P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 7; July 2025; Page No. 638-643

Received: 05-05-2025
Accepted: 07-06-2025

Indexed Journal
Peer Reviewed Journal

# Assessing socio-economic impact and land use changes in Gangrel dam command areas, Chhattisgarh

**[1]Deepak and [2]Vijay K Choudhary**

[1]Ph.D. Research Scholar & Professor, Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

[2]Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

**DOI:** https://www.doi.org/10.33545/26180723.2025.v8.i7i.2195

**Corresponding Author:** Deepak

**Abstract**

This study was conducted in Chhattisgarh, during 2024-25, to understand the socio-economic status and land use pattern in the areas served by the Gangrel dam. The data were collected from 192 respondents, using a random sampling methods and statistical tools. The study found that the dams have positive effects on agricultural, livestock rearing, drought mitigation, and electricity generation. They provide a consistent water supply, which support various sectors that rely a water. As a result, the dam has contributed to increased income, improved employment, health, education, and agricultural land. However, the respondents are aware of the potential risk associated with dams, such as flood issues and water hazards. The study observed significant changes in land use patterns over the years. The Dhamtari area experienced an 11.63% decrease in forest area, while Raipur saw a 4.54% growth in cultivated area. Balod experienced a 15.90% decrease in forest cover, with uncultivated and bare land decreasing. Urban growth resulted in a 4.98% rise in non-agricultural use areas. Balodabazar-Bhatapara saw a net sown area increases, while Dhamtari and Balod experienced the biggest drops in cultivable wasteland. The geographical distribution of land use categories across three time periods (2015-16, 2019-20, and 2023-24) showed that Dhamtari had the highest location coefficient for the forest category, while Raipur had the lowest. Raipur had the highest location coefficient for cultivable wasteland, while Dhamtari and Balod saw slight reductions. The Gangrel dam command area has undergone significant socio-economic and environmental changes due to the provision of a reliable water supply for potential irrigation during critical periods. This has enabled optimal land use according to seasonal crop pattern in the command area.

**Keywords:** Gangrel dam, socio-economic status, land use pattern, location coefficient

## Introduction

Water is vital for agriculture and plays significant role in shaping the lives of peoples. It effects livelihoods, justice, food security, employment, as well as sustainable growth. As the global population grows, climate changes, intensification and competition for water resources increase, investing in agriculture become essential. Chhattisgarh, a state in India, has a rich history of water storage, dating back to the Kalachuri dynasty. Despite the fact that Chhattisgarh is sometimes depicted as a wealthy state with impoverished citizens, this paradox may be most apparent when it comes to water. The state has 59,900 MCM followings into five river basins. Unfortunately, only 22% of water is utilized for irrigation, industrial, and domestic purposes. Chhattisgarh has 13,678 MCM of groundwater with 20% already being used. With 80% of the population being rural and primarily dependent on agriculture, Chhattisgarh needs more irrigation facilities due to the monsoon variability. The state average rainfall is 1300 mm and the state falls under the rice Agro-climate zone. To address this, more irrigation facilities are needed to ensure the state water supply and maintain its agricultural crops. The state gross sown area is 5.683 million hectares, with an irrigation potential of 31.83%, compared to 22.94% before Chhattisgarh's formation, which was only 1.710 million hectares. In the state, the gross irrigated area is only 38%, and the net irrigated area is 35% of the total cultivable area (source: water resource management government of C.G.). Among these, the 1979-built Gangrel Dam is one of the largest dams in India known as Pandit Ravishankar Sagar is situated in Dhamtari district of Chhattisgarh. According to official records built on the other side of the Mahanadi River. It is situated at latitude 20.595798 and longitude 81.561769. It is Chhattisgarh longest and biggest dam. This dam serves as Bhilai Steel Plant's primary water source and provides year-round irrigation, enabling farmers to harvest two crops annually. The dam has a 10 MW hydroelectric power capacity. Five districts—Dhamtari, Balod, Durg, Raipur, and Balodabazar—receive water from the dam for drinking, irrigation, and other uses. Gangrel Dam is a stunning architectural marvel with a height of 30.5 meters, a length of 1,830 meters, and a surface area of 95 $km^2$. With a water capacity of 910,500,000 $m^3$, it offers recreational activities like jet skiing, water surfing, scuba diving, sailing, parasailing, and kite surfing. The dam overlooks the Mahanadi River's swift torrents, and on its banks, there are resorts and sandbanks, creating a mini-Goa-like atmosphere (district profile, Dhamtari 2024).

Despite having a favorable climate and abundant soil suitable for a wide range of crops, Chhattisgarh ensures a successful paddy harvesting state, earning the state the title of "rice bowl" of India. However, in this case, the crop fails as a result of the year-round uneven distribution of rainfall. Rabi seasonal crops require irrigation because the remaining eight months of the year see little rain. As a result, the land and its wonderful climate were left unused. In order to alleviate this suffering, the Gangrel dam project was constructed. It claimed to give the people and land of Chhattisgarh an entirely new perspective on life by supplying water through its perennial canal system to irrigate the drought-stricken area. In view of this present study was undertaken with the following specific objectives.

1. To assess the impact of the Gangrel dam on the socio-economic conditions of the study areas.
2. To examine the change in land utilization patterns within the command area of the Gangrel dam in Chhattisgarh.

**Methodology**

The present study was confirmed to Chhattisgarh state, during 2024-25. The dam is located in Dhamtari district due to the district was selected purposively and the Gangrel dam command area have four division were supply water by dam namely Mahanadi water management division -01, Rudri Dhamtari and Balod, Mahanadi water management division -02, Rudri Dhamtari, water management division -01, Raipur and water management division -02, Balodabazar - Bhatapara out of which all division was selected purposively. Purposively, two villages are chosen from each Dam division. Total 8 villages—Khirgitola, Vishrampur, Gatapur, Chhatti, Nimora, Karmadi, Bagbuda and Chherkapur, were chosen from each of the four Dam divisions. The number of respondents from each division varies, with 47 in Division-01 Rudri, 52 in Division-02 Rudri, 46 in Division-01 Raipur, and 47 in Division-02 Balodabazar. This results in a total of 192 respondents across all divisions by using proportional random sampling technique. The data provides insights into the distribution of water management efforts and community participation in these areas. Primary data was collected from the farmers through well prepared schedule and questionnaire. secondary data was collected from various government sources like; directorate of agriculture, directorate of land revenue, directorate of economics & statistic govt. of Chhattisgarh, executive engineers Mahanadi water management dam divisions and water resources dept. of Chhattisgarh.

The following tools and techniques were employed and an analysis has been carried out in probability packages, and an MS Excel sheet for the study by using simple arithmetic averages and percentages. For land use pattern was analyzed by using the inter-sectorial shift in land use pattern was examined by using a simple identity of linearly additive land use changes. The first accounting identity linearly summed up the area under all land-use classes which was equal to the total reported area, given by Eq. 1.

$$R = F_r + P + M + N + U + W + F_c + F_o + C \ldots 1$$

where, R = Total geographical area, $F_r$ = Total forest area, P = Area under total permanent pastures, M = Area under miscellaneous tree crops and groves, N = Total area under non-agricultural uses, U= Total barren and uncultivated land, W = Total cultivable wasteland, $F_c$ = Current fallows, $F_o$ = Fallows other than current fallow, C = Total net area cultivated. The change in the total reporting area is given by

$$\Delta R = \Delta F_r + \Delta P + \Delta M + \Delta N + \Delta U + \Delta W + \Delta F_c + \Delta F_o + \Delta C. \quad 2$$

where, Δ indicates the change in a particular class of land.

**Location coefficient**

The study examined the distribution of specific land categories in Gangrel dam command area using the location coefficient, indicating that a higher value indicates a higher concentration of that specific land category in the region.

$$L = (L_{ij}/L_i) / (L_i/L_s)$$

Where, $L_{ij}$ = area of $j^{th}$ category of land in $i^{th}$ district/ region, $L_i$ = area of all categories of land in the district/ region, $L_j$= area of $j^{th}$ categories of land in the state and $L_s$= area of all categories of land in the state.

**Results and Discussion**

The result presented an overview survey of the selected respondents, covering aspects such as family size, their socioeconomic status, cropping patterns and land holding. Additionally, it examined socioeconomic status of dam, land use pattern and major constraints.

**Table 1:** Overview of sample farmers profiles.

| S. No. | Particulars | Farm size | | | | |
|---|---|---|---|---|---|---|
| | | Marginal | Small | Medium | Large | Overall |
| 1 | Number of households | 60 | 51 | 45 | 36 | 192 |
| 2 | Family size (Average | 7.11 | 7.00 | 7.31 | 8.05 | 7.30 |
| 3 | Average land holding (ha.) | 0.82 | 1.71 | 3.29 | 6.98 | 2.79 |
| 4 | Area under irrigated (ha.) | 0.54 (65.85) | 1.06 (61.98) | 2.14 (65.04) | 4.91 (70.36) | 1.87 (67.03\|) |
| 6 | Tube well irrigated area (ha.) | 0.28 (34.15) | 0.56 (32.74) | 1.14 (34.65) | 2.39 (34.25) | 0.95 (34.05) |
| 7 | Canal irrigated area (ha.) | 0.26 (31.70) | 0.50 (29.24) | 1.00 (30.39) | 2.52 (36.10) | 0.92 (32.97) |
| 8 | Rainfed agriculture area (ha.) | 0.28 (34.15) | 0.65 (38.02) | 1.15 (34.96) | 2.07 (29.65) | 0.92 (32.97) |
| 9 | Gross cropped area (ha) | 1.36 | 2.96 | 5.53 | 12.29 | 4.81 |
| 10 | Net cultivated area (ha) | 0.82 | 1.71 | 3.29 | 6.98 | 2.79 |
| 11 | Cropping intensity (%) | 165.85 | 173.09 | 168.08 | 176.07 | 172.44 |

**1. Socio-economic impact of Gangrel dam**

**1.1 Intangible benefits of dam in the following services/amenities**

The table 2, indicate the requirements and advantages of a dam, the data represents the views of farmers from the head reach, mid reach, and tail end farmers of a canal system. A closer look at the answers from 99 head reach farmers, 46 mid-reach farmers, and 47 tail end farmers, reveals that their perspectives differed according to their location and availability of water supplies during cropping seasons. Farmers in the head reach area reported the highest perception of benefits across nearly all categories. For instance, 76.76% of head reach farmers acknowledged agriculture and livestock rearing as a significant intangible benefit, compared to 67.39% in the mid reach and 61.70% at the tail end. A similar trend was seen in income and employment, where 68.68% of head reach farmers recognized the benefit, followed by 63.04% in the mid reach and 59.57% at the tail end.

Water-related services such as water storage and flood control, reduction in water cost, and drought mitigation also followed a pattern of declining perception from head to tail. while nearly 60% of head reach farmers appreciated the benefits of water storage and flood control, only 47.82% of mid reach and 36.17% of tail-end farmers shared this view. This trend suggests that the farther farmers was from the dam, the less they perceive the benefits, likely due to challenges in distribution and access.

Other categories, such as recreation, tourism, and fishing, were considered less significant across all groups, but the perception was still highest among head reach farmers (45.45%), dropping sharply to 26.08% and 21.27% among mid and tail-end farmers, respectively. Similar differences are observed in responses related to electricity, where only around 24% of both mid and tail-end farmers acknowledged any benefit, compared to 44.44% among head reach farmers. The data also reveal some divergence in the perception of ecosystem-related benefits. While 46.46% of head reach farmers recognized the dam's role in supporting biodiversity and ecosystem management, only 28.26% of mid reach and 31.91% of tail-end farmers felt the same.

**Table 2:** Farmers perspective on the advantages of Dams.

| S. No. | Opinions | Head reach farmers | | Mid reach farmers | | Tail end farmers | |
|---|---|---|---|---|---|---|---|
| | | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| 1. | Crop production and livestock | 76 | 76.76 | 31 | 67.39 | 29 | 61.70 |
| . | Recreation, tourism and aquatic resources | 45 | 45.45 | 12 | 26.08 | 10 | 21.27 |
| 3. | Economic benefits and employment opportunities | 68 | 68.68 | 29 | 63.04 | 28 | 59.57 |
| 4. | Animal, bio- diversity | 46 | 46.46 | 13 | 28.26 | 15 | 31.91 |
| 5. | Water resource management & Flood prevention | 59 | 59.59 | 22 | 47.82 | 17 | 36.17 |
| 6. | Diversification of farming activities | 63 | 63.63 | 29 | 63.04 | 22 | 46.80 |
| 7. | Reduction water cost | 59 | 59.59 | 22 | 47.82 | 21 | 44.68 |
| 8. | Drought mitigation | 60 | 60.60 | 28 | 60.86 | 19 | 40.42 |
| 9. | Electricity | 44 | 44.44 | 11 | 23.91 | 11 | 23.40 |
| Based on respondents | | 99 | | 46 | | 47 | |

**1.2 Farmers perceive the impact of dams on the following services and amenities**

The table 4.6, presents farmers perceptions of the impacts of dams across various social, environmental, and management-related dimensions. Responses are categorized by location within the irrigation system: head reach, mid reach, and tail end farmers. These perceptions highlight the varied experiences of communities affected by dam-related developments and operations. The displacement and resettlement were most strongly expressed by head reach farmers, where 47.47% acknowledge it as a concern. This figure slightly declines to 41.30% among mid reach farmers and further to 29.78% among tail end farmers, possibly indicating that those closer to dam construction sites experienced direct physical displacement more acutely. Livelihood problems are also broadly recognized, though fairly consistent across groups, with 46.46% of head reach farmers, 47.82% of mid reach, and 36.17% of tail end farmers reporting such issues. This suggests that dam development affects employment and income opportunities, especially among those nearer to central operations or land acquisition areas.

A stark contrast appears in the perception of environmental and economic losses, which rises dramatically from 28.28% among head reach farmers to 54.34% among mid reach and peaks at 78.72% in the tail end. This upward trend indicates increasing dissatisfaction and negative experiences with dam-related impacts, possibly due to compounded environmental degradation and reduced economic returns in downstream areas because crops failure due to dry spoil.

Issues of water access and canal management are also prominent. Unequal water access during the rabi season was perceived by 32.32% of head reach farmers, while more than 63% of both mid and tail-end farmers report facing such inequality. Similarly, water logging during the kharif season due to inefficient canal management was cited by 28.28% of head reach farmers but jumps significantly to 67.39% and 70.21% among mid and tail-end farmers, respectively. These patterns indicate that poor infrastructure and management have more severe effects as distance from the dam increases, leading to unreliable water supply and soil degradation downstream.

Loss of cultivable land was another widely acknowledged concern. While half of the head reach farmers report this issue 50.50%, the figure increases to 76.08% among mid reach and 65.95% in the tail end, suggesting that land acquisition and flood risks may be disproportionately affecting mid and lower regions of the canal system. Perceptions of unequal profit distribution from the dam vary slightly, with tail end farmers 48.93% reporting it more frequently than head 44.44% and mid reach 41.30% groups, hinting at a belief that economic advantages are not shared

equitably.

Psychological, emotional, and cultural impacts are perceived by approximately one-third of farmers across all regions, indicating a consistent but moderate concern regarding the broader social disruption caused by dam development. Lastly, perceptions related to government policy implementation are reported most by mid reach farmers 60.86%, followed by tail end 51.06% and head reach 43.43% farmers. This suggests that policy-related grievances may be more acutely felt in the middle and lower canal sections, possibly due to unmet expectations or ineffective local execution of dam-related schemes.

**Table 3:** Perceived consequences of Dams on farmers.

| S. No. | Opinions | Head reach farmers | | Mid reach farmers | | Tail end farmers | |
|---|---|---|---|---|---|---|---|
| | | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| 1. | Displacements/Resettlement | 47 | 47.47 | 19 | 41.30 | 14 | 29.78 |
| . | Challenges to livelihood | 46 | 46.46 | 22 | 47.82 | 17 | 36.17 |
| 3. | Environmental and financial losses | 28 | 28.28 | 25 | 54.34 | 37 | 78.72 |
| 4. | Water unequal distribution in Rabi Season | 32 | 32.32 | 29 | 63.04 | 30 | 63.82 |
| 5. | Water shortage in Kharif season due to poor canal management | 28 | 28.28 | 31 | 67.39 | 33 | 70.21 |
| 6. | Reduction of Cultivable Land | 50 | 50.50 | 35 | 76.08 | 31 | 65.95 |
| 7. | Unequal benefits from Dam | 44 | 44.44 | 19 | 41.30 | 23 | 48.93 |
| 8. | Psychological, Emotional and Cultural impacts | 37 | 37.37 | 17 | 36.95 | 16 | 34.04 |
| 9. | Govt. policy implementation issues. | 43 | 43.43 | 28 | 60.86 | 24 | 51.06 |
| | Based on respondents | 99 | | 46 | | 47 | |

**2. Land use pattern in the Gangrel dam command area**

The table 4, indicate that the land use pattern in the Gangrel dam command area has changed over time, as indicated by the percentage variations in different categories across Dhamtari, Raipur, Balodabazar-Bhatapara, and Balod districts from 2012-13 to 2023-24.

The report shows that the reporting area in Dhamtari has decreased by 11.63%, indicating less land available. A significant 25.81% reduction in forest area suggests land conversion or deforestation. Urban expansion has resulted in a minor rise of 2.37% in non-agriculture areas. Permanent pasture and grazing land have remained relatively consistent, increasing by 1.41%. Cultivable wasteland has dropped by 8.40%, while the area covered by tree crops and groves has grown by 17.64%. The significant rise in other fallow land and 282.68% growth in present fallow land is likely due to altered agricultural methods or soil fertility problems. An increase in agricultural activity is shown by the 4.54% growth in the net cultivated area. In Raipur, the amount of forest cover has grown by 3.47%, with a 12.34% increase in non-agricultural land area pointing to increased infrastructure and urbanization. Permanent pasture and grazing land have been reduced by 0.84%, while barren and uncultivable land has fallen by 12.63%. Cultivable wasteland has decreased by 4.16%, while the area covered by groves and other tree crops has decreased by 32.29%. Present fallow land has substantially decreased by 48.19%, while other fallow land has decreased by 14.79%, suggesting improved cropping patterns.

In Balodabazar-Bhatapara, the reported area has drastically decreased by 15.90% and the forest cover has decreased by 14.94%. The area under non-agriculture has decreased by 13.50%, with a 17.61% decrease in permanent pasture and grazing area indicating a move away from animal grazing. In Balod district reporting area shows minimal deforestation, with a 2.01% decrease in forest cover. Urban growth was evident in the 4.98% increase in non-agricultural use. Permanent pasture and grazing land have grown by 0.85%, while barren and uncultivable land have dropped by 8.76%. Better land use is seen in the 8.19% decrease in acreage under tree crops and groves and the 16.91% decrease in cultivable wasteland. Fallow land has grown by 6.49%, while other fallow land has declined by 3.54%. The 1.89% increase in net sown area suggests stable agricultural land usage. These changes highlight the impact of urbanization, deforestation, and shifting farming methods on land-use patterns in the Gangrel dam command area.

**Table 4:** Land use classifications: Percentage shifts in Gangrel Dam command region (ha.)

| Particulars | Damtari | | | Raipur | | | Balodabazar-Bhatapara | | | Balod | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use classes | 2012-13 | 2023-24 | Change (%) | 2012-13 | 2023-24 | Change (%) | 2012-13 | 2021-22 | Change (%) | 2012-13 | 2023-24 | Change (%) |
| Reporting area | 408193 | 360710 | -11.63 | 291437 | 291437 | 0 | 467697 | 467697 | 0 | 352700 | 352700 | 0 |
| Forest | 221228 | 1,64,113 | -25.81 | 2820 | 2918 | 3.47 | 133361 | 1,23,615 | -7.30 | 99762 | 97749 | -2.01 |
| Area under non-agriculture | 29270 | 29966 | 2.37 | 44292 | 49759 | 12.34 | 31275 | 30912 | -1.16 | 31764 | 33348 | 4.98 |
| Barren & uncultivable | 1558 | 1,478 | -5.13 | 380 | 332 | -12.63 | 5674 | 12119 | 113.58 | 4986 | 4549 | -8.76 |
| Permanent pasture & grazing | 15838 | 16062 | 1.41 | 36237 | 35931 | -0.84 | 32535 | 36211 | 11.29 | 19802 | 19972 | 0.85 |
| Land under misc. tree crops & groves | 17 | 20 | 17.64 | 96 | 65 | -32.29 | 5 | 7 | 40 | 61 | 56 | -8.19 |
| Cultivable wasteland | 3081 | 2,822 | -8.40 | 21534 | 20,637 | -4.16 | 12962 | 10071 | -22.30 | 9713 | 8070 | -16.91 |
| Other -fallow | 1210 | 2,364 | 95.37 | 15176 | 12,930 | -14.79 | 12472 | 9161 | -26.54 | 6493 | 6263 | -3.54 |
| Current fallow | 618 | 2,365 | 282.68 | 5411 | 2,803 | -48.19 | 6521 | 4868 | -25.34 | 3309 | 3524 | 6.49 |
| Net sown area | 135373 | 141520 | 4.54 | 165491 | 166062 | 0.34 | 232892 | 240733 | 3.36 | 176810 | 180169 | 1.89 |

**Table 5:** Annual rate of change in land use classes in Gangrel dam command area

| Land use sector | Land use categories | Annual rate of change (ha) | | | |
|---|---|---|---|---|---|
| | | Dhamtari | Raipur | Balodabazar-Bhatapara | Balod |
| Ecological (E) | Forest ($\Delta F_r$) | -57115 | 98 | -9746 | -2013 |
| | Barren & uncultivable ($\Delta U$) | -80 | -48 | 6445 | -437 |
| | Permanent pasture & grazing ($\Delta P$) | 224 | -306 | 3676 | 170 |
| | Land under misc crop ($\Delta M$) | 3 | -31 | 2 | -5 |
| Agriculture (A) | Net sown ($\Delta C$) | 6147 | 571 | 7841 | 3359 |
| | Current fallow ($\Delta F_c$) | 1747 | -2608 | -1653 | 215 |
| | Other- fallow ($\Delta F_o$) | 1154 | -2246 | -3311 | -1230 |
| | Cultivable wasteland ($\Delta W$) | -259 | -897 | -2891 | -1643 |
| Non-agriculture (N) | Area under non-agriculture ($\Delta N$) | 696 | 5467 | -363 | 1584 |

In the table 6, presented by using location coefficients for four regions which have under Gangrel dam command area which has namely Dhamtari, Raipur, Balodabazar-Bhatapara, and Balod, shows the geographical distribution of land use categories under the Gangrel dam command area across three time periods: 2015–16, 2019–20, and 2023–24. Dhamtari was the greatest location coefficient for the forest category 1.1 in 2015–16 and 2019–20, with a minor decline to 0.96 in 2023–24, whereas Raipur was the lowest 0.02 in all years. About 0.6 was where Balodabazar-Bhatapara and Balod keep their values comparatively constant. Raipur was the largest non-agricultural area, rising from 2.99 in 2015–16 to 3.24 in 2023–24, a sign of growing urbanisation. With Balodabazar-Bhatapara rising from 1.24 to 1.3 and Balod from 1.75 to 1.79, the remaining regions exhibit moderate increase. All regions continue to have low levels of barren and uncultivable terrain, with values varying throughout time between 0.05 and 0.63. There were very slight variations in the permanent pasture and grazing category; Raipur continuously had the highest values going from 1.86 in 2015–16 to 1.94 in 2023–24, while other locations stay near 1.0.

Though its location coefficient had dropped from 2.04 in 2015-16 to 1.37 in 2023-24, indicating a slight decline in this category, Raipur still highest coefficient for cultivable wasteland, although it slightly declines from 2.88 in 2015-16 to 2.62 in 2023-24. Dhamtari remains low, while Balodabazar-Bhatapara and Balod see slight reductions. Raipur was a high concentration of land under miscellaneous tree crops & groves. Similar trends can be seen in the other fallow land category, where Raipur was the highest values but has seen a reduction over time, going from 2.61 to 2.01. All areas currently have low levels of fallow land, with Balodabazar-Bhatapara seeing a little rise from 0.55 in 2015–16 to 0.9 in 2023–2024. Last but not least, there are minor fluctuations in the net sown area, with a tiny rise in Dhamtari 1.05 to 1.2, Raipur 1.65 to 1.75, Balodabazar-Bhatapara 1.48 to 1.54, and Balod 1.48 to 1.57, suggesting a slow development of agriculture.

**Table 6:** Comparative analysis of land use pattern in the Gangrel Dam Command Area across three distinct time periods (2015-16 to 2023-24)

| Particular | 2015-16 | | | | 2019-20 | | | | 2023-24 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land use classes | Dhamtari | Raipur | Balodabazar-Bhatapara | Balod | Dhamtari | Raipur | Balodabazar-Bhatapara | Balod | Dhamtari | Raipur | Balodabazar-Bhatapara | Balod |
| Forest | 1.1 | 0.02 | 0.62 | 0.6 | 1.1 | 0.02 | 0.62 | 0.61 | 0.96 | 0.02 | 0.56 | 0.58 |
| Area under non-agriculture | 1.37 | 2.99 | 1.24 | 1.75 | 1.15 | 3.02 | 1.22 | 1.72 | 1.57 | 3.24 | 1.25 | 1.79 |
| Barren & uncultivable | 0.22 | 0.06 | 0.58 | 0.61 | 0.25 | 0.05 | 0.58 | 0.62 | 0.2 | 0.05 | 1.27 | 0.63 |
| Permanent pasture & grazing | 0.79 | 1.86 | 1.09 | 0.88 | 0.71 | 1.88 | 1.08 | 0.87 | 0.7 | 1.94 | 1.21 | 0.89 |
| Land under misc. tree crops & groves | 0 | 2.04 | 0.08 | 0.96 | 0.14 | 1.58 | 0.06 | 0.75 | 0.34 | 1.37 | 0.09 | 0.97 |
| Cultivable wasteland | 0.17 | 2.88 | 1.11 | 1 | 0.31 | 2.8 | 1.16 | 0.98 | 0.28 | 2.62 | 0.79 | 0.84 |
| Other fallow | 0.16 | 2.61 | 1.27 | 0.93 | 0.3 | 2.41 | 1.17 | 0.83 | 0.29 | 2.01 | 0.89 | 0.67 |
| Current fallow | 0.09 | 1.1 | 0.55 | 0.56 | 0.29 | 1.06 | 0.76 | 0.74 | 0.34 | 0.5 | 0.54 | 0.52 |
| Net sown area | 1.05 | 1.65 | 1.48 | 1.48 | 1.03 | 1.65 | 1.47 | 1.48 | 1.2 | 1.75 | 1.58 | 1.57 |

The table 7, present the major constraints faced by respondents during irrigation with dam water, based on responses from 192 individuals. The challenges are ranked according to their average scores, reflecting their relative severity. The upper area of the command region does not receive adequate water, hindering agriculture activities farmers area having reliant on monsoon which introduced significant risk to their agricultural production. The dam operation led to soil erosion and decreased fertility downstream, affecting soil overall health. The canal is not adequately maintained, which can lead to inefficient in the irrigation system.

It also observed during rainy season the dam operations sometime result in excessive water release causing flooding in downstream areas. These constrains highlighting the various challenges faced by respondents during the cropping season, ranging from water availabilities and soil health to infrastructure and compensation issues.

**Table 7:** Present list of constraint faced by farmers during cropping season along with their total score and the constraint as follows

| S. No. | Particulars | Total score | Average | Rank |
|---|---|---|---|---|
| 1. | Insufficient water supply to the upper region | 10645 | 55.44 | II |
| 2. | Vulnerability to monsoon related uncertainties | 8411 | 43.80 | VI |
| 3. | Soil degradation and erosion downstream due to the dam operation | 12172 | 63.39 | I |
| 4. | Irregular maintenance of irrigation canals | 9107 | 47.43 | V |
| 5. | Relocation of communities due to dam construction | 10139 | 52.80 | III |
| 6. | Inadequate financial support from government | 9277 | 48.31 | IV |
| 7. | Subpar irrigation infrastructure, including canal and pipelines | 8241 | 42.92 | VIII |
| 8. | Excessive water release from the dam leading to following | 8808 | 45.87 | VII |

## Conclusion

The Gangrel Dam has played a vital role in enhancing agricultural productivity, drought resilience, and rural livelihoods across its command area. Reliable water supply has contributed to increased income, employment, and also improved access to health and education services. However, these benefits have been accompanied by notable land use changes. Dhamtari and Balod witnessed significant declines in forest cover by 11.63% and 15.90%, respectively, while Raipur experienced a 4.54% increase in cultivated land and a 4.98% rise in non-agricultural use and Balodabazar-Bhatapara saw a net sown area increases. These shifts reflect a trade-off between development gains and environmental impacts, underscoring the need for balanced resource management in dam-affected regions.

## References


1. Bhatti NB, Siyal AA, Qureshi AL, Bhatti IA. Socio-economic impact assessment of small dams based on T-paired sample test using SPSS Software. Civil Eng J. 2019;5(1):153-64.
2. Choudhary VK. Economics of crop enterprises in tank irrigation system. J Interacademicia. 1997;1(4):340-5.
3. Choudhary VK, Katre PK. Development of lift irrigation project for enhancing agricultural production. Indian J Agric Econ. 2006;61(3):516-26.
4. Choudhary VK, Rajput YS, Kosta AK. Economics of crop production under assured and protective irrigation system of Chhattisgarh. Indian J Econ Dev. 2015;11(1):183-96.
5. Choudhary VK. Comparative economic analysis of vegetable under drip and conventional irrigation system in Durg district of Chhattisgarh. Indian J Agric Econ. 2008;63(3):391.
6. Choudhary DJ, Leua AK. Assessment of change in land use pattern in south Gujrat region. J Indian Soc Coast Agric Res. 2023;41(2):94-9.
7. Chavhan AP, Kumbhar JS, Deokate TB, Pawar BN, Waghmare MN. Economic analysis of temporal changes in land use pattern of western Maharashtra. Asian J Agric Ext Econ Sociol. 2023;41(4):42-7.
8. Chikkala N, Kumar KA. Environmental and social issues and concerns of Indira Sagar project (Polavaram dam). Int J Creat Res Thought. 2019;7(3):508-21.
9. Deepak, Seth MK. Assessment of compound growth rate and economic analysis of cotton in Bemetara district of Chhattisgarh, India. Asian J Agric Ext Econ Sociol. 2024;42(5):177-86.
10. Deokale N, Khandre AV, Wahekar AR, Sexena B. Constraints faced by beneficiaries of Won irrigation project in agricultural and socio-economic development. Pharma Innov J. 2022;11(12):1526-8.
11. Marothiya DK, Joshi S, Choudhary VK. Irrigation tanks in Chhattisgarh; traditional technology for sustainable rainfed agriculture in India: prosperity and challenges. Jaipur: Rawat Publishers; 2009. p. 200-20.
12. Marothiya DK, Guaraha AK, Choudhary VK. Land transaction: some field level realities. Artha Vikas. 1995;31(1):1-9.
13. Marothiya DK, Guaraha AK, Choudhary VK. Agricultural land market: A macroeconomics analysis. Indian J Agric Econ. 1991;46(3):392-3.