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Water Harvesting Structures: To Sustain Rainfed Farming through Watershed Management

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Abstract
Worldwide, crop yields from rainfed systems are around 50% lower than those from irrigated ones. The primary cause of hunger, poverty, unemployment, and illegal migration is the low productivity of rainfed agricultural systems. Farmers are only able to produce their crops during one growing season every year due to rainfall reliance, and they are highly susceptible to recurrent droughts and flooding. The only option is to make efforts to sustainably diversify and intensify high-risk rainfed production systems by capturing runoff rainfall in reservoirs and converting those systems into extremely profitable irrigated systems. The concepts, findings, and experiences from water harvesting pilot farms are compiled in this article. These farms' irrigation systems, when paired with clever crop management techniques, allowed small- and medium-sized farmers to increase cereal and high-value crop yields by two to four times when compared to past yields from rainfed conditions.

Keyword: Catchments Area, Water Resources Management, Water Harvesting Techniques

Overview
The act of collecting and storing precipitation or runoff from various sources for future use is referred to as "water harvesting." This is an essential technique that enhances the availability of water, supports numerous aspects of human life, and solves the water scarcity.
The following are the primary concepts on the importance of collecting water:

- Water Safety: Water harvesting can provide an additional water source, especially in areas where access to fresh water is erratic or limited. Drought and water scarcity can be mitigated by collecting and storing rainfall during heavy downpours for use during dry times.
- Benefits to Agriculture: Water harvesting helps in agricultural efforts by supplying crops with irrigation water during dry spells. When farmers use stored rainwater to supplement their irrigation needs, they can enhance crop productivity and reduce their need on erratic and sporadic rainfall.
- Improved Water Access: Water harvesting makes additional water available in areas where groundwater supplies are overused or unavailable. Water harvesting ensures a more steady supply of water and supports sustainable water management by recharging groundwater reserves and gathering rainwater.
- Preservation of Ecosystems: Water harvesting can help restore or maintain the ecological balance in regions with limited water supplies by replenishing natural water bodies like lakes, ponds, and wetlands. This helps to preserve biodiversity, supports wildlife habitats, and upholds the sustainability of ecosystems.

- Recharging Groundwater: Water harvesting facilitates the replenishment of groundwater aquifers, which are essential freshwater sources. By directing precipitation into the ground through techniques like percolation tanks, recharge wells, or infiltration basins, water harvesting restores subsurface water supplies.
- Flood Protection: Water harvesting prevents excessive water runoff and the damages that come from floods by collecting rainfall in storage structures like reservoirs or ponds. This reduces the likelihood of flooding.
- Home Water Source: Water harvesting provides a backup supply of water for domestic use in remote or rural places where piped water supply is limited. Rainwater collected and saved for use in cooking, cleaning, drinking, and other household chores can be cleansed.
- Cost savings: Water collection and use can save a lot of money for individuals, groups, and institutions. Rainwater harvesting can reduce the need for expensive water sources and large-scale water infrastructure, resulting in financial benefits.
- Resistance to Climate Change: Water collection increases resistance to climate change by improving adaptive capabilities. As rainfall patterns become more variable due to climate change, water harvesting presents a practical and sustainable solution for improving water supply management.

The phrase "water harvesting" describes a collection of techniques for collecting and storing rainfall or runoff for future use. Both small-scale home settings and large-scale community efforts can make use of these techniques.

Here are a few well-liked techniques for collecting water

- Rainwater Harvesting on Rooftops: This technique collects rainfall and directs it into underground reservoirs or storage tanks. Rainwater is collected by gutters and downspouts and then directed into storage containers for later use.
- Harvesting Surface Runoff: Water from surface runoff is created when rain falls on the ground. This water can be gathered and stored in a variety of ways. Micro-catchments, contour trenches, and small check dams are examples of small-scale techniques that can be constructed to collect and store runoff water in certain areas. Building reservoirs, farm ponds or percolation tanks to store runoff for irrigation or groundwater replenishment are examples of large-scale techniques.
- Infiltration Pits and Trenches: These are earthen depressions created by excavation that are used to collect rainfall and aid in its absorption into the soil. These structures recharge groundwater and increase the moisture content of the soil.
- Percolation Tanks: Built to collect and store rainfall, percolation tanks are expansive structures. To create them, a trench is lined and then excavated to let rainfall to seep in and replenish the aquifers beneath it.
- Rechargeable Wells: Recharge wells are constructed to quickly replenish underground aquifers with precipitation or runoff. They facilitate the direct replenishment of groundwater reservoirs.
- Farm Ponds: On farms, small reservoirs called "farm ponds" are constructed to collect and store rainfall for use by irrigation or cattle. They provide a readily available source of water during dry spells.

Crop management in regions receiving rain

Crops in rainfed locations require special management because they are dependent on natural rainfall and may experience water constraint. In rainfed areas, the following are some crucial considerations for effective crop management:

- Choose Your Crop: Make sure the crops you choose are suitable with the local agro-climatic conditions, soil type, and rainfall patterns. Choose crop varieties that can withstand dry spells and exhibit resiliency in the face of unpredictable rains.

- Crop diversity: Growing a range of crops with varying water needs will result in crop diversity. Diversification improves yield stability under a variety of climatic conditions and reduces the likelihood of a complete crop failure during dry times.
- Conservation Tillage: Apply conservation tillage methods to lessen soil disturbance, preserve soil moisture, and improve water infiltration. Remaining crop material should be applied to the soil's surface where it will act as mulch, reducing evaporation and maintaining soil moisture levels.
- Water Resources Management: Use efficient water management techniques, such gathering rainwater and irrigating with drip irrigation or microsprinklers, to conserve water. When planning an irrigation schedule, take crop water requirements, weather conditions, and soil moisture monitoring into account.
- Handling of Organic Matter: Adding organic matter to the soil can be done through composting, green manuring, or the application of organic amendments. Organic matter improves the soil's structure, increases its capacity to hold onto water, and facilitates the uptake of nutrients by crops.
- Management of Nutrients: Apply balanced fertilisation based on soil tests to meet crop nutrient requirements. To enhance nutrient uptake, adopt efficient nutrient management strategies including split fertiliser delivery and slow-release fertiliser use.
- Managing Crop Waste: Leave crop residues on the soil's surface to increase soil health, reduce soil erosion, and maintain soil moisture. By acting as a barrier, crop residues improve soil water absorption and lower evaporation loss.

Crop planning dependent on a typical meteorological circumstances

Contingent crop planning is the process of developing strategies to mitigate the effects of unusual weather events, such as severe rain, a drought, or abrupt temperature changes. It aims to lessen the risks caused by irregular weather events and ensure crop productivity.

Utilising a variety of resources

Farmers that depend only on agriculture face a significant risk of failure and unpredictability because of market shocks, pest and disease outbreaks, and other catastrophic events. As a result, at different sizes, the integration of agricultural (on-farm) and non-agricultural (off-farm) activities is necessary to produce a steady stream of income and sustain farmers' livelihoods. For instance, embracing agricultural production alone can not create the same level of resilience and sustainability as combining agriculture, animal production, and dairy farming. One system's byproducts or products could be used to another system, and vice versa. In this instance, crop straw produced as biomass after harvesting could be fed to cattle, animal dung or excrement could be used to fuel biogas plants, which would then produce energy. The nutrient-rich slurry produced by the biogas plants could be spread over agricultural plots to preserve soil fertility. Aquaculture, animal husbandry, and horticultural plantations at the individual, household, or community levels are all included in the integrated system. In addition to the standard soil and water conservation methods, productivity development and revenue-generating activities are used in all community watersheds to address equality issues.

The Watershed as a Point of Entry

Investigating the various livelihood solutions should start with the watershed as a point of entry. The new community watershed management strategy offers an envelope that fits into the framework as a tool to help promote sustainable rural lives. The overarching goal of the approach is to eliminate poverty through sustainable development. The challenge is to increase the complexity of agricultural production systems in a sustainable manner without

endangering biodiversity or natural resources, and to raise farmer welfare by enhancing value and creating market connections.

The Integrated Watershed Development has Several Advantages

In the semi-arid tropics (SAT), the implementation of IWM has a surprising multiplication of effects on resource-poor agricultural households. The change in farmers' economies was indicative of a reduction in rural poverty in the watershed communities. Increased crop intensification and diversification with high-value crops led to improved livelihoods through increased production with the introduction of affordable water harvesting structures. Through the creation of revenue, it also helps women, the landless, and members who are more vulnerable.

Summary

It is advised to manage a small watershed or catchment using a participatory approach in order to boost agricultural output and decrease rural poverty through the sustainable use of natural resources. Integrated watershed management is a method that goes beyond seeing a watershed as merely a hydrological unit and incorporates sustainable management of natural resources through the collaborative action of resource users. The country's watershed development should be prioritised by scientific criteria, and the interdependence of humans and animals for survival through sustainable use of scientific land use planning on interconnected natural resources needs to be codified up to the national level. Some or all of the following characteristics are present in improved models of watershed development: transparency, science-based productivity enhancement, monitoring and evaluation measures, better farming practices, involvement of women and landless people through income-generating activities, community participation, collective action, consortium of soil and rainwater conservation structures, building capacity of formal and informal rural institutions, productive partnerships and alliances in

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