RWH and Conservation

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Abstract –
Water plays a vital role in the ecosystem. The precipitation over the country is not only unevenly distributed, but also uneven with regard to seasonal distribution as well as within season. steep slope and terrain in hilly areas quickly releases the flow towards the outlet and thus creates scarcity of water. Geomorphology and the way land surface is managed, strongly influences the movement of water over and below the ground. According to Indian Meteorological Department (IMD), there are around 40 rainy days in India, and a long dry spells and period. Due to the increasing population, industrialization etc, the per capita availability of water in terms of quality and quantity is decreasing day by day. Water scarcity in hills is a severe problem .With time the problem may accelerate and create acute shortage of water resources. Management and development of water resources involves decision-making about the use and conservation of available water resources for many purposes (irrigation, drinking etc.). Migration in hilly areas is very common principally due to the lack of water. The Population growth of Uttarakhand in decade (2001-2011) was 19.17 percent while in previous decade (1991-2000) it was 20.41 percent. Hence, integrated approach in hilly areas is essential to deal with the problem. Topography of the hilly areas is quite sensitive to soil erosion and landslides. Suitable water conservation practices may be adopted to cater the water scarcity and related social problems. Water conservation is of great importance to the economic, social and cultural development in hills. This paper deals with some water conservation /rain water harvesting techniques like Check dams, roof top rain water harvesting.

Keywords: *Water scarcity, water conservation. Check dams, Rain water harvesting, integrated approach.*

I. INTRODUCTION

Water plays a vital role in the ecosystem. Without water life cannot exist. According to Indian Meteorological Department (IMD), there are around 40 rainy days in India, and a long dry spells and period. Due to the increasing population, industrialization etc, the per capita availability of water in terms of quality and quantity is decreasing day by day. Water scarcity in hills is a severe problem. It can be clearly understood by the "GAON BACHAO YATRA" proposed by Environmentalist Padamshri Anil Joshi. In Uttarakhand, many people are escaping due to water scarcity (Table-1). With time the problem may accelerate and create acute shortage of water resources. Management and development of water resources involves decision-making about the use and conservation of available water resources for many purposes (irrigation, drinking etc.). Migration in hilly areas is very common principally due to the lack of water. The Population growth of Uttarakhand in decade (2001-2011) was 19.17 percent while in previous decade (1991-2000) it was 20.41 percent. Hence, integrated approach in hilly areas is essential to deal with the problem. Topography of the hilly areas is quite sensitive to soil erosion and landslides. Suitable water conservation practices may be adopted to cater the water scarcity and related social problems. Water conservation is of great importance to the economic, social and cultural development in hills. This paper deals with some water conservation /rain water harvesting techniques like Check dams, roof top rain water harvesting.

Table-1 Census of India-2011

State/District	1901-2001 (% Increase)	2001-2011 (% Increase)
Uttarakhand	20.41	19.17
Uttarkashi	23.07	11.75
Chamoli	13.87	5.60
Rudraprayag	13.43	4.14
Tehri Gadhwal	16.24	1.93
Dehradoon	25.00	32.48
Gadhwal	3.91	-1.51
Pithoragadh	10.95	5.13
Bageshwar	9.28	5.13
Almora	3.67	-1.73
Champawat	17.60	15.49
Nainital	32.72	25.20
Udham Singh Nagar	33.60	33.40
Haridwar	28.70	33.16

II. CHECK DAM

A check dam is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to reduce the speed of concentrated flows for a certain design range of storm events.

A. Advantage of Check Dams

Check dams serves mainly two purposes: the first is to provide direct irrigation when rain fails, and the second is to facilitate the recharging of surrounding wells through percolation of water. Additionally, check dams provide water for other uses also Due to the check dams, there has been an improvement in the water table of the wells, intensity of irrigation, and yield rate of some major crops and cropping areas. Women are benefited, as water for bathing, washing clothes and for animals is available near the house.

In spite of their positive impact, check dams have some negative aspects such as submergence of land, and siltation of wells. However, the positive impact outweighs the negative impact. If more care and precautions are taken in the construction of check dams, the negative impacts such as siltation of wells and the submergence of cultivated land can be avoided. Check dams are a sustainable source of water (Barry Underwood et al, AKRSP Gujarat).

B. *Limitation*

It is constructed on a stream in areas where ground water table fluctuation is very high and stream is influent. Average catchment area may be 20- 50 ha. Check dams, up to a height of 2.0 meter. can be constructed across small tributaries / Nallah / drainage channel within the banks and streams in middle and higher reaches (within approx. 50 meter. wide)

C. *Types of Check Dams (Gramya, Uttarakhand)*

Depending upon the material used check dams can be classified as following:

- Brush Wood Check Dams
- Log Dams
- Loose Stone Check Dams
- Crate Wire (Gabion) Check Dams

1) Brushwood Check Dams:

These dams are constructed with the help of locally available wooden poles and brushwood. Wooden poles are driven into the ground and brushwood is packed on the upstream face of the check dam.
(Fig. 1)

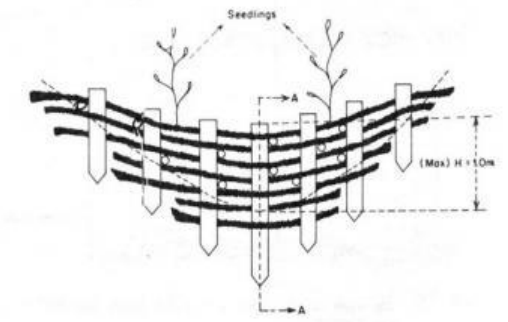

Fig. 1: Brushwood Check Dam Placed Across the Gully. Source: Fao (1986)

Suitability

This type of check dams are provided in small and medium gullies where wooden poles are locally available and the side slope of the gully is less than 45degrees. Depending upon the size of the gully and area of catchments, poles of about 7.5 cm dia. are driven into the ground. The posts used should preferably be of species Lannea coromandelica, Sisso and Ficus which will strike roots.

2) Log Check Dams:

These check dams should be restricted only to the places where no other material such as stones, brick etc. is available and the wooden logs are available in abundance. White ants are the greatest enemy of this type of structures and accordingly the required measures should be taken before hand (Fig. 2).

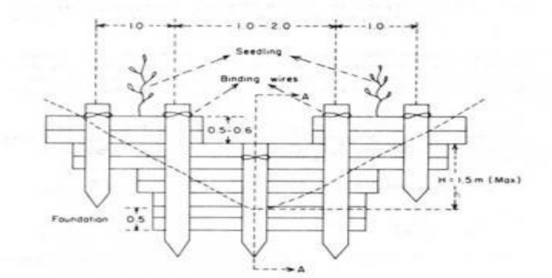

Fig. 2: Log Check Dam. Source: FAO (1986)

3) Loose Stone Check Dams:

These types of check dams are used for checking runoff velocity in steep and broad gullies where good size of stones is available in abundance. Dry stone/loose rock check dams have longer life and usually require less maintenance as compared to brushwood check dam (Fig. 3).

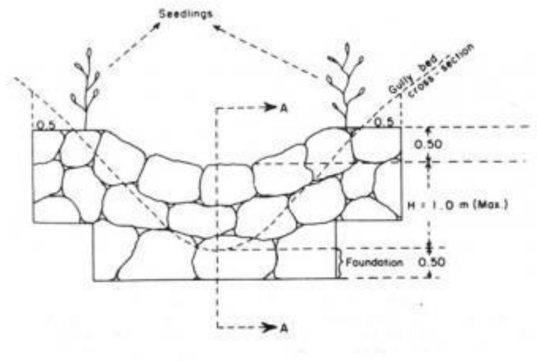

Fig. 3: A Loose Stone Check Dam. Source: FAO (1986)

Suitability

These are generally constructed at upper reaches of drainage lines/gullies in the newly formed or branches of main nallas less than 100 m in length, where plenty of boulder stones are locally available.

*4) **Gabion Check Dams**:*

Gabion check dams are used for retention of debris in the main nallas and are constructed by filling of stones in wire mesh cage. The size of the wire mesh is generally kept 15cm x 15 cm and the wire used for these cages is galvanized iron wire of 8 – 7 gauge (4 - 4.5 mm). These structures are widely adopted for the treatment of drainage lines because they are flexible (bend without breaking), porous (water can seep through them) and are economical as compared to masonry structures (Fig. 4).

Fig. 4: Gabion Structures

Suitability:

Gabion check dams are used in the main drainage channels receiving relatively large quantities of runoff and debris. These structures are constructed up to a height of about 1- 3 m.

D. Spacing of Check Dams:

While planning the location of check dams in a particular gully/Nalla is the spacing between two consecutive dams. Hence the distance between two check dams could be such that at no point the flowing water should acquire an erosive velocity. This can be achieved if the bunds or check dams are so placed that the bottom of the upper structure and the top of the lower structure are kept almost on the same level (Fig 5).

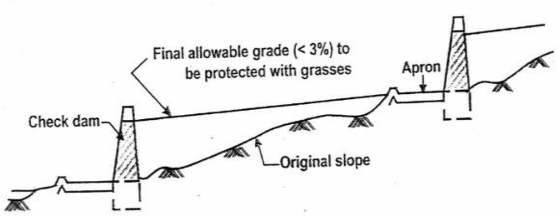

Fig. 5: Spacing Between Two Check Dams

E. Operation and Maintenance

Check dams should be inspected regularly for sediment accumulation after each significant rainfall. Sediment should be removed when it reaches one-half of the original height or before. Ensure that the flow is over the centre of the dam and not either under or around the dam (AKVOPEDIA 2012).

F. Impact of Check Dam-

Generally check dams have the positive impacts on various things such as livelihood, groundwater quality etc. Some impacts are given below:

Reference	**Location**	**Findings**
Balooni et al.(2008)	Kerala, India	Increase in agriculture activity during summer season.
Khosla, (1990)	Madhya Pradesh, India	Increased income due to sustained agriculture.
Mudrakartha(2003), Palanisami et al.(2003), Gale et al. (2006), Neumann et al. (2004)	Gujarat, Coimbatore, Maharashtra, India.	Increased the crop production, well irrigation and increase in the number of livestock.
Redlich (2010)	Madhya Pradesh, India	Assured water supply for forming.
Samwanshi et al. (2006)	Maharashtra, India.	No longer subject to vagaries of monsoon and women not spending their time in fetching water.

A. Impact of Check Dam on Groundwater Quality Use of Waste in Concrete

Reference	**Location**	**Findings**
Gale et al. (2006)	Satlasana, India.	Recharge increased from 6% to 24%.
Gale (2006)	Gujarat, Tamil Nadu, Maharashtra, India.	Considerable contribution to aquifer recharge.
Mudrakartha (2003)	Gujarat, India.	Suggested to increase number of wells near to the structure to get maximum benefit.
Muralidharan (2007)	Andhra Pradesh, India	Recharge increased from 27% to 40%.
Neumann et al.	Tamil Nadu,	33% of additional

(2004)	India.	water could be extracted from the wells located nearer to the check dam.
Niranjan and Srinivasu (2012)	Saurashtra, Gujarat, India	Groundwater level near the check dam was increased about 2m.
Palanisami et al. (2006)	Tamil Nadu, India.	Impact of check dam on water quantity was identified.
Pandey et al. (2004)	Rozam, Gujarat, India.	Well yield has increased from 0.64 liter per second to 1.50 liter per second after the intervention structure.
Saxena et al. (2010)	New Delhi, India.	Rise of groundwater level up to 4m.

III. RAINWATER HARVESTING

The concept of rainwater harvesting involves 'tapping the rainwater where it falls'. A major portion of rainwater that falls on the earth's surface runs off into streams and rivers and finally into the sea. The technique of rainwater harvesting involves collecting the rain from localized catchment surfaces such as roofs, plain /sloping surfaces etc., either for direct use or to augment the ground water resources depending on local conditions. Roof catchments have the maximum runoff and are generally considered clean and safe.

A. Components of Roof top Rainwater Harvesting System

Rainwater from the roof is collected in a storage vessel or tank for use during periods of scarcity. Such systems are usually designed to support the drinking and cooking needs of the family. Therefore, a typical Roof top Rainwater Harvesting System comprises following components:

1. Catchment area where the rain falls
2. Conduit pipes that channels the flow of water
3. First flush (a valve that ensures that runoff from the first spell of rain is flushed out and does not enter the system) and filter system.
4. Storage tank.

IV. CASE STUDY

A. Rooftop Raiwater Harvesting, govt. Polytechnic Gauchar (chamoli)

Polytechnic campus have a sufficient building structure. There is a water scarcity problem. Rooftop rain water harvesting study has been taken. Study shows that per capita per day water availability is 30 litre.(Table.-3). Average annual rainfall has been taken as 1573 mm and runoff coefficient 0.85

Table.3 Total Water Availability Govt Polytechnic Gauchar (Chamoli)

	No	**Area (sq m)**	**Water Available (cu m)**
Type II Quarter(Zone A)	12	1536	2006.71
Type IV Quarter(Zone A)	2	240	313.55
GIRL,S Hostel(Zone B)	1	500	653.23
Multipurpose Hall(Zone B)	1	720	940.64
Block B (Zone C)	1	1000	1306.45
Block A (Zone D)	1	850	1110.49
Workshop (Zone D)	1	525	685.89

Water available (cu m)= Roof coefficient*catchment area (sq m)*average annual rainfall (meter)
Total water available per year=7016.96 cu m=7016960 litre
Water available per day=19224.55
No. of student=430
No. of staff members (including family members)=90
No. of student (Girls Hostel)=50
No. of student (Boys Hostel)=60
Water availability per capita per day=30.52 litre

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