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Surface Runoff Recharge Techniques in Drought Prone Area of Satara District (M.S.)

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Abstract:

Satara district in Maharashtra, India, faces acute water scarcity due to erratic and limited rainfall, leading to drought-like conditions for most of the year. Rainwater harvesting is crucial for augmenting water resources and recharging aquifers in this drought-prone area. This study examines the current rainwater harvesting practices in Satara district, focusing on techniques, methods, and challenges. The research identifies prevalent rainwater harvesting structures, their effectiveness, and factors influencing adoption. The study highlights the need for site-specific approaches to rainwater harvesting, considering terrain, climate, and hydrogeological conditions. The findings can inform policymakers and stakeholders in promoting sustainable surface runoff recharge techniques practices for climate resilience and water security in drought-prone areas like Satara district.

Keywords: Rainwater Harvesting, Runoff Recharge, Water Scarcity, Climate Resilience

Introduction:

Water is the most important natural resource. It is received in short time period in the form of rain which is causes crises for major period of the year in most of the drought areas. Therefore it is essential to harvest rainwater and recharge aquifers for wellbeing of the living being. In the region techniques and methods used vary from place to place depending upon their specific problems, nature of terrain, climate, hydrogeological conditions, etc.

Objectives:

1. To assess the current rainwater harvesting practices in Satara district, focusing on techniques, methods, and structures used.
2. To evaluate the effectiveness of prevalent rainwater harvesting structures in augmenting water resources and recharging aquifers.
3. To identify factors influencing adoption of rainwater harvesting practices in the study area.
4. To examine site-specific approaches to rainwater harvesting considering terrain, climate, and hydrogeological conditions in Satara district.
5. To suggest recommendations for promoting sustainable rainwater harvesting practices for climate resilience and water security in drought-prone areas like Satara district.

These objectives align with the abstract, focusing on understanding current practices, effectiveness, influencing factors, site-specific approaches, and suggesting recommendations for sustainable rainwater harvesting in Satara district.

Data Sources:

1. Primary data: Household surveys and interviews with farmers, villagers, and stakeholders in Satara district to gather

information on current rainwater harvesting practices.

2. Secondary data: Reports from government departments (e.g., Maharashtra Water Resources Department, Satara District Administration), NGOs, and research institutions working on water resources in Satara district.
3. Field observations: On-site observations of rainwater harvesting structures and practices in the study area.
4. Climatological data: Rainfall and climate data from the Indian Meteorological Department (IMD) or Maharashtra State Meteorological Department.

Methodology:

1. Survey and sampling: Conduct household surveys and interviews in selected villages of Satara district to gather data on rainwater harvesting practices, using a structured questionnaire.
2. Identification of rainwater harvesting structures: Identify and document prevalent rainwater harvesting structures (e.g., check dams, ponds, rooftop harvesting systems) in the study area.
3. Effectiveness assessment: Assess the effectiveness of rainwater harvesting structures based on water storage, recharge, and usage data.

The Study Area:

This micro-watershed undertaken for the present study falls in the drought-prone area of Man, Khatav and Phaltan tahsil in Satara district. This area falls in the rain shadow zone of Western Ghats receiving an average rainfall of 500-mm. In this region it is a normal phenomenon that the monsoons fail once in 5-10 years However, the increased water availability through micro-level water harvesting measures the provision of one or two supplemental irrigation to the existing crop at critical stages can made possible with which the yields can be improved dramatically. This is possible by adopting surface runoff recharge techniques on a micro-watershed.

Surface Runoff Recharge Techniques:

i) Continuous Contour Trenching (CCT):

The CCT work starts from top to bottom of hill. The area covered not only retention of soil in its own place but also harvest every drop of water and infiltrate into the sub-soil instead of flowing as surface water with evaporation losses making soil erosion. It recharges downstream water sources e.g. nalla, dug wells, tube wells etc.

This particular technique has proved most effective in drought prone region of Satara district. The hilly area (> 5 % slope) of Khatav, Man, Phaltan and Khandala taluka more than 200 hectare area of per taluka constructed CCT structures with the help of government forest department and peoples participation. In the drought year 2012-13 many villages constructed CCT under the Integrated Watershed Development Programme (IWDP).

Figure 1 shows the year 2019 benefited above 10454 hectares of land and about captured 3136 thousand cubic metre rainwater. CCT structure has runoff collection average capacity is 0.30 TCM average per hectare land in drought prone region of Maharashtra (IWDP Manual). Highest area of these structures constructed in drought prone areas of Khatav and Man talukas in Satara district (Fig.1). These talukas favourable sites of constructed CCT are Mahadev hills, Tathavada hill, Mograla Ghat and Shitabai dongar. Best example of the benefited village is Nidhal in Khatav, Bidal in Man taluka and Tathavada and Girvi in Phaltan taluka. This has helped mostly in control the soil erosion and recharging the groundwater. After the

construction of CCT these villages area increased of social forestry and grass for animal husbandry.

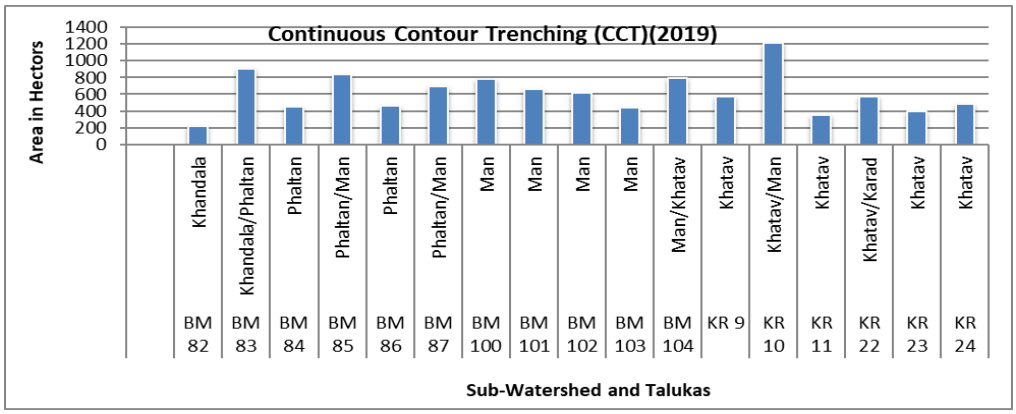

Fig. 1

ii) Earthen Stone Bunds:

A single line of stones, or a stone bund, depending upon the availability of stones, is laid along a contour. The contour stone bunds do not concentrate runoff but keep it spread. They also reduce the rate of runoff allowing infiltration. It is also called loose boulder structures of rainwater harvesting in hilly areas. These structures purpose is reduce soil erosion and conserve soil moisture.

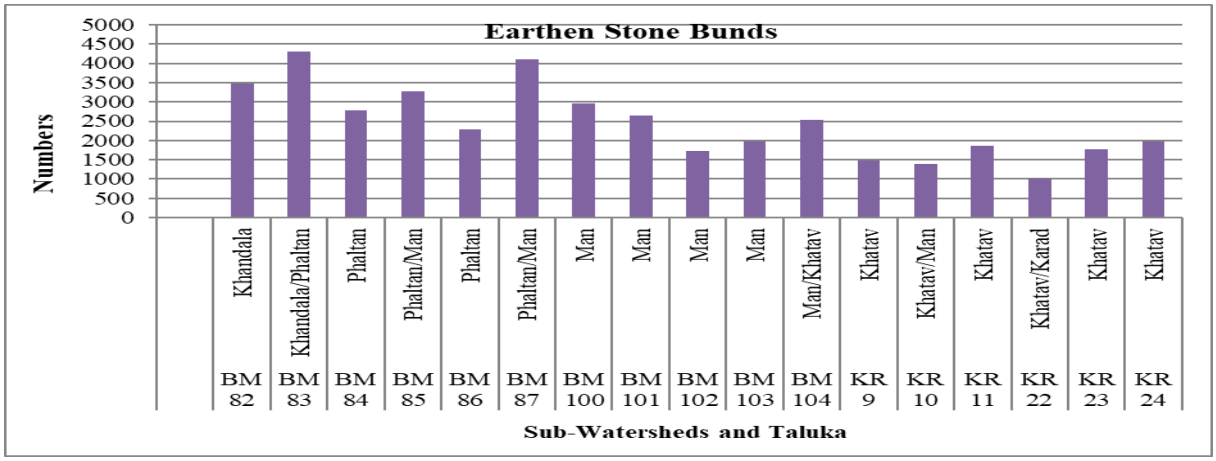

Fig. 2

In the drought prone area of Satara district loose boulder structures were constructed from ridge to vally in series along the eastern site of sub Sahyadri Mountain, sites of Tathavada ghat (Phaltan), Shambhu Mahadev, Shitabai and Mograle hills in Man tehsils. Vardhangad and Mahimangad hills in Khtav tehsils. In the reserve forest area of Khandala, Phaltan, Man and Khatav tahsils many loose boulder structures was constructed with the help of government forest department.

In the study region total 41560 earthen stone bunds structures were founded in the year 2019. Highest number of (4300) stone bunds found in BM83 sub-watershed area in the year 2019 (Fig.2) In BM87 watershed 4107 stone bunds has been constructed. These structures are important for conserve soil moisture and ground water recharge. The data available from government forest department and agriculture department.

iii) Cement Check Dams:

In the management of water, self-help is the best help. A simple and cheap method of harvesting rainwater through check dams are drastically transforming lives in various villages of drought prone area. Villagers worked as labourers. The water harvesting through construction of small check dams using stones and cement began in the drought year of 2003 and

2013 and gave sense of ownership over water-bodies Employment Guarantee Scheme (EGS) has helped to build nearly 645 locally owned water-harvesting projects in Satara district. 'Soil and Water conservation department (Jalswaraj Prakalp) of Maharashtra government and NGO' has helped and guided to build over 2945 check dams on streams of drought prone area of Satara district it's found in 2019 (Fig. 3).

In the year 2003, only 158 check dams were constructed and its water storage capacity is 464 TCM. These dams facilitating irrigation water to about 370 hectares of cropland. Subsequently the number of check dams goes on increasing up to 2945 in the year 2019, Its water storage capacity is 23560 TCM, irrigating over 3870 hectares agricultural land (Fig. 3). These check dams have provided the water for livestock and recharging the ground water as well. Most of the check dams are constructed through Employment Guarantee Scheme of State Government and people's participation. Per Check dam water average capacity is 8 TCM. The chain of check dams has been constructed in drought prone area with the help of government of Maharashtra in 2012-13.

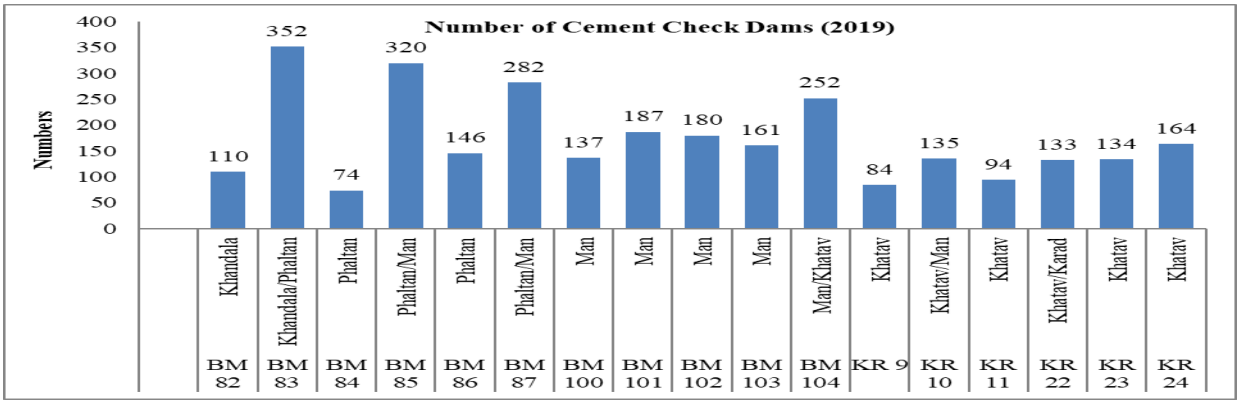

Fig. 3

iv) Gabion Structures or Small Bandharas:

A Gabion is semi permeable barrier, made of boulders in a mesh of steel wires and anchored to the stream bank, to slow but not stop the flow of storm water in a small watercourse so to favour water infiltration to groundwater and help prevent soil erosion. The height of such structures is around 0.5 m and 1 metre wide, and is normally used in the streams with of less than 10 metre.

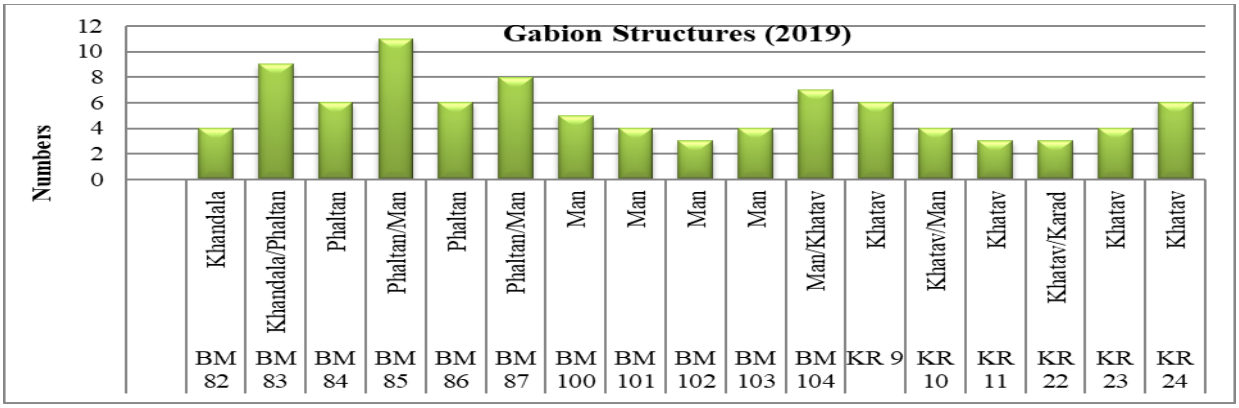

Fig. 4

Fig 4 shows in the study region total 93 gabion structures found in the year 2019. BM85 watershed in Phaltan and Man taluka 11 gabion structures have been constructed with the help of Integrated Watershed Development Programme (IWDP). In Khandala and Phaltan taluka BM83

watershed constructed 9 gabion structures (Fig.4). Rainwater harvesting average capacity of one gabion structure is 0.5 TCM every year. Highest number of Gabion structures has been constructed in hilly area of Khandala, Phaltan, Man and Khatav talukas.

v) Percolation tanks:

Percolation tanks refer to an artificial tank mainly developed to store the rainwater and to enrich water table in downstream areas. These are built mainly to impound monsoon runoff over a large area to augment ground water recharge. Moderate to high porosity of soil and/ or underlying rocky strata is the main criteria for the choice of percolation tanks. Ponding is achieved in much the same way as is done in case of check dams except that the height of the bund is low but the length is large.

The design aims at filling the pond as many times as possible during the rainy season in such a way that most of the water impounded during one spell of rain percolates into the ground before the next spell starts. In actual field conditions, however, this ideal ope ration is rarely achieved. These are also built by the government agencies since these require special skills in hydrogeology.

The device of tapping rainwater has been emerged during the last three decades in famine-affected areas. Although the concept of water percolating tank is the recent advancement in the field of irrigation, it has many fold effects on agriculture landscape. As such, the percolation tanks have become new phenomena in the drought prone area of Maharashtra. It has enabled to increase the water level in the wells, yield & duration of water in the wells (Pawar 1989). The Fact Finding Committee also states (Govt. of Maharashtra, 1973) that ground water potential of the area supported by the percolation tank has increased almost three fold.

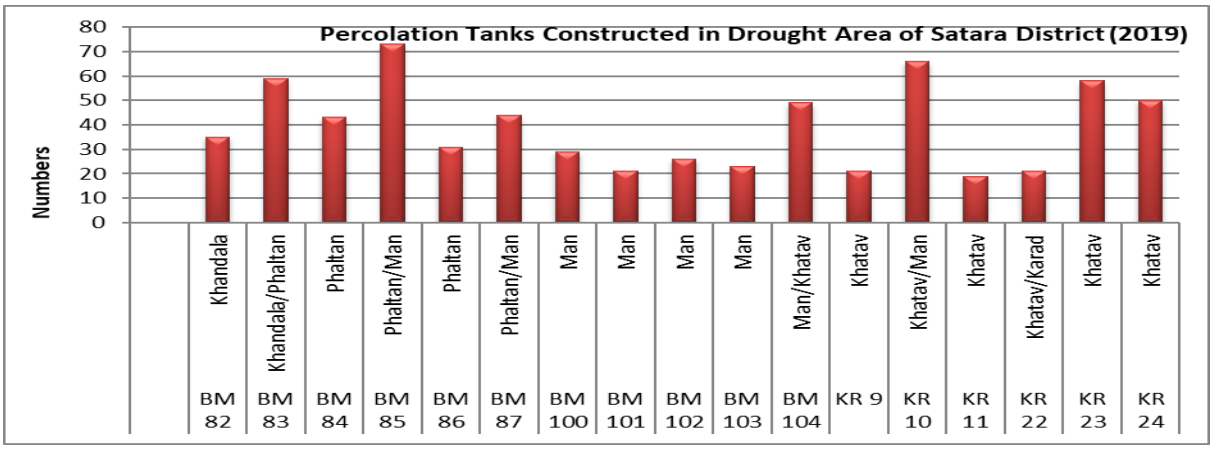

Fig. 5

In the study region, 668 percolation tanks have constructed during 1991 to 2019 (Fig.5). The oldest one is Pingali percolation tank near Dahiwadi, which has constructed in the year 1978, having 300 hectares are of catchment and 75.32 TCM storage capacities. This tank has facilitated over 456 hectares of cultivated land. Similarly, during 2001 another 15 percolation tanks have constructed and five more in next decade.

The total benefited area by all percolation tanks comes to about 668 hectares. This is a big achievement in the drought prone region. The water storage capacity of all these percolation tanks ranges between 19835 cubic metres to 1650 cu. meters except Pingali percolation tank. In the study region percolation tank local name is ***'PazarTalav'.***

In the study region dug wells is the major source of irrigation (60.58 % of total irrigated

area in 2010). The dug wells and bore wells can be well attributed to the increased recharge of ground water level due to the construction of percolation tanks.

vi) Sub-Surface Dam or underground dam:

These are basically ground water conservation structures and are effective to provide sustainability to ground water structures by arresting sub surface flow. A ground water dam is a sub-surface barrier across stream which retards the natural ground water flow of the system and stores water below ground surface to meet the demands during the period of need.

The main purpose of ground water dam is to arrest the flow of ground water out of the sub-basin and increase the storage within the aquifer. By downing so the water levels in upstream part of ground water dam rises saturating the otherwise dry part of aquifer. The underground dam has many advantages it is the water is stored within the aquifer, submergence of land can be avoided and land above reservoir can be utilised even after the construction of the dam. No evaporation loss from the reservoir takes place. No siltation in the reservoir takes place.

In the study region total 17 sub-surface dams constructed with the designed and granted by construction department of Maharashtra state. In Khatav taluka 6 sub-surface dams have been constructed in Nidhal and Pushegaon villages with the help of Integrated Watershed Development Programme (IWDP). In Vinchurni and Dhaval villages of Phaltan taluka constructed 5 sub-surface dam. In Man taluka 6 sub-surface dams constructed in Shindhi and Takewadi village

Conclusion:

Surface rainwater harvesting is widely practiced in drought-prone areas of Satara district using structures like percolation and cascade tanks, contour bunds, and farm pond networks, which are most effective on basalt hard rock bases. These micro watershed interventions have shifted agriculture towards high value cash crops and improved social-economic status, while rooftop harvesting in rural settlements like Ranand village can meet approximately 90% of dry day water demand. Micro level water harvesting act as crucial tool for rural development in semi-arid regions by providing supplemental irrigation and successful site specific models should be replicated.

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