

## Integrated Watershed Management for Sustainable Agriculture in Rajasthan

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### Abstract

The three most important problems facing Rajasthan are desertification, low natural resource availability, and water scarcity. The state has the highest chance of experiencing a drought nationwide. Animal husbandry and agriculture are the main sources of income. However, the jobs are risky and pay little because of the little rainfall and little availability of subsurface water. In the region, low income has contributed to a number of other problems, such as resource exploitation, women's drudgery, hunger, and forced migration. Many farmers in Rajasthan continue to cultivate using traditional methods, which has an adverse effect on productivity because of the scarcity of irrigation water and the harsh weather. The bulk of people are poor, marginalized farmers who rely mostly on cattle and agriculture for their livelihoods. Rainwater from monsoon rains is lost through runoff because traditional rainwater gathering structures like johads, paals, and bandhs are neglected. Furthermore, there are no everlasting rivers that can support human requirements. The population is often unclear as a result of COVID-19. A scenario of drought and scarcity of water would worsen people's suffering. Particularly during the long summers, communities require sufficient access to water for residential use and means of subsistence. Plans for managing watersheds will take into account customary community water saving measures.

### Introduction

The Rajasthani community will also be involved in the third process, which involves choosing water bodies that are ideal for development to maximize the benefits for the intended recipients.

Low-income community members who are enrolled in the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) will be employed in project activities like reforestation, shrub pruning, and embankment strengthening in compliance with government protocol. As a result, assisting day workers will strengthen the community's financial stability.

Methods of planned implementation and associated benefits are:

1. Using a combination of machinery and labor from the community to complete the project quickly.
2. To obtain the most water possible during the monsoon rains, the watershed's path is examined. Rainfall-collected water will aid in the storage of surface water and encourage water to percolate, raising ground water levels.

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The project incorporates the crucial element of conserving soil and enhancing vegetation to lessen the effects of climate change. Communities will be inspired to take action and comprehend the value of increasing green space and planting trees. Enhancing the green cover has been achieved through the effective approach of stimulating slow-growing tree stumps for rapid development.

Communities become more capable of managing the watershed in the future as they organize through the water user committees. The Krishi Vigyan Kendra (KVK) of the Department of Agriculture, farmer groups, Panchayat villages, district and state governments, and community organizations will all collaborate closely on this project.

Since they bear the brunt of fetching water for the household, women are significant stakeholders who suffer during droughts. Long-term ownership of the project and its sustainability will be facilitated by addressing women's challenges, including them in water user organizations and encouraging leadership and decision-making positions among them.

High risks of drought, deteriorated natural resources, widespread poverty, food insecurity, and malnutrition characterize agriculture in low-rainfall districts of eastern Rajasthan, India. The primary impediment to rainfed agriculture's advancement in this region is water. Rehabilitating fragile and degraded lands and promoting agricultural growth are acknowledged goals of integrated watershed management in these locations. An integrated watershed project employing the holistic systems approach was carried out at Gokulpura-Goverdhanpura village in Bundi, eastern Rajasthan, India. We go through the ways in which this watershed program affects ecological, environmental, socioeconomic, and biophysical factors. The results show a significant increase in groundwater availability as a result of watershed interventions, which has changed cropping patterns with high-value crops. notable increases in cropping intensity and irrigated area were seen, as well as a shift in crop mix from traditional to commercial income crops. Additionally, the socioeconomic standing of the watershed community was greatly enhanced by the watershed initiative. The watershed's population is now less impoverished and has higher incomes. In addition to creating many job opportunities, the watershed interventions greatly decreased the flow of labor from the watershed village to the cities, both skilled and unskilled. Additionally, the watershed's ecological state and environmental quality have both improved. Reducing rainfall, soil loss, and degradation of land, as well as improving the biodiversity in fragile ecosystems, are the outcomes of watershed interventions. Ultimately, in addition to soil and water conservation and other beneficial environmental benefits, the integrated watershed program at Gokulpura-Goverdhanpura created resilience by guaranteeing ongoing and sustained multiple outputs.

The Gokulpura-Goverdhanpura watershed's comprehensive watershed management program has had a major positive influence on the environment, ecology, rural livelihoods, and water resources. Enhanced surface and groundwater availability, even during the crucial post-rainy and summer seasons, was the main effect of the watershed initiative. enhanced cropping intensity and diversity to more profitable systems of land use involving livestock, horticultural, and vegetable production were the results of enhanced surface and groundwater availability. The majority of crops had improved productivity thanks to the watershed initiative, which raised profit margins. Additionally, it greatly

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reduced the negative effects of the drought and increased the community's security of food, water, and fodder. The number of animals and their productivity both significantly rose as a result of watershed initiatives, especially for marginal and small farms. The population's socioeconomic standing considerably improved as a result of the watershed program's effects. People living in the watershed now earn more money and are less impoverished thanks to the watershed program. The watershed activities provided comparatively more benefits to small and marginal farmers. All farmer categories saw an increase in working days, and by giving villagers improved job possibilities, it was successful in lowering both the seasonal and permanent migration of farmers to urban areas. In conclusion, the watershed program reduced soil erosion, limited land degradation, increased vegetative cover, improved ecological status, and, most importantly, brought wealth to the residents of the watershed villages. It also improved groundwater and surface waters.

### Discussion

Globally, there has been incredible advancements in science, technology, and economic growth; yet, environmental damage has been caused by development, and this harm is now negatively impacting development itself. Additionally, an evaluation of watershed management is being attempted in order to investigate how it affects the land cultivation and use pattern in the Thanagazi tehsil. Furthermore, since a change in the pattern of crops is the best indicator of the socioeconomic and cultural development of an area, the study aims to rationally and objectively investigate the changing dynamics of land use and land use for agriculture pattern, as well as its findings and questions to make helpful suggestions for better crop pattern. A watershed, which is delimited by natural ridges and permits proper drainage of rainfall-induced runoff, is the most scientifically defined agroclimatic and hydrological unit. streams that are produced inside the watershed boundary have a predetermined drainage pattern. The watershed approach fosters sustainable development with the goals of raising living standards, reducing poverty, and enhancing the general well-being of the rural populace that depends on the physical area of land. Watersheds, which capture surface runoff water, are now recognized as the main drivers of growth throughout the delicate Bairath region.

Rapid subterranean water depletion, expanding mining and industrial activity, and population growth are all negatively impacting Thanagazi Tehsil's ecology, as well as the surrounding rural and agricultural communities.

The delicate ecosystem of the Bairath region, which is a part of the Aravalli mountain ranges, is under tremendous stress due to the ever-increasing population pressure combined with the ineffective handling of water and land resources in Thanagazi tehsil. When it comes to the kind, extent, and size of agricultural land in relation to the micro-level effects of watershed development, land use data offer a wealth of opportunity for rapid and accurate information extraction.

In addition to developing agriculture, horticulture, pisciculture, and other industries, watershed development aids in the rehabilitation and revival of degraded land and forest water resources through a variety of innovative inputs (both Indigenous and technology). This helps people become self-sufficient and self-reliant in the areas of food, fuel, fodder, forage, fiber, and fertilizer.

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The watershed's soil is found in brown, shallow to medium-depth soils. Physiographically, the watershed slopes in a terrace-like manner, with a gentle to moderate incline seen in its upper and lower levels. The region is primarily made up of Aravalli hills geologically. In worn and fractured rocks, groundwater occurs in unconfined conditions; in undulating terrain, it occurs under semi-confined to confined conditions. The watershed region has 750 residents overall, 150 of whom live in households with a median family size of five.

Since the communities in this watershed—Sanwatsar, a portion of Thanagazi, and Rundh-Jhiri—have varying socioeconomic backgrounds, different strategies were used to organize the villagers and persuade them to support Sharamdan and other fundamental values like the prohibition on tree-cutting and open grazing. In the upper reaches of the watershed, for instance, the villages of Kabligarh and Rundh-Jhiri are primarily home to Gurjars, but the lower portion of the watershed, Sanwatsar, has a mixed community primarily made up of Meena, Gurjar, Brahmin, and SC. For instance, the tribal villages of Sanwatsar and Kabligarh, which are found in the upper reaches of the watershed, required a lot of persuasion to implement social fencing because the majority of the households had cattle and the villagers were heavily dependent on the forest for their livelihood. In this section of the watershed, a new approach was adopted to persuade the villagers and carry out the project because the farmers were unwilling to accept the guidelines' watershed concepts.

Farmers' inclination for vegetable crops and their altered cropping patterns are the main effects of the watershed. Currently, the community is one of the primary vegetable suppliers to Thanagazi and nearby Alwar. The guaranteed market in Alwar City, together with the nearby tehsils of Thanagazi and Narayanpur, have encouraged all of the farmers to cultivate vegetables and fodder. This indicates that the residents of the watershed village have reacted favorably to the demand in the market.

The Sanwatsar exhibits a notable shift in cropping patterns. While no change is seen in the fodder crop and spices are not cultivated, the maximum growth in wheat, barley, gram, mustard, and maize has been noted, rising from 25.66% to 21.50%. Remarkably, despite the construction of the watershed program, the veggies area has not showed any modification or cropping in the watershed region. The Sanwatsar watershed is not used for the cultivation of Jowar or spices.

The Rajpura watershed is situated in Rajasthan's Thanagazi Panchayat Samiti in the Alwar district, approximately 90 kilometers from the district office. As a watershed, a metallic road connects the area. The three villages that make up the watershed region are Rajpura, Basai Abhayram, and Gudha-Chotti Chind. There are 1623 people living in the hamlet, and 1216.34 hectares of treatable area are covered by the watershed. In the community, 66% of people are literate. The bulk of the residents in the watershed area are Gurjar and Meena. With their own cultures and customs, the many communities in the area have managed to preserve their individual identities. In all, 17 households across the watershed communities are landless.

Rainfed agriculture is the only source of food for the population, and during Kharif, crops including guar, moong, bajara, and moth are grown. Activities to establish agroforestry and pasture have not yet been completed, and horticulture has not been appropriately taken up in the watershed. The

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productivity of crops, the subsurface water table, and the availability of clean drinking water have all been slightly impacted by watershed activity. Additionally, the treatment has made it easier to resist the negative effects of irregular rainfall. Additionally, it has guaranteed the livelihood for the whole year. There are now restrictions on seasonal migration. The indirect effect is seen in the general rise in living standards, which includes better housing and greater household assets. The results appear to show overall somewhat favorable interactions in agricultural output, while the growth of pastures and forests is moving extremely slowly. On the other hand, the watershed area's subsurface water level is marginally rising. They have also added more land for farming. Ultimately, the actions done to address the fill date have raised the groundwater table, increased crop productivity, and created jobs with wages.

Overall productivity, agricultural patterns, socioeconomic conditions for a sustainable drinking water supply, and seasonal migration have all improved as a result of the watershed intervention. Nowadays, this region is well-known for its potato, tomato, and onion farming, which has assisted the agricultural people in achieving self-sufficiency in terms of a stable income.

Farmers' inclination for vegetable crops and their altered cropping patterns are the main effects of the watershed. Currently, the town is one of the primary vegetable suppliers to nearby Alwar. The guaranteed market in Alwar City, together with the nearby tehsils of Thanagazi and Narayanpur, have encouraged all of the farmers to cultivate vegetables and fodder. The Rajpura shows a notable shift in the cropping pattern. The highest increases in barley, bajra, mustard, gram, and fodder have dropped from 28.57% to 13.19%, while wheat has only slightly changed (7.75%). Remarkably, despite the construction of the watershed program, the veggies area has not showed any modification or cropping in the watershed region. The Rajpura watershed is not used for the cultivation of Jowar or spices. The majority of important crops, including heat, grain, mustard, bajara, and fodder, have shown good effects on the area; however, the percentage of the total cultivated area that is made up of urad and bajara has been trending downward, while the percentage of the area that is made up of wheat, gram, and other crops has been rising.

But it's been noted that the region has already been designated as a "dark zone," which means farmers aren't able to receive loans to build wells. Farmers have now turned to digging bore wells, and following watershed intervention, about 27 new bore wells are being drilled, severely over-taxing the ground water regime.

The watershed area's groundwater availability has been negatively impacted by overexploitation of groundwater and irregular rainfall in recent years. Of the 110 bore wells drilled to date, only 25 to 30 are said to be operational; the remaining wells are either dry or have minimal water. When a large area of fallow land was spotted during the field visit, the lack of groundwater and the extremely low rainfall over the previous few years were given as the cause. This demonstrates unequivocally that during protracted dry spells, watershed measures are currently unable to aid in drought proofing.[6]

The initiative has enhanced income, which has multiplied many times over mostly as a result of agricultural activity. This watershed's location next to the Alwar-Narayanpur district highway and its

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close proximity to the Thanagazi, Narayanpur, and Alwar markets have increased the area's farming communities' income. Additionally, the hamlet has advanced a little by starting other development projects, particularly to enhance the drinking water infrastructure. At Vijayapura, the new water supply project is almost finished. The hamlet currently receives help from the agricultural department as well, which has greatly aided in the adoption of horticultural activities and improved irrigation techniques. Currently, about 30% of tomato farmers use drip irrigation. Even though the Rajpura watershed has made significant progress, problems like excessive groundwater extraction, summertime land migration, malfunctioning institutions, and underutilization of maintenance funds continue to pose serious threats to the long-term viability of watershed interventions and must be addressed immediately.

### **Review of Literature**

Rajasthan is confronted with extreme difficulties because of desertification, a lack of natural resources, and acute water scarcity, which are made worse by erratic and light rains. Low productivity and unstable economies are the results of these problems being exacerbated by conventional farming methods and inadequate infrastructure for collecting rainfall. Improved groundwater levels, increased crop yields, agricultural diversification, and improved rural lives are just a few of the benefits of integrated watershed management. Additionally, by reducing labor migration, improving ecological conditions, and mitigating the consequences of the drought, these measures support sustainable agricultural practices and the socioeconomic growth of the area.

### **Outcomes**

Rajasthan is known for its unpredictable, low-intensity rainfall and its unequal distribution of short bursts of intense rainfall. Furthermore, tiny and marginal farmers find it extremely difficult to make a living off of natural resources due to the steep slopes and sandy soils. Rainfall dissipates mostly as drainage, which also removes the top soil layer from the crops. Due to overdraft, the water tables are already quite low and are getting lower overall. The region's agricultural industry faces significant challenges due to the combination of these variables. As a result, the main objectives of this project are watershed development and protection of soil and water.

Animal husbandry, watershed management, and soil conservation, etc. The following are the precise goals:

- Delivering instruction and training in several agricultural and related disciplines. especially the fields of horticulture, forestry, fisheries, engineering, community sciences, and applied sciences, etc.
- The improvement of knowledge and research, looking for answers to new issues in the fields of allied sciences such as dairy and food science, animal science, communities and applied sciences, agricultural engineering, and agriculture.

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- Transfer of technology through various extension programs, particularly for the rural population of the state of Rajasthan, to farmers, the farming community, and government and non-government agricultural groups.
- Delivering a range of technical services and consulting to agriculture-related sectors in order to maximize resource use and ensure appropriate use of technology developed in labs and on the farm. establishing connections for research, education, and extension on a national and worldwide scale.

The three agroclimatic zones of the state serve as the basis for the priorities and requirements of extending the scope and research programs, which serve regional purposes.

The university has worked tirelessly to accomplish the aforementioned goals, and all plans for development were systematically and successfully carried out, leading to quick and organized advancement in every area of teaching, research, and extension. Among the nation's agricultural universities, the university enjoys a good reputation.[10] The Indian Council of Agricultural Research and the Government of Rajasthan have provided unwavering and sincere assistance in making this happen. The university is currently actively working to improve the socioeconomic conditions of the farming community, especially the tribal communities in the south and southeast of Rajasthan. It does this by encouraging sustainable productivity through crop diversification, high-quality seed production, and ecological security in the use of natural resources. To achieve a sustainable farming system, focused efforts are being made in the areas of processing and value addition, cropping system diversification, integrated pest management, bio-fertilizer and vermi-composting, integrated nutrient management, prudent use of scarce irrigation water, collecting rainwater management, farm mechanization, women's empowerment and ergonomics, entrepreneurship promotion, livestock improvement, and production. The university also provides the Commission for Agricultural Costs and Prices with the database needed to determine the costs of production of the main crops that the government of India uses for its minimum support price policy.

The Rajasthan College of Agriculture (RCA), College of Community and Applied Sciences (CCASC), College of Technology and Engineering (CTAE), College of Dairy and Food Science Technology (CDFST) at the former Rajasthan Agricultural University campus in Udaipur, Bikaner, Agricultural Research Stations, Sub- Stations, Livestock Research Stations, and Krishi Vigyan Kendras in ten districts within the university's designated service area were all transferred, along with their personnel and assets, to this newly established university as its constituent units. Later, the College of Fisheries at Udaipur in 2010 and the College of Horticulture and Forestry at Jhalawar (CHF) in 2004 were founded. The university has set up a distinct cell called the "Socio-Economic and Agricultural Policy Planning Research Cell" to handle research-related concerns pertaining to socio-economic and policy planning in agriculture and associated fields.

The institution boasts an extensive infrastructure for research at its headquarters and other research units, along with a fully functional Directorate of Research. Many research initiatives with specified goals are underway in which postgraduate students are involved by bringing their research concerns

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under the main project. As part of the initiative, postgraduate students frequently receive financial assistance in the form of research fellowships.

Another significant division of the institution that is in charge of creating procedures for extension education and distributing technology to stakeholders is the Directorate of Extension Education. Some of the directorate's main initiatives include farm advisory services, field day planning, different training programs, etc. through a network of Krishi Vigyan Kendras.

The institution established the Directorate of Student's Welfare with the goal of planning and coordinating co-curricular activities for learners at the university and college levels in light of the aforementioned broad academic programs. The Directorate's main goals are to organize various NCC, NSS, athletics, literary, social, moral education, placement, and counseling activities in order to support students' overall growth in personality and instill fundamental values in them so they can grow up to be good citizens of the country. In order to enable the Students' Union to operate democratically and close the communication gap between the student body and university management, the Directorate is also overseeing the Union's operations.

Concluding remarks: The Ministry of Jal Shakti is launching a nationwide campaign called "Jal Shakti Abhiyan: Catch the Rain" (JSA: CTR) with the theme "Catch the rain, in which it falls, when it falls" from 29 March to 30 November 2022 during the pre-monsoon and monsoon periods of 2022, encompassing both urban and rural areas of all the regions in the country. The campaign is focused on saving and conserving rainwater.

National Water Mission, Ministry of Jal Shakti initiated the "Catch the Rain" campaign in 2020 and 2021 with the slogan "Catch the rain, where it falls, when it falls" to encourage states and all stakeholders to design Rain Water Harvesting Structures (RWHS) that are appropriate for the local climate and subsurface strata, with citizen involvement. In anticipation of the "Jal Shakti Abhiyan: Catch the Rain" campaign in 2021, a nationwide awareness campaign engaging Youth Clubs in 623 districts was initiated on December 21, 2020, in partnership with the "Nehru Yuva Kendra Sangathan" (NYKS).

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