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Proceeding Paper

Watershed Development Plans as an Approach to Re-Invent Lost Crops in Sarguja Division of Chhattisgarh, India †

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Abstract: Since the last three decades, the Government of India (GOI) has used watershed management as a solution to solve the issue of sustainable agricultural output in the rainfed areas. Additionally, since 2003, the GOI has made watershed management a national policy. A lot of thought is given to all the significant crops that have disappeared from cropping systems in today's Indian development plans' watershed development programmes (WDPs), which are primarily focused on increasing and sustaining productivity levels. In Sarguja division of Chhattisgarh, The present study attempted to document the on-site and off-site effects of the watershed development programs, as it observed an increase in ground water level, rise in surface water and stream flow, reduction in runoff as well as soil erosion, change in land use and cropping patterns, increased agricultural and dairy production, improved livelihood and employment generation, and change in land use and cropping patterns. The findings showed that the percentage of cropland increased in both Kharif and Rabi, but in Zaid, they started planting crops, particularly cucumber, melon, and vegetables that had been kept fallow. The patterns of land usage in the WDP regions have improved. Due to farmers utilizing more wasteland for productive reasons, there has been a rise in net sown area in these locations. Additionally, it has been claimed that many crops that were abandoned due to water shortages and other requirements are now being cultivated. Responses from the region have been in favor of the introduction of innovative techniques like Agroforestry systems.

Keywords: watershed; agroforestry; conservation; runoff; wasteland

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1. Introduction

Since the last few decade, the Government of India has taken a lot of initiative for the development of Watershed. To address the sustainable agricultural productivity in the rainfed areas furthermore the Government of India has also adopted the Watershed development policy since 2003 and has been always improving Ever since. However, the major problem of the country is the environmental degradation and the lack of water for the agriculture and the domestic purposes. This leads to decline in the per capita production of the agriculture produce. Many previous research studies have highlighted that the management of water resources and rainwater harvest management and utilization have helped in increasing the productivity of agricultural produces. However, systematic assessment of on-site and off- site impact studies of watershed development has been lacking.

Watershed Development Programmes (WDPs) have accorded high priority in India's development plans have started in India to improve and sustain productivity and the production potential of the dry and semi-arid regions of the country through the adoption of appropriate production and conservation techniques [1]. Main objective of watershed management program is to focus more on water with improving the agricultural productivity through moisture conservation techniques, which intern help in socio-economic development of rural people [2]. The general focus of the Watershed improvement plan is on enhancing and fostering a variety of land. These programs sought to assist in boosting and raising the level of productivity in the command land regions through the adoption of appropriate production and conservation measures. The current thorough study on watersheds was conducted with the goals of analyzing the consequences of watershed development initiatives and documenting their off-site and on-site effects. It was started in order to learn more about how watershed management initiatives were carried out and to find ways to accelerate their development and impact.

2. Methodology

The study site Sarguja lies to the northern part of Chhattisgarh State of India. About 58% of the area in the district lies under forests. Borders of Uttar Pradesh, Jharkhand, Orissa, and Madhya Pradesh States are adjoining to the district. The population of Sarguja district is 2,359,886 (Table 1). It lies between 23°37′25″ to 24°6′17″ north latitude and 81°31′40″ to 84°4′40″ east longitude. 244.62 km long east to west and 167.37 broad norths to south, this land has as area of about 16359 km^2. Major population comprises tribal population. Among these primitive tribes are Pando and Korwa. The study site of the sarguja division consists of Ambikapur, Sitapur and Batauli. The climate of district Sarguja is hot humid tropical with an average annual rainfall of 1100–1250 mm. It gradually decreases from South–East direction to North–West direction. About 80 per cent of annual rainfall is received from South–West monsoon, during June to August. Number of rainy days varies from 90–100 days. The mean monthly maximum temperature ranges from 28.2 °C in January to 42.5 °C in May and means monthly minimum temperature range from 20.4 °C in December to 27.3 °C in May. The mean annual maximum and minimum temperature of study area are 35.4 °C and 20.5 °C, respectively. The soil of the Sarguja district can be broadly classified into four major types: red and yellow soils, alluvial soils, laterite soils and medium blue soils. Red and yellow soils is found particularly in east Sitapur and south Ambikapur. These soils are poor in potash, nitrogen, humus, and carbonate and differ greatly in consistency, colour, depth, and fertility. It is important, as management of agriculture water and freshwater resources has become a challenging task owing to climate change, which can substantially reduce agricultural yields and deplete existing water resources, as reported by the Intergovernmental Panel on Climate Change [3].

Table 1. Population structure of Sarguja.

Population	Males	Female	Household
2,359,886	1,193,129	1,166,757	383,217

Source: Population | District Surguja, Government of Chhattisgarh | India.

The Present study was based on extensive and intensive field surveys during 2022. The first-hand information or primary data was recorded during the field visits at the study area. Information was collected through questionnaire and personal interview on the spot. Secondary data was collected to complement the fresh information collected from the field work, Panchayat and Department of Agriculture, Sarguja, Chhattisgarh.

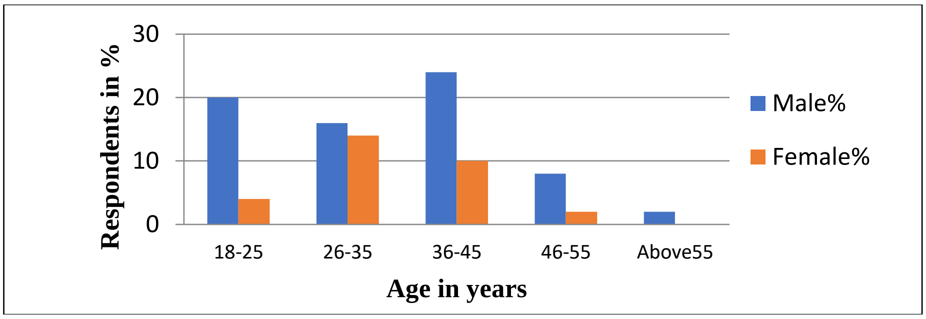
Field surveys were performed to explore the impact of watershed development programs on-site as well as off-site trough semi-structured questionnaires method. In the interview total 150 informants from all age groups, except children below 18 years were interviewed for the related information. Informants were also requested to accompany to the field. In cases of illiterate informants, the questionnaires were filled from their responses. Friendly conversation was made with teenagers and youngsters of both genders, to collect information from people of different age groups. Adopting participatory and group interaction approach, data were further cross-checked.

3. Result and Discussion

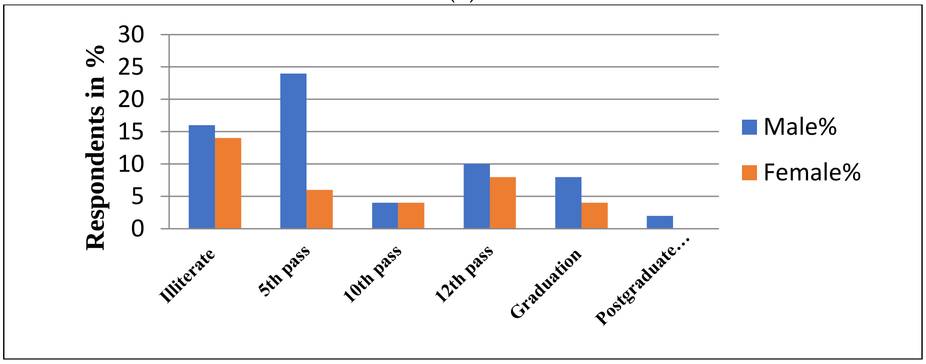
3.1. Demographic Profile

In the study site the demographic profile were as follows:

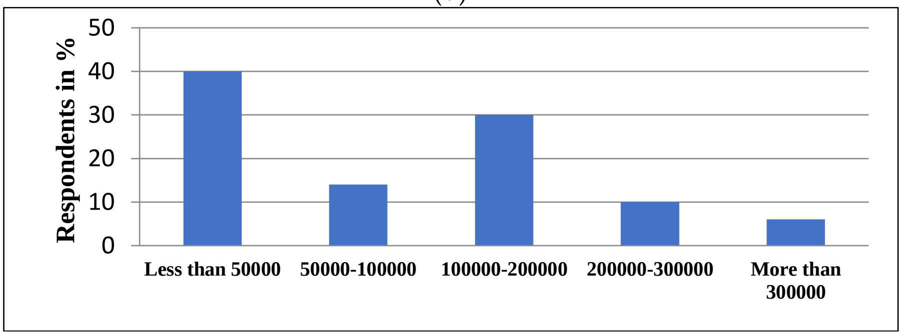
The maximum numbers of male informants were from the age group 36–45 years and female were 26–35 years i.e., 24 percent and 14 percent respectively. The minimum numbers of male and female informants were from the age group above 55 years i.e., 2 percent and nil respectively Figure 1a. The Education level of the respondents were the maximum percent male informants were 5th pass i.e., 24 percent whereas in female they were illiterate i.e., 14 percent. The minimum percent of male and female informants were postgraduate and above as 2 percent and nil respectively Figure 1b. The annual income of the respondents fall maximum in the group Less than 50000 i.e., 50 percent followed by group 100,000–200,000 i.e., 30 percent and minimum annual household income lie in group More than 300,000 i.e., 6 percent Figure 1c.



(**a**)



(**b**)



(**c**)

Figure 1. Demographic profile of study site. (**a**): Number of respondents; (**b**): Number of respondents; (**c**): Income in Indian Rupees.

3.2. The major Watershed Development Structures

- **Boulder check dam**
- The boulder check dam was primarily built to stabilize gully heads and manage channel erosion. Its purpose is to prevent waterfall erosion by stabilizing gully

heads and to control channel erosion along the gully bed. The beginning and tiny gullies, as well as the branch gullies of a continuous gully or gully network, are stabilized using loose stone check dams (Table 2, Figure 2).

- Gabion check dam
- To combat soil loss and reservoir siltation, gabion check dams (GCDs) are among the most widely employed soil and water conservation techniques. GCDs are specifically adaptable, permeable structures erected in gullies to produce a sedimentation bench that lowers the typical upstream slope (Table 2, Figure 2).
- Dabri/pond
- Farm ponds are small pools of water that are created by digging an outcropping, building a short embankment or dam over a watercourse, or both. Typically, water is drawn from a small catchment area and used for irrigation over an extended period of time. More recently, ponds appeared as vital in the provision of new climate space as a response to global climate change [4]. The farm ponds are used to collect surplus runoff during rainy seasons, store water for supplemental crop irrigation, provide drinking water for livestock during times of drought, and spray pesticides all while preserving soil and moisture (Table 2).
- Kuaa (well) and Deepening of pond
- The well for water conservation and pond for water conservation was constructed in the study site wherever required (Table 2, Figure 2).

Table 2. The financial details of few watershed structures from the study site.

S.N.	Watershed Structure	Construction Year	No. of Structure	Cost (Rs.)		Total Cost (Lac Rs.)	Source
				Labour	Material		
1	**Boulder check dam**	2021-22	05	55,795	3932	0.59728	Tec. Assistant Deogarh
2	**Gabion check dam**	2015	01	17,565	28,443	0.46000	Tec. Assistant Petla
3	**Dabri**	2021-22	01	274,400	24,694	2.99095	Tec. Assistant Guturuma
4	**Stop dam**	2015	01	213,307	786,468	10.00	S.D.O. R.E.S. Petla
5	**Kuaa (well)**	2015	01	64,027	152,041	2.16	S.D.O. R.E.S Guturuma
6	**Deepening the pond**	2021-22	01	423,035	30,943	4.53980	S.D.O R.E.S. Sitapur

(**a**)

(**b**)

(**c**) (**d**)

Figure 2. Watershed structure in the study site. (**a**) Boulder check dam; (**b**) Gabion check dam; (**c**) Well; (**d**) Stop dam.

3.3. On-Site and Off-Site Impact Assessment of the Watershed Development Programs in the Study Area

- The most important details in this text are the on-site and off-site impacts of a successful watershed project. One of the key quantitative indicators of a successful watershed project is an increase in the ground water table in watershed regions. Land development measures such as contour bunding, land levelling, and agricultural operations have been used to reduce soil erosion. There was a rise in production in Kharif, Rabi as the cultivation area increased, and farmers started taking crop in Zaid, which was otherwise fallow (Table 3). In an effort to establish Chhattisgarh as the millet hub of India, the state government there announced Mission Millet Chhattisgarh in September 2021. Promoting the growing of Kodo millet*Paspalum scrobiculatum*), small millet (*Panicum sumatrense*), and finger millet (*Eleusine coracana*), often known as ragi in India. The tribes of the study site responded that they once saw these millets as poor people's bread; nevertheless, they now welcome these millets in their cropping method. The largest area under cultivation is for finger millet (ragi), which is followed by kodo and small (kutki) millets, respectively. Due to a rise in demand for millets as well as the Watershed Program, which supported farmer efforts, millets (Kodo, Kutki and Ragi) have found a place in cropping systems of the study site.

Table 3. Cropping season status in relation to the cultivated area.

Before Watershed Structure			After Watershed Structure		
Kharif	**Rabi**	**Zaid**	**Kharif**	**Rabi**	**Zaid**
Rice (30–50%)	Pulse (20–30%)	Fallow	Rice (60–70%)	Pulse (35–40%)	Cucumber (25–30%)
Maize (10–12%)	Vegetable (10–12%)	Fallow	Maize (15–20%)	Vegetable (30–35%)	Melons (20–40%)
Vegetable (8–10%)	Wheat (30–35%)	Fallow	Vegetable (25%)	Wheat (40–45%)	Vegetable (35–40%)

The best performing watersheds are those where soil erosion was reduced by more than 50%. The WDPs (watershed development programmes) have also helped improve land use pattern and agricultural productivity across different watershed regions, with positive changes in land use due to vegetable cultivation and decrease in cultivable wastelands due to WDPs. In high-population areas, land degradation is directly linked with food security, both in terms of upland watersheds and downstream effects [5].

The cropping frequency, cash crop, horticulture, crop area is increases due to watershed construction, etc. Milk production has increased by 50–100% of the average output, and about 90% of the working population depends on agriculture. Unavailability of water for irrigation over most of the area, improper drainage, difficulty in digging wells due to rocky basement, undeveloped means of communication and transportation have restricted the extension of cultivated land. Soil properties may show significant spatial variations [6].

4. Conclusions

With the introduction of the watershed in the sarguja division there have been significant positive impacts on various biophysical aspects such as soil and water conservation, soil fertility, changes in cropping pattern, cropping intensity, there have also been a massive positive impact on the water table and increase in the water levels. The planned WSD project included measures for soil and water conservation, improving agricultural productivity, and enhancing livelihoods of landless and poor households. Apart from this creating Mitra Kissans and formation of self-help groups (SHG) ensures people's participation Support was also provided to landless labourers, women and marginal farmers by creating employment opportunity under household activity in the watershed areas. The livestock developments by providing animal camps for the care of their animals are the other important activities taken up in watershed area. With available water harvesting structure farmers are inclined to new cropping pattern and agricultural diversification. Both agricultural diversification and intensification lead to increase in agricultural productivity in the regions where watershed programmes are effective. There was a rise in production in Kharif and Rabi as the cultivation area increased and farmers started taking crop in Zaid which was otherwise fallow. Due to a rise in demand for millets as well as the Watershed Program, which supported farmer efforts, millets (Kodo, Kutki and Ragi) have found a place in cropping systems.

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References

1. Ninan, K.N.; Lakshmikanthanthamma, S. Social Cost-Benefit Analysis of a Watershed Development Project in Karnataka. *R. Swed. Acad. Sci.* **2001**, *30*, 3.
2. Joshi, P.K.; Vasudha Pangare Shiferaw, B.; Wani, S.P.; Bouma, J.; Scott, C. Socioeconomic and Policy Research on Watershed Management in India: Synthesis of Past Experiences and Needs for Future Research. Global Theme on Agroecosystems ICRISAT, Hyderabad. 2004. 2006, Vol. 2, Issue 1. Available online: http://www.icrisat.org/Journal/agroecosystem/v2i1/v2i1soci.pdf (accessed on).
3. IPCC. Fresh water resources and their management climate change; impact, adaptation, and vulnerability. In *Contribution of Working Group-II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*; Cambridge University Press: Cambridge, UK, 2007.
4. Rosset and Oertli. The Ecological Role of Ponds in a Changing World 2011 Retrieved. Available online: https://www.researchgate.net/publication/259634564_The_ecological_role_of_ponds_in_a_changing_world (accessed on 2 April 2023).
5. Food and Agricultural Organization (FAO). *The Role of forestry in Food Security*; FAO: Rome, Italy, 1985.
6. Robinson, T.P.; Metternicht, G. Testing the Performance of Spatial Interpolation Techniques for Mapping Soil Properties. *Comput. Electron. Agric.* **2006**, *50*, 97–108. https://doi.org/10.1016/j.compag.2005.07.003.