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# A STUDY OF MORPHOMETRY AND GAZE REPORT OF KURNUR DAM AT AKKALKOT TALUKA, DURING 2014 TO 2016

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**ABSTRACT:**

*Kurnur Dam plays a crucial role in human development and environmental conservation. Built across the Bori River, it serves essential functions such as irrigation, drinking water supply, hydroelectric power generation, flood management, and recreation. Beyond human benefits, the dam supports biodiversity and ecological balance. Its significance extends to water supply, irrigation, disaster management, and tourism. However, sustainable management is necessary to address ongoing challenges. In 2015, a severe drought occurred due to low rainfall and high temperatures, leading to critically low water storage. 2016 saw a strong recovery, with heavy monsoon rains in August–October replenishing the reservoir. While rainfall is the primary factor influencing water levels, high temperatures accelerate water loss through evaporation.*

**KEYWORDS:** *human development and environmental conservation, flood management .*

## INTRODUCTION :

Earth is a one-of-a-kind planet that contains water. Throughout history, human civilizations have thrived, been sustained, and ultimately vanished in connection with water. Water is the essence of life, and it is believed that life on Earth began in aquatic environments (Oparin et al., 2003). In living organisms, water makes up between 70% and 90% of their body mass (Mitchell et al., 1945). It acts as a natural universal solvent, providing an essential medium for various metabolic reactions—both catabolic and anabolic—within the organism. In nature, the hydrological cycle moves water throughout the Lithosphere, Atmosphere, and Biosphere.

Water is not evenly distributed across the globe. Icecaps, oceans, lakes, and rivers are present on the Earth's surface. Among these, freshwater resources are scarce yet essential. The United Nations (UN) designated 2003 as the "Year of Freshwater." The surface of the Earth consists of 29.2% land and 70.8% water. Water occupies a surface area of 5.1 billion $km^2$ on Earth. Water on the planet is divided into saline and freshwater. According to the United States Geological Survey, as edited by Peter H. Gleick in 1993, only 1.3% of the total available freshwater exists. Throughout history, most human settlements have developed near water bodies, with several civilizations, such as the Indus Valley, Mayan, Nile, and Mesopotamian cultures, springing up around these water sources. The distribution of water across the globe is uneven due to various climatic, physiographic, and geological factors (Bralower, 2012). The increasing demand from the growing population on existing water resources has risen dramatically.

The excessive use of freshwater resources for domestic purposes, agriculture, and industry has led to the issue of water scarcity (The International Bank for Reconstruction and Development (IBRD)).

## OBJECTIVES

To record the morphometric details of Kurnur dam
To provide the base data for further research
To note the significance of reservoir for local people and residents of Akkalkot Taluka
Its role in management of flood.

## MATERIAL AND METHODS

The data was collected through frequent visit to Kurnur dam through photographs, from reservoir office and meteorological department. The data was analysed to compare the amount of rainfall and storage capacity of the reservoir. The base data was collected to record economic and social activities undergoing in the site.

## RESULT AND DISCUSSION

The water reservoir creates a self-supporting ecosystem. The ecosystem of the reservoir is regulated by interaction between abiotic and biotic factors. Abiotic factors influence niche of the organisms hence controls the biotic factor. Water is essential factor for survival of an aquatic ecosystem. The volume of water in reservoir is controlled by precipitation, evaporation, percolation, inflow, and outflow and storage capacity of the dam. Other a biotic factors that influence the reservoir ecosystem are temperature, pH, salinity, DO, BOD,COD, hardness, TDS etc. which are discussed in concern to Kurnur dam later. These factors fluctuate corresponding with season.

The location of Kurnur dam is in rain shadow region of western ghates, in monsoonal (South West Monsoon – SWM) climate, which possess three distinct seasons, summer from February to May, rainy season June to October and winter season from November to January. As the location of reservoir is in tropical climate with wide variation of temperature and precipitation from season to season, while the monthly changes are gradual, it is easy and convenient to study biotic and

Figure.1.1 Location of Kurnur Dam From Solapur and Akkalkot


Figure.1.2 Water divide and catchment area of Kurnur dam.


Figure.1.3 Satellite view of Kurnur Dam.

Figure.1.4 Different Parts of study area of Kurnur dam

Figure 1.5 Kurnur Dam or Bori Dharan dam structure.

Figure 1.6 Kurnur Reservoir (Dry).

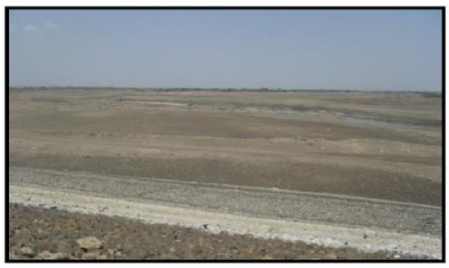


Figure 1.7 Kurnur Dam water level information.

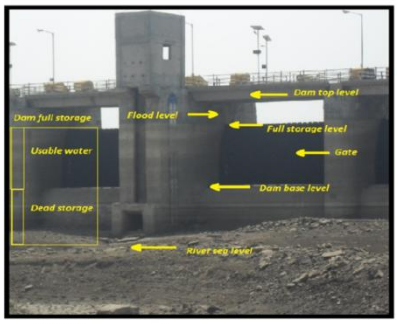
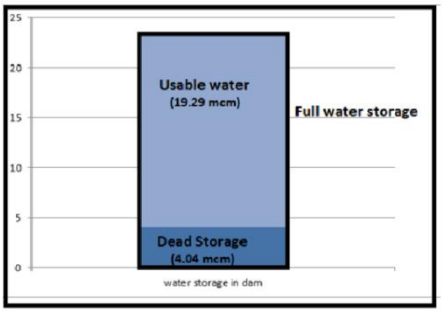



Figure. 1.8 Water storage at Kurnur dam.




abiotic factors monthly therefore seasonal variations are calculated from monthly observation.

## Climatic conditions of the reservoir.

The Kurnur reservoir is located in tropical climate; the atmospheric temperature has very much influence over the water temperature. The influx of water is especially depends on the monsoonal rainfall in the catchment area. Therefore air temperature, monthly precipitation is measured as average daily temperature and precipitation. Average monthly level of water in the reservoir depends on influx of water through rivers in catchment area and monsoonal rainfall within reservoir, are the climatic characters studied in this reservoir. Average of monthly characters aggregated in to seasonal characters. Information of average monthly temperature and precipitation information of Akkalkot is collected from Tehsil office at Akkalkot and compared the temperature of dam water which is directly collected from thermometer.

As already discussed about the geographical location of dam, its climatic conditions are necessary to study. Therefore data of atmospheric temperature, precipitation and water storage of the reservoir are collected from authentic sources from dam office, Tehsil office and authenticity was cross verified by self-collected data. The dynamism of reservoir water with respect to various climatic factors.

**Table.No.2.1.1 Seasonal classification of months at Kurnur dam**

| Sr.No | Seasons | Months |
|---|---|---|
| 1 | Summer season | February, March, April, May |
| 2 | Monsoonal Rainy season | June, July, August, September October |
| 3 | Winter season | November, December, January |

The location dam comes under the category of *BSh* dry (arid and semiarid) climate according to the Koppen climate classification (Subrahmanyam B. 1965). This region is dry in most part of the year. This region has three distinct seasons: summer, monsoon and winter as mentioned in Table No. 2.1.1.

## Morphometry of Kurnur Dam

Morphometry is the details about the reservoir supplied by the Kurnur Dam or Bori Prakalpa Office. It informs about the exact position of the dam, its length, height, surface area wand water holding capacity.

**Table.No.2.1.2 Morphometry of Kurnur dam**

| Morphometry | Details |
|---|---|
| Official Name | Kurnur Dam D04235 |
| Opening year | 1968 |
| Latitudinal position | 17.61 N |
| Longitudinal Position | 76.21 E |
| Ownership | Government of Maharashtra (India) |
| Type of the dam | Earth fill |
| Length of the dam | 1206 m |
| Height of dam | 23.7 m |
| Dam volume | 45 $Km^3$ |
| Surface area | 570 $Km^2$ |
| Mean Sea Level | 447 mall |
| Storage capacity | 32,670 $Km^3$ |
| Full Storage | 23.29 mcm |
| Dead storage | 4.02 mcm |
| Number of gates | 9 |
| Catchment are | 1,254 $km^2$ |
| Irrigation Potential | 14,000 Ha |
| Average rain fall | 877 mm |

(Source *Bori Praklpa office. Govt. of Maharashtra*)

## Gaze Report.

It is collected at the time of every visit from the Gaze meter and additional information collected from the Kurnur Dam office, which informs about the amount of water stored in the reservoir in terms of MCFT (Million Cubic Feet)

## Data Examination of Gaze Report 2014

The dataset includes measurements for Gaze (in meters), Water Level (in meters), and Water Storage (in MCFT) at a dam throughout the year 2014. Below is an analysis based on the collected data:

### 1. Water Storage Patterns:

The peak recorded storage reached 822.62 MCFT (on 28-09-2014), likely influenced by monsoon inflow. The lowest storage was 60.017 MCFT (on 06-07-2014), indicating significant depletion before the onset of the monsoon. The reservoir began with 631.93 MCFT (on 19-01-2014) and exhibited a gradual decline, hitting its lowest point in July before rebounding in August and peaking in September.

Table.No.2.1.3 Gaze Report of 2014 at Kurnur dam.

| Date of Sample collection | Gaze in Meter | Water level in Meter | Water storage in the dam MCFT |
|---|---|---|---|
| 19-01-2014 | 458.30 | 4.20 | 631.93 |
| 16-02-2014 | 457.07 | 2.97 | 407.93 |
| 16-03-2014 | 456.84 | 2.74 | 377.03 |
| 13-04-2014 | 454.66 | 0.56 | 182.38 |
| 11-05-2014 | 454.18 | 0.08 | 148.49 |
| 08-06-2014 | 453.70 | 0.40 | 107.77 |
| 06-07-2014 | 452.47 | 1.61 | 60.017 |
| 03-08-2014 | 452.70 | 1.40 | 68.306 |
| 31-08-2014 | 457.50 | 3.40 | 478.48 |
| 28-09-2014 | 459.10 | 05 | 822.62 |
| 26-10-2014 | 458.18 | 4.88 | 710.34 |
| 23-11-2014 | 457.83 | 3.73 | 537.46 |
| 21-12-2014 | 457.27 | 3.17 | 440.79 |

Source- Bori, Irrigation Section, Solapur

## 2. Water Level Variability:

Water levels fluctuated from a minimum of 0.08 meters (on 11-05-2014) to a maximum of 4.88 meters (on 26-10-2014). In May and June, water levels were alarmingly low, implying high water usage and evaporation rates. A notable increase occurs from July through September, likely attributable to monsoon rains replenishing the reservoir.

## 3. Relationship Between Gaze and Water Storage:

Higher Gaze values typically correspond with elevated water levels and storage. A distinct decline is recorded from January to June, with the lowest Gaze measuring 452.47 meters in July, aligning with minimal storage. A sharp increase in Gaze (459.10 meters, on 28-09-2014) corresponds to the peak storage level.

## 4. Seasonal Effects:

Pre-Monsoon Period (January-May): Storage declines due to water usage and evaporation. Monsoon Period (June-September): Storage increases, peaking in September. Post-Monsoon Period (October-December): A gradual reduction occurs as water is consumed.

## Key Insights during 2014:

**Seasonal Differences:** The dam's storage is significantly influenced by the monsoon season. Summer Water Shortage: The months of April to June show critically diminished storage levels. Effective Replenishment During Monsoon: Water levels exhibit a notable rise after July, indicating successful replenishment from monsoon rains. Gaze-Water Storage Correlation: Elevated gaze values are associated with increased storage, revealing a consistent trend in water level variations.

**Table.No.2.1.4 Gaze Report of 2015 at Kurnur dam.**

| Date of Sample collection | Gaze in Meter | Water level in Meter | Water storage in the dam MCFT |
|---|---|---|---|
| 18-01-2015 | 457.03 | 2.13 | 403.93 |
| 15-02-2015 | 454.92 | 0.82 | 200.82 |
| 15-03-2015 | 454.33 | 0.23 | 159.08 |
| 12-04-2015 | 453.79 | -0.31 | 111.33 |
| 10-05-2015 | 452.91 | -1.19 | 73.95 |
| 07-06-2015 | 451.15 | -2.15 | 39.90 |
| 05-07-2015 | 450.73 | -3.37 | 21.02 |
| 02-08-2015 | 449.20 | -4.90 | 6.09 |
| 30-08-2015 | - | Below dead storage | Less than 0.640 |
| 27-09-2015 | 449.70 | 1.70 | 8.36 |
| 25-10-2015 | 441.00 | 1 | 5.18 |
| 22-11-2015 | Dry | Below dead storage | Less than 0.5 |
| 20-12-2015 | Dry | Below dead storage | Less than 0.5 |

Source- Bori, Irrigation Section, Solapur

Note- Dry Gaze meter means when water level is far below dead storage and water is in patches along the baseline of river basin.

The dataset outlines Gaze (in meters), Water Level (in meters), and Water Storage (in MCFT) for the year 2015, reflecting the water status of the dam throughout the year.

### 1. Water Storage Trends:

Peak Storage: 403.93 MCFT (18-01-2015), representing the maximum level before it began to decline.Lowest Storage: Below Dead Storage (under 0.5 MCFT) in August, November, and December, signaling severe depletion.Significant Drop: By 02-08-2015, storage fell to 6.09 MCFT, emphasizing extreme water scarcity. Inadequate Replenishment: Unlike 2014, the monsoon recovery in September-October was not sufficient, leaving storage critically low.

### 2. Variations in Water Level:

Starting Water Level: 2.13 meters (January), which was already below optimal levels.
Sharp Decrease: Negative water levels from April (-0.31m) through August (-4.90m) indicate rapid depletion. Dead Storage Scenario: By August and in November-December, the dam was entirely dry, indicating a water crisis.

### 3. Connection Between Gaze and Water Storage:

A distinct downward trend in Gaze values corresponds with declining water levels and storage. Lowest Gaze Measured: 449.20 meters (02-08-2015), reflecting critical depletion. Insufficient Refilling: Even after the monsoon, Gaze values did not reach safe levels, suggesting inadequate rainfall or overuse.

### 4. Seasonal Influences:

Pre-Monsoon (Jan-May): Gradual depletion followed by a sharp decline in May-June.
Monsoon (June-Sep): Inadequate replenishment, leaving storage at crisis levels. Post-Monsoon (Oct-Dec): Ongoing dry conditions resulted in a nearly empty reservoir.

### Key Insights:

Severe Water Crisis: The year 2015 experienced an extreme decline, with storage dropping below dead storage levels on several occasions. Lack of Monsoon Recovery: Unlike 2014, the monsoon rains did not

significantly restore reservoir levels. Gaze-Water Level Link: Decreasing Gaze values coincide with alarmingly low storage and dry conditions. Risks to Agriculture and Domestic Water Supply: The water scarcity would have dramatically affected local farming and the availability of drinking water.

**The Gaze Report for 2016 highlights the following major trends:**

Severe Dry Conditions (Jan–July 2016). From January until early July 2016, the dam experienced a dry spell, with water levels falling beneath dead storage. Water storage consistently stayed under 0.5 MCFT, reflecting extreme drought conditions. Gradual Water Level Recovery (July–December 2016). By July 31, the water level had risen to 9.80 meters (456.80 meters gaze) with 371.52 MCFT of water stored. The highest level was noted in October at 459.10 meters gaze, 12.10 meters water level, and 822.62 MCFT storage. Water levels began to slightly decrease from November (798.09 MCFT) to December (733.28 MCFT), indicating seasonal depletion.

**Key Observations:**

The first half of the year was marked by severe drought, resulting in no measurable water. Water levels saw a substantial increase following July 2016, likely due to monsoon rainfall.The maximum storage was recorded in October 2016, after which there was a steady decline toward the end of the year.

**Table.No.2.1.5 Gaze Report of 2016 at Kurnur dam.**

| Date of Sample collection | Gaze in Meter | Water level in Meter | Water storage in the dam MCFT |
|---|---|---|---|
| 17-01-2016 | Dry | Below dead storage | Less than 0.5 |
| 14-02-2016 | Dry | Below dead storage | Less than 0.5 |
| 13-03-2016 | Dry | Below dead storage | Less than 0.5 |
| 10-04-2016 | Dry | Below dead storage | Less than 0.5 |
| 08-05-2016 | Dry | Below dead storage | Less than 0.5 |
| 05-06-2016 | Dry | Below dead storage | Less than 0.5 |
| 03-07-2016 | Dry | Below dead storage | Less than 0.5 |
| 31-07-2016 | 456.80 | 9.80 | 371.52 |
| 28-08-2016 | 458.17 | 11.17 | 604.72 |
| 25-09-2016 | 459.06 | 12.06 | 811.72 |
| 23-10-2016 | 459.10 | 12.10 | 822.62 |
| 20-11-2016 | 459.01 | 12.01 | 798.09 |
| 18-12-2016 | 458.75 | 11.75 | 733.28 |

Source- Bori, Irrigation Section, Solapur

Note- Dry Gaze meter means when water level was far below dead storage and water was in patches along the baseline of river basin.

**Table.No.2.1.7 Amount of rainfall at Tuljapur and Akkalkot Tehsil and average rainfall in the catchment area of Kurnur dam between 2014 to 2016.**

| Month | Amount of Rainfall in mm at Tuljapur station | | | Amount of Rainfall in mm at Akkalkot station | | | Average amount of rainfall | | |
|---|---|---|---|---|---|---|---|---|---|
| January | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 |
| February | 0 | 4.5 | 0 | 0 | 3.1 | 0 | 0 | 3.8 | 0 |
| March | 13.9 | 0 | 5.3 | 9.3 | 0 | 0 | 11.6 | 0 | 2.65 |
| April | 19.9 | 12.2 | 20.7 | 55 | 13.6 | 0 | 37.45 | 12.9 | 10.35 |
| May | 0 | 44.2 | 6.9 | 0 | 22.4 | 0.3 | 0 | 33.3 | 3.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| June | 0 | 25.4 | 7.9 | 1.8 | 54.7 | 3.9 | 0.9 | 40.05 | 5.9 |
| July | 41.5 | 63.4 | 175.5 | 12.8 | 49.7 | 91.9 | 27.15 | 56.55 | 133.7 |
| August | 100.6 | 19.4 | 256.6 | 97.6 | 6.6 | 140 | 99.1 | 13 | 198.3 |
| September | 255.6 | 117 | 87.8 | 229.5 | 68.1 | 27.5 | 242.55 | 92.55 | 57.65 |
| October | 104.2 | 127.1 | 263.8 | 59.3 | 84.1 | 165.5 | 81.75 | 105.6 | 214.65 |
| November | 22.5 | 74 | 60.1 | 33.4 | 42.9 | 31.6 | 27.95 | 58.45 | 45.85 |
| December | 13.9 | 0 | 0 | 29.1 | 4.8 | 0 | 21.5 | 2.4 | 0 |

Source- IMD (Indian Metrological Department, Pune)

## Climatic Characters of catchment area- Atmospheric temperature

### Table.No.2.1.8 Maximum, Minimum and average atmospheric temperature at Kurnur dam in 2014.

| Meteorological data on specific date | | Temperature (Maximum) In $^0$C | Temperature (Minimum) In $^0$C | Temperature (Average) In $^0$C |
|---|---|---|---|---|
| Summer | 16-02-14 | 29.4 | 15.6 | 22.5 |
| | 16-03-14 | 36.5 | 21.6 | 29.05 |
| | 13-04-14 | 40.5 | 21.6 | 31.05 |
| | 11-05-14 | 38.5 | 23.1 | 30.8 |
| Rainy | 08-06-14 | 38.1 | 24.6 | 31.35 |
| | 06-07-14 | 36.3 | 24.7 | 30.5 |
| | 03-08-14 | 33 | 22.6 | 27.8 |
| | 31-08-14 | 28.3 | 22.2 | 25.25 |
| | 28-09-14 | 34.7 | 22.5 | 28.6 |
| | 26-10-14 | 22.8 | 21.01 | 21.91 |
| Winter | 23-11-14 | 31.6 | 17.6 | 24.6 |
| | 21-12-14 | 29.5 | 11.9 | 20.7 |

### Table.No.2.1.9 Maximum, Minimum and average atmospheric temperature at Kurnur dam in 2015.

| Meteorological data on specific date | | Temperature (Maximum) In $^0$C | Temperature (Minimum) In $^0$C | Temperature (Average) In $^0$C |
|---|---|---|---|---|
| Winter | 18-01-15 | 32.6 | 13.01 | 22.81 |
| Summer | 15-02-15 | 35.8 | 16.6 | 26.2 |
| | 15-03-15 | 35.8 | 22.3 | 29.05 |
| | 12-04-15 | 31.5 | 21.2 | 26.35 |
| | 10-05-15 | 39.01 | 25.1 | 32.06 |
| Rainy | 07-06-15 | 38.3 | 24.6 | 31.45 |
| | 05-07-15 | 35.9 | 22.5 | 29.2 |
| | 02-08-15 | 35.7 | 23.3 | 29.5 |
| | 30-08-15 | 34.1 | 22.6 | 28.35 |
| | 27-09-15 | 35.8 | 22.6 | 29.2 |
| | 25-10-15 | 35.7 | 24.1 | 29.9 |
| Winter | 22-11-15 | 31.6 | 22.5 | 27.05 |
| | 20-12-15 | 34.1 | 20 | 27.05 |

**Table.No.2.2.0 Maximum, Minimum and average atmospheric temperature at Kurnur dam in 2016.**

| Meteorological data on specific date | | Temperature (Maximum) In $^0$C | Temperature (Minimum) In $^0$C | Temperature (Average) In $^0$C |
|---|---|---|---|---|
| Winter | 17-01-16 | 30.8 | 18.2 | 24.5 |
| Summer | 14-02-16 | 36.01 | 20.6 | 28.31 |
| | 13-03-16 | 37.4 | 25.4 | 31.4 |
| | 10-04-16 | 41.3 | 24.4 | 32.85 |
| | 08-05-16 | 41.4 | 26.6 | 34 |
| Rainy | 05-06-16 | 32.4 | 21.4 | 26.9 |
| | 03-07-16 | 30.8 | 23.3 | 27.05 |
| | 31-07-16 | 28.4 | 20.5 | 24.45 |
| | 28-08-16 | 32.1 | 22.6 | 27.35 |
| | 25-09-16 | 29.6 | 19.7 | 24.65 |
| | 23-10-16 | 33.9 | 19.7 | 26.8 |
| Winter | 20-11-16 | 32.9 | 14.5 | 23.7 |
| | 18-12-16 | 31.9 | 14.9 | 23.4 |
| | 19-01-17 | 31.2 | 16.2 | 23.7 |

## DISCUSSION

### 1. Summary of Water Storage Trends

2014: Water levels fluctuated but remained above dead storage, peaking in September (822.62 MCFT). 2015: The dam experienced a severe decline, reaching below dead storage by August 2015, and remained dry in November and December. 2016: The worst year initially, with no measurable water storage until late July. However, it recovered significantly, peaking again in October (822.62 MCFT).

### 2. Rainfall Trends

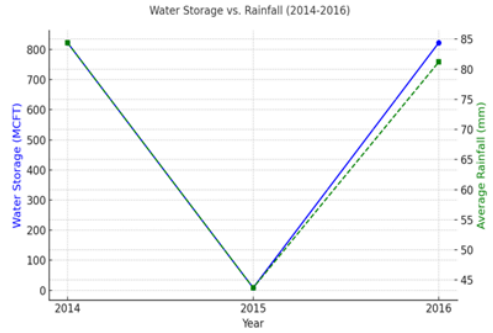
2014: The highest rainfall occurred in September (242.55 mm), contributing to the highest water storage. 2015: Overall much lower rainfall than in 2014, especially in July (56.55 mm) and September (92.55 mm), leading to severe drought and empty storage. 2016: Extremely low rainfall in the first half of the year but very high rainfall in August (198.3 mm) and October (214.65 mm), leading to a rapid increase in water levels.

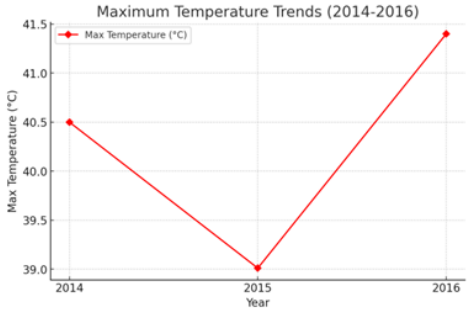
### 3. Temperature Trends

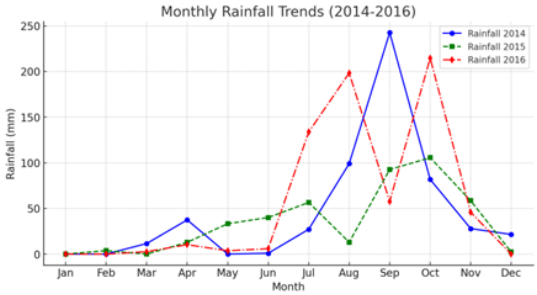
2014: Moderate temperatures, with summer max at 40.5°C (April). 2015: Hotter overall, with max temp 39.01°C (May). 2016: Hottest, peaking at 41.4°C (May), likely exacerbating evaporation and water scarcity early in the year.

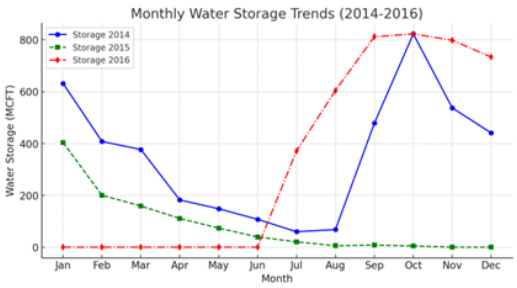
### 4. Correlation Analysis

Rainfall Directly Affects Water Storage: In 2014, steady rainfall supported stable storage levels. In 2015, lower rainfall resulted in drastic depletion. In 2016, late but intense monsoon rainfall replenished the dam. High Temperatures Exacerbate Water Loss: 2016's record heat coincided with the worst early-year water crisis. Lower summer temperatures in 2014 likely reduced evaporation rates, aiding water retention.




Water Storage vs. Rainfall (2014-2016)
This shows that higher rainfall correlates with better water storage (2014 & 2016 had high rainfall and high storage, while 2015 had both low rainfall and severe depletion).
Maximum Temperature Trends (2014-2016)
2016 had the highest recorded temperature, which likely contributed to the rapid evaporation of water before the monsoon replenished it.
Monthly Rainfall Trends (2014-2016)
2014 had the highest rainfall in September, explaining the high storage in that period.
2015 had very low rainfall overall, especially in key months, leading to the worst drought.
2016 had very low rainfall until July, but strong monsoon rains in August-October restored water levels.
Monthly Water Storage Trends (2014-2016)
2014 maintained moderate water storage throughout, peaking in September-October.
2015 showed a steady decline, reaching almost zero storage by November-December.
2016 started at dead storage but recovered drastically from July onward.
This clearly highlights how rainfall directly controls water storage, with drought years (2015) showing a severe impact.

## CONCLUSION

Kurnur Dam play a vital role in the development of human society and the preservation of the environment. These water storage areas are formed by constructing dams across Bori river in naturally occurring hollows that collect and hold water. Kurnur Dam serve essential purposes for various human activities, including irrigation, potable water provision, hydroelectric energy production, flood management, and leisure activities. Their importance goes beyond just human advantages, as they also promote biodiversity and contribute to maintaining ecological equilibrium. It has greater significance in concern to water supply and irrigation, flood control and disaster Management, ecological and environmental benefits and recreational and tourism opportunities. It has several challenges that needs its sustainable management.

In 2015 it was a drought year due to significantly lower rainfall and slightly higher temperatures. 2016 saw an extreme recovery after a severe dry phase, thanks to heavy monsoon rains in August–October. Rainfall is the dominant factor, but temperature amplifies water loss during hot, dry months.

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