending water crisis in country. The work done for conservation, development and management of water resources in hilly region by various authors in India and abroad are given below:

Paul Polak Et Al., (1997) Present a brief review on low cost drip irrigation system for small farmers in developing countries. In their paper they applied this system in hill area in Nepal. The first of these systems was installed on the half an acre of vegetables at an agricultural research station outside Kathmandu. Test was run on uniformity of flow from the drip holes, head losses in the drip lines, and uniformity of flow from one terrace to next. After their research they found that in areas with high concentration of small farmer operations and a scarcity of water, the low cot drip irrigation system will provide access to water, saving irrigation technology which is affordable on small scale and divisible.

R. A. Singh Et Al., (2001) studied on the traditional and water management system of North –East hill region .They found that a number of tribes inhabiting the NEH region. These tribal societies with long history and traditions have developed ingenious indigenous farming system, which have built-in ecofriendly system for conservation, preservation, and utilization of natural resources. They briefly described these tradition farming practices-

- Zabu or Ruza System
- Agriculture with Alder trees
- Panikheti system
- Hubur and Bund system
- Rice cum fish culture
- Bamboo drip irrigation

After their study they found that this traditional system can again be made economically viable. The added advantages will include reduction in shifting cultivation and misuse of natural resources.

P. P. Dabral (2002) presents a review on indigenous techniques of soil and water conservation north

eastern region of India. He studied some traditional irrigation system such as bamboo irrigation system, rooftop harvesting, apatani water management, zabo system of farming in Nagaland, Meghalaya and Mizoram. Also gives some detail about cattle and paddy-cum – fish culture. After the study his conclusion was that there is a scope for improving efficiency/productivity of these system using modern scientific methods. Before developing or recommending any new farming practice/technique in the region, researchers and planner should consider these indigenous techniques of soil and water conservation into account for better implementation at field condition in the region.

G. C. S. Negi et al., (2002) studied on traditional methods of water management in the central Himalayan agriculture maintenance of crop field bunds, ploughing methods, relay cropping, mulching, putting weeds and crop remains to fire etc. are some of the methods of in-situ moisture conservation and soil fertility improvement practiced by the farmers. Use of household wastewater and rooftop water harvesting to supplement moisture for kitchen garden and household demands, and disposal of excess water from the crop fields is also in practice traditionally. These practices are now degenerating slowly as a consequence of reduction in water resources and apathy of the people for participatory programs. There is a need to analyze these practices from scientific and socio-economic standpoint to popularize them for cost-effective and environment-friendly management of water resources. They talk about irrigation water management and in-situ methods in crop fields; the conclusion of their paper was that there is an urgent need to make a critical appraisal of the traditional knowledge system and how the modern technological advances can be blended for better scientific management of water in traditional agriculture in this region.

S. K. Gupta et al., (2004) study was on water for India in 2050, first-order assessment of available options. They argued that due to considerations of gestation period and capital requirements, rainwater harvesting and water-conservation measures must receive the highest priority followed by renovation and recycling to be followed by intra- and then inter-basin transfers in the last phase. But, investigations and planning processes for all options must begin immediately. The priority of action, however, must be for rainwater harvesting and groundwater recharge followed by renovation and reuse of wastewater and then inter basin transfers. This is the larger national picture, though adjustments at local and regional levels may have to be made.

III. METHODOLOGY

A. For Drinking Purposes

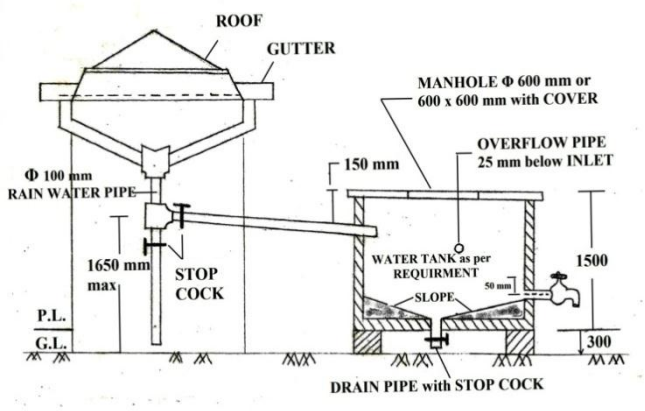
There are some types of water conservation through which we can utilize the water for drinking and living hood purposes.

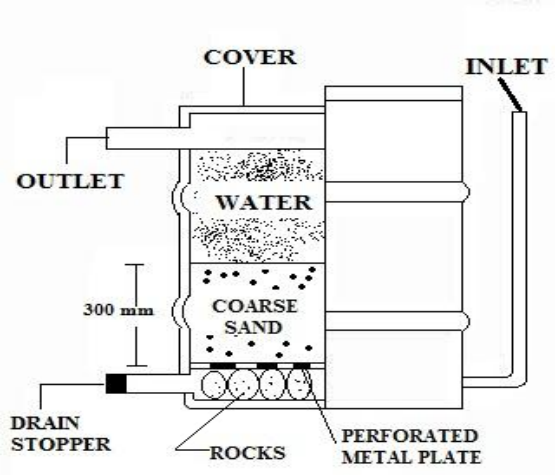
(1) Rain water harvesting
- Rooftop rain water harvesting
- Percolation pits
- Development of chaals/ponds

(2) Slow Sand filtration
(3) The pot chlorinator

B. For Irrigation Purposes

(1) Water management in Apatani Platea (Rice + Fish culture)
(2) The 'Zabo' system of water management
(3) Bamboo Drip Irrigation
(4) Panikheti





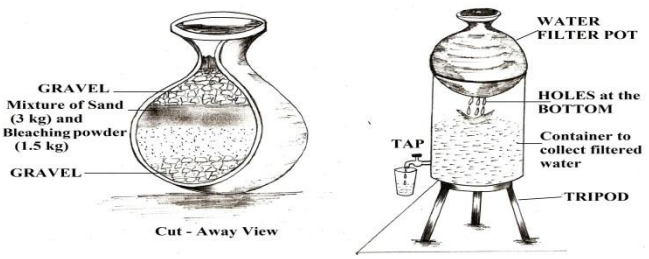


Fig: 1- Rooftop rain water harvesting 2-Percolation pits 3-chaals/ponds 4 - Slow Sand filtration 5- The pot chlorinator

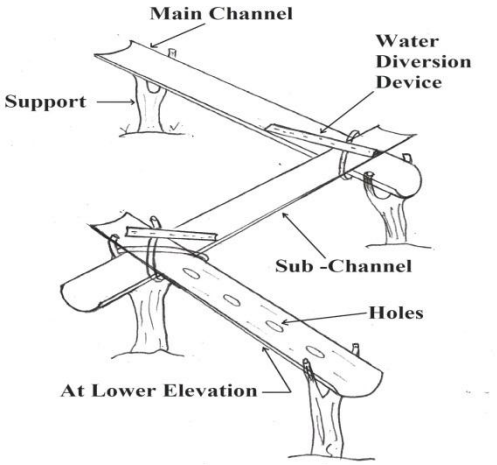


Fig: 1- Water management in Apatani Plateau (Rice+Fish culture) 2- The 'Zabo' system of water management 3 - Bamboo Drip Irrigation 4 – Panikheti

IV. ACVTIVATED CARBON INSTEAD OF CHLORINE FOR SAFE DRINKING

In recent, scientist use activated carbon with iodine instead of chlorine for water purification and they make some portable water purification devices which is cost effective and easy to use. In this way life straw is the smallest, portable, light weight and cost effective device with the iodine and active carbon water purification technology.

Activated Carbon – For reuse, Granular activated carbon is recycled, by thermal reactivation, when saturated, or the treatment objective is reached. For reactivation of spent carbon it involves treating in a high temperature reactivation furnace to over 800^{o}C. An undesirable organics on the carbon are thermally destroyed during this thermal treatment process. For recycling of activated carbon, thermal reactivation is a highly skilled process to ensure that spent carbon is returned to a reusable quality. From industrial and municipal waste waters, contaminants in landfill leachate and contaminated groundwater, activated carbon is one of the most effective media for removing these contaminants. This is the world's most powerful adsorbent. This can cope with a wide range of contaminants. Carbon may be used to treat the water because there can be present different contaminants in same discharge. In multistage approach it is best suited for remove the specific contaminants.

Different types of environmental water contaminants which can be treat by activated carbon:

- Non-biodegradable organic compounds
- Absorbable Organic Halogens
- Toxicity
- Colour compounds and dyestuffs
- Inhibitory compounds for biological treatment systems
- Aromatic compound including phenol and bis-phenol A
- Chlorinated/halogenated organic compounds
- Pesticides

Estimination of Bacterial Number - In the hilly areas, there are very few industries and 99% people used stream , fresh water resources or purified rain water for drinking , so we neglect the physical and chemical testing

but must take a biological testing to find out MPN in chlorinated water and water purify by iodine + active carbon.

Procedure to find out coliform MPN

(1) First we take 2 water samples from chlorinated water an water purified by life straw.
(2) Inoculate the sample in exponential order in tubes each of MacConkey's broth.
(3) Use double strength tubes for 10ml portions and single strength tubes for 1.0 ml.
(4) Incubate for 24 hours at 35 $\pm$ 0.5^{o} C.
(5) Next day positivity is determined by the change in color from purple to yellow and accumulation of gas in formation tube.
(6) Find out the 24 hours presumptive MPN from the MPN table.

After the examination of both water samples it is found that water purified by life straw gives good result than the chlorinated water. In chlorinated water 1 tube of 1 ml give positive reaction ,while water purified by activated carbon don't gives any positive reaction. In chlorinated water 3 MPN/100 ml found while water purified by activated carbon have 0 MPN/ 100 ml (from MPN table).

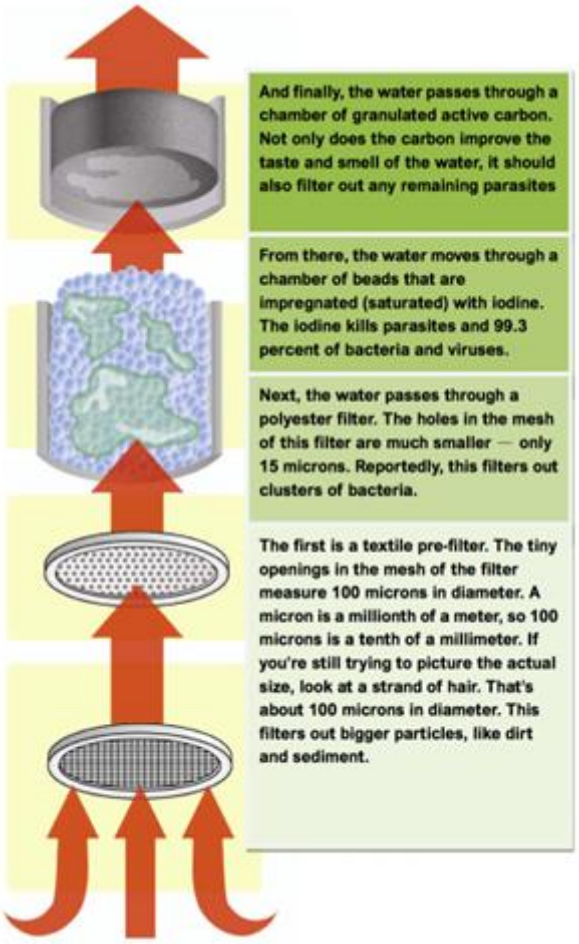
A. Apparatus Used in Practical

1) Life straw

Life straw is developed by Torben Vestergaard Frandsen in South Africa .The Life Straw is a plastic tube 310 mm long and 30 mm in diameter. Water that is drawn up through the straw first passes through hollow fibers that filter water particles down to 0.2 µm across, using only physical filtration methods and no chemicals. The entire process is powered by suction, similar to using a conventional drinking straw, and filters up to 1000 liters of water. Life Straw now removes a minimum of 99.9% of waterborne protozoan parasites including giardia and cryptosporidium. Life straw works on purotech disinfecting resin (PDR) which is a patented extraordinarily effective material that kills bacteria when it came in contact. The first iteration of Life Straw used iodine to kill bacteria. To remove particles up to 15 microns text pre filters is used. Active carbon kills/absorb particles such as parasites.

Fig.: Life Straw

2) Working of life straw



3) MPN table

Number of tubes giving positions reactions			**MPN index per 100 ml**
3 of 10 ml	**3 of 1 ml**	**3 of 0.1 ml**	
0	0	0	3
0	1	0	3
1	0	0	4
1	0	1	7
1	1	0	7
1	1	1	11
1	2	0	11
2	0	0	9
2	0	1	14
2	1	0	15
2	1	1	20
2	2	0	21
2	2	1	28
3	0	0	23
3	0	1	39
3	0	2	64
3	1	0	43

3	1	1	75
3	2	2	120
3	2	0	93
3	2	1	150
3	2	2	210
3	2	3	290
3	3	1	460
3	3	2	1100
3	3	3	2400

Source: WHO (Multiple-tube method for thermotolerant (faecal) coliforms)

V. Results and Discussion

From above study we can say that life straw is best and cost effective technology which can be adopted at the place of pot chlorinator and should be adopted in the ruler and hilly area in India.

(1) Life straw has portable size, plastic tube 310 mm long and 30 mm in diameter than the pot chlorinator, mixture of bleaching powder (1.5 kg) and coarse sand (3 kg).
(2) In Pot chlorinator storage system is required for filtered water while with life straw; water can be drink directly from source.
(3) Algae can be formed after sometime between the stones pieces in pot chlorinator while a very few chances to form in life straw.
(4) Polyethylene and sand filter is used for water filtration in pot chlorinator and textile pre filter, polyester filter are used for water filtration in life straw.
(5) Price of pot chlorinator is near about 400 to 500 rupees and of life straw also.
(6) Pot chlorinator reduces 900 to 3 MPN /100 mL after purifying in and life straw 0 MPN /100 mL after purifying.

VI. Conclusions

The design, development and commissioning of rainwater harvesting structures with the introduction of pot chlorinator has resulted in improved groundwater recharge and safe water supply respectively in study area.

- The design, development, commissioning of appropriate technological intervention through SSF plant with the introduction of pot chlorinator has resulted in improved and safe water supply in hilly area. But some new cost effective technology should be adopted instead of such old technologies.
- The environmental awareness programs and training had interactive participation to change current non-scientific thinking and practices.
- The pre and post assessment of socio-economic survey, water quality, health survey and beneficiary's opinion reflect positively in achievements of anticipated benefits and impacts.
- All over the bamboo drip irrigation system is also best suitated and cost effective and easily useable technic for poor farmers of hilly region but we can replace these bamboo channels with the low cost plastic folding pipes which should be lightweight, portable and price should be low.
- Once the systems are erected by the tribal people they run for years, provided, maintained properly. The methods adopted traditionally by the tribal farmers of the region due to their skill and experience are simple, make use of locally available resources, require no investment and are most suitable for hilly terrains.
- These methods combining soil and water conservation techniques, do not involve deforestation, and, therefore, are eco-friendly.
- Water harvesting and development of water area by utilizing runoff water have to be perfected. Formulation of suitable combination of various land uses for optimum utilization of land, water and natural energy sources. Rehabilitation of jhum lands with horticultural crops. Develop new technologies of water management with the help of Pvt. Ngo's and Govt. organizations and spread these technologies in needy persons.

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