

Impact of Geomorphology on Land Use and Water Resources: A Geospatial Analysis of Watershed 2D2A4, Eastern Rajasthan

Dr. Harnam Singh*

Assistant Professor, Baijnath Chaudhary Government College for Women, Nangal Chaudhary, Mahendragarh, Haryana.

*Corresponding Author: harnam.yadav@gmail.com

Citation: Singh, H. (2026). Impact of Geomorphology on Land Use and Water Resources: A Geospatial Analysis of Watershed 2D2A4, Eastern Rajasthan. International Journal of Global Research Innovations & Technology, 04(03), 212–216. <https://doi.org/10.62823/ijgrit/04.03.9554>

ABSTRACT

The present study examines the interrelationship between geomorphology, land use/land cover and water bodies in watershed 2D2A4. The watershed, covering morel reservoir catchment, is characterized by diverse geomorphic unit ranging from Aravali denudational hills to alluvial plains. Geomorphic units and land use were calculated by SRTM DEM data using Arc GIS. High relief and high drainage density lead to wasteland and water scarcity, whereas low relief and low drainage density lead to agriculture and water abundance. Study area 2D2A4 is a semi-arid watershed where eastern hills generate runoff and western plains store water and support agriculture. The significance of the study lies in identifying suitable sites for water harvesting structures based on geomorphic controls, which is crucial for suitable agricultural development in the region.

Keywords: Land Use, Water Bodies, Watershed, Geomorphology, Eastern Rajasthan.

Introduction

The present study was conducted in Watershed 2D2A4, one of the five watersheds within the Morel River Basin. It is the third-largest watershed in the basin and forms part of the Dund–Morel River drainage system. The watershed is situated on the eastern side of the Aravalli Range. The study area extends between 26°10' N and 26°40' N latitude and 75°50' E and 76°40' E longitude. It is covered by the Survey of India topographical sheets 45N/14, 54B/2, 54B/3, 54B/7, 54B/8, 54B/11, and 54B/12.

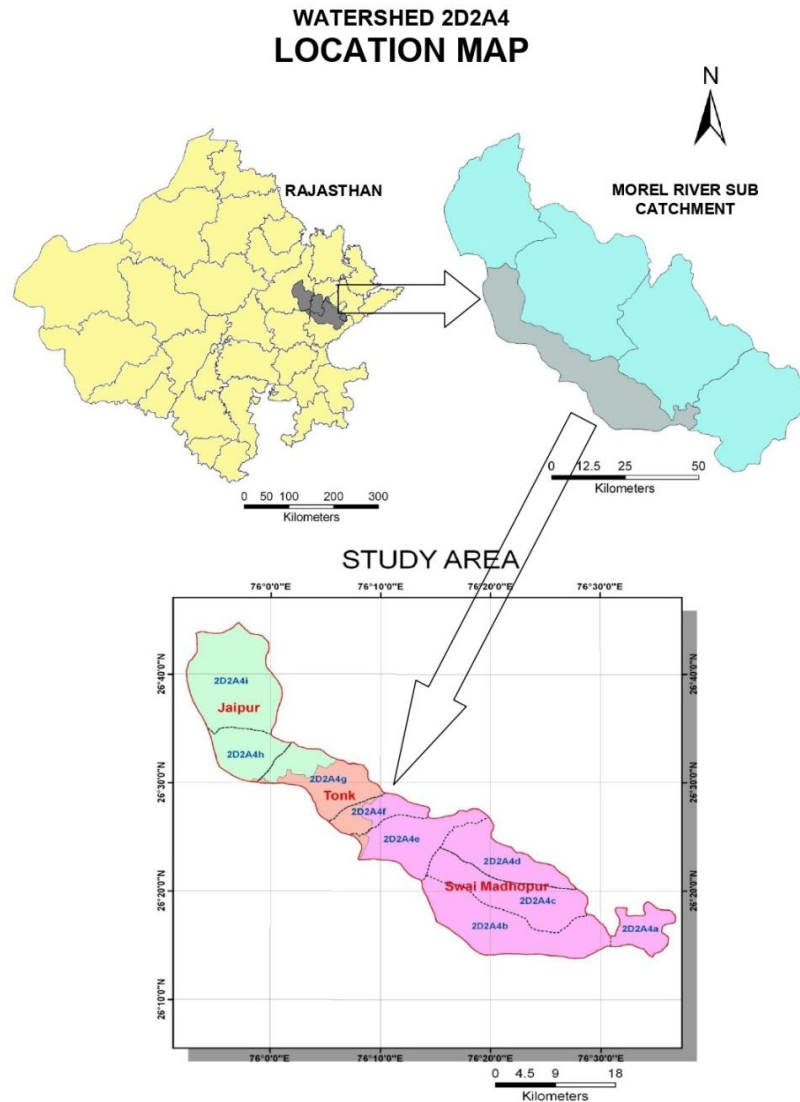
Administratively, the study area includes parts of Sanganer, Bassi, and Chaksu tehsils of Jaipur District; Niwai tehsil of Tonk District; and Bonli, Malarna Dungar, Bamanwas, and Sapotra tehsils of Sawai Madhopur District. The total geographical area of the watershed is 1,027 hectares.

The watershed is further subdivided into nine sub-watersheds and 116 micro-watersheds, facilitating detailed analysis and effective watershed management.

The significance of land resources is closely linked to the availability and management of water resources. Consequently, the integrated study and planning of land and water resources within a watershed framework have become increasingly important for sustainable resource management. In the present study, the watershed code 2D2A4 was adopted from the Watershed Atlas of India. The hierarchical classification of the watershed code is presented below:

Code	Classification	Description
2	Region	The Ganga System
D	Basin	The Chambal System
2	Catchment	The Banas System
A	Sub-catchment	The Morel System
4	Watershed	Part of the Morel System

Watershed 2D2A4 comprises a total of 290 villages, of which 272 villages were selected for the present study.



Aims

- To assess the correlation between geomorphology, land use and water resource.
- To identify priority micro watersheds for water conservation and sustainable management.

Methodology

A Digital Elevation Model (DEM) was downloaded from USGS Earth Explores. Using 3D Analyst tool in Arc GIS, contours interval were generated. The geomorphology map was obtained from District Resource Map based on Geological Survey of India on 1:50,000 Scale. Different geomorphic Units such as denudational hills, pediment and alluvial plain were classified based on GSI classification. Land sat (2005) imagery with 30m resolution was used for LULC mapping. Geospatial analysis using GIS was performed to correlate geomorphic units with land use pattern and water bodies.

Geomorphology and Land use Combination

There is a strong positive correlation between geomorphology and land use. Geomorphic processes through erosion and deposition determine soil fertility and its erodibility, which ultimately

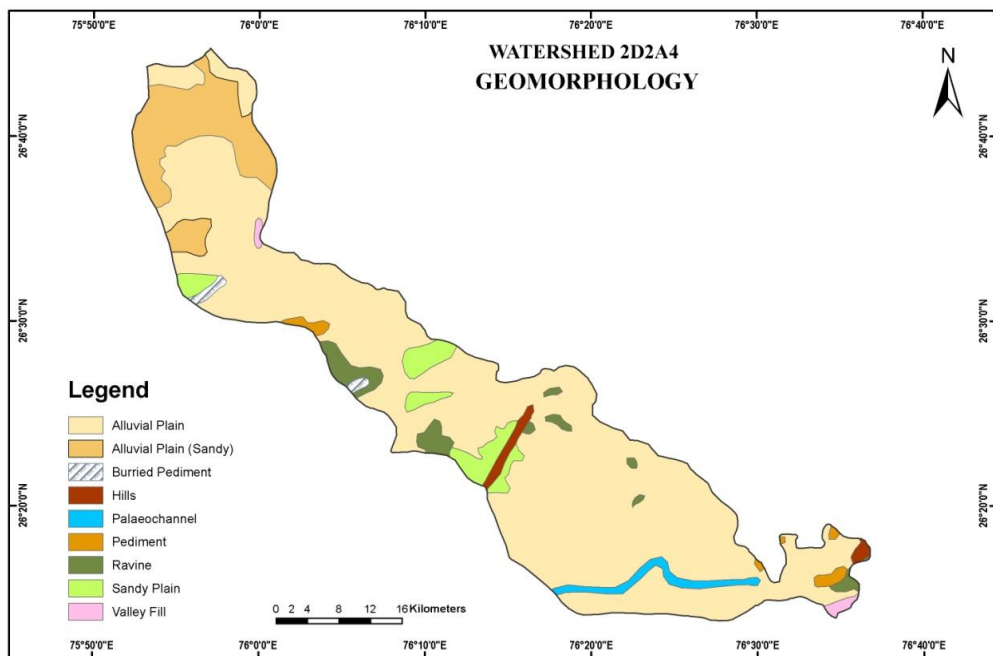
reflects in the land use pattern. With the help of remote sensing the geomorphology and land use of the study area were analyzed. The result show that 25% of the total watershed area is used for agriculture. This agricultural land is mainly concentrated in the alluvial plain land form, which itself covers about 18% of the watershed area. Furthermore 54% of the alluvial plain area is found to be fallow land whereas fallow land covers about 68% of the total watershed area. About 77% of the watershed area is covered by alluvial deposit, which is used for various land use purpose.

Table: Watershed 2D2A4
Geomorphology & Land Use Combination (in %)

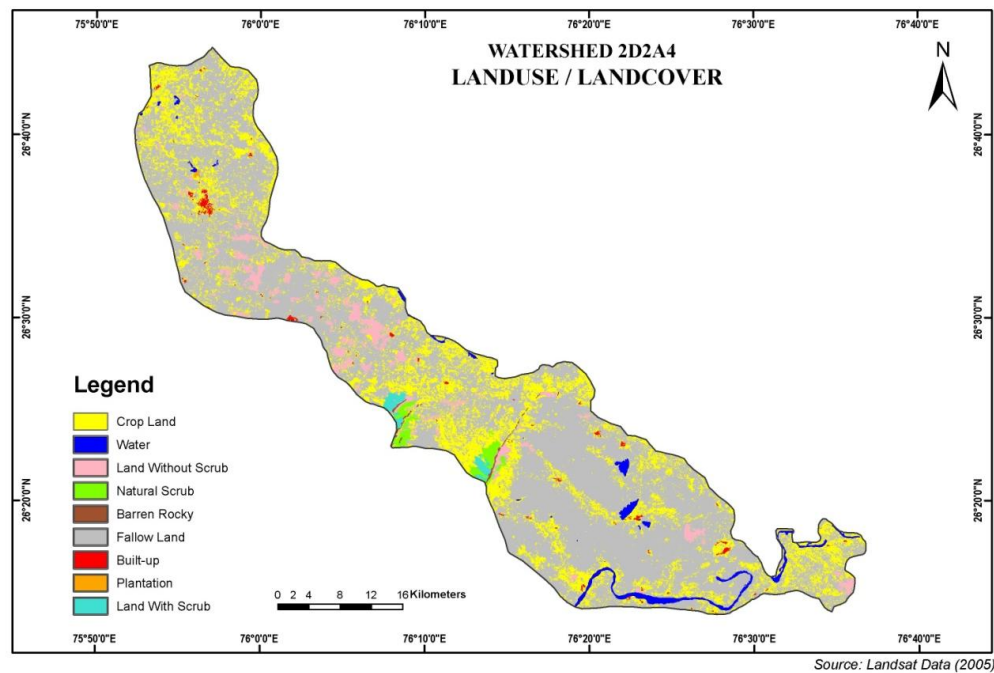
Geomorphology / Land Use	Cropped Land	Water Bodies	Land without Scrub	Natural vegetation	Barren Rocky	Fallow Land	Built-up Area	Plantation	Land with Scrub	Total
Alluvial Plain	17.82	1.51	2.77	0.41	0.08	54.25	0.44	0.03	0.34	77.66
Alluvial Plain (Sandy)	3.06	0.05	0.09	0.00	0.00	7.07	0.05	0.00	0.00	10.32
Upper Pediment	0.18	0.00	0.02	0.00	0.00	0.36	0.00	0.00	0.00	0.56
Hill	0.33	0.00	0.13	0.08	0.09	0.37	0.00	0.00	0.04	1.04
Palaeo Channel	0.27	0.10	0.01	0.00	0.00	1.22	0.00	0.00	0.00	1.60
Pediment	0.26	0.02	0.04	0.00	0.00	0.62	0.04	0.00	0.00	0.97
Ravine	0.71	0.01	0.40	0.00	0.00	1.86	0.01	0.00	0.00	2.99
Talus Plain	1.82	0.03	0.12	0.43	0.00	1.75	0.02	0.00	0.18	4.34
Valley Fill	0.11		0.05	0.00	0.00	0.35	0.00	0.00	0.00	0.51
Total	24.56	1.72	3.63	0.92	0.17	67.85	0.56	0.03	0.56	100.00

Source: Calculated by Researcher using Arc GIS

This combination clearly shows that land use pattern in the watershed is controlled by geomorphic characteristics and availability of water.



Source: District Resource Maps, Geological Survey of India, Western Region, Jaipur (2000)



Geomorphology and Water Bodies Combinations

Detailed analysis of Satellite imagery obtained through remote sensing reveals that the spatial distribution of water bodies is strongly controlled by geomorphic characteristics. An overlay analysis of geomorphology and surface water bodies was performed using GIS techniques to understand this relationship.

Table: Watershed 2D2A4
Geomorphology & Water Bodies Combination (in %)

Geomorphology	Area in Sq. KM	Percentage
Alluvial Plain	29.96	82.30
Alluvial Plain (Sandy)	2.78	7.64
Aeolian Plain/Sandy Plain	1.32	3.61
Valley Fill	0.85	2.33
Palaeo Channel	0.71	1.94
Pediment	0.32	0.87
Ravine	0.24	0.65
Hill	0.23	0.63
Buried Pediment	0.01	0.02
Total	36.41	100.00

Source: Calculated by Researcher using Arc GIS

The results reveal that 82.30% (29.96 sq.Km) of the total water bodies in watershed are located on the Alluvial Plain. This is attributed to the low slope, high infiltration capacity and presence of natural depressions which favour water accumulation. The Sandy alluvial plain account for 7.64% of water bodies, while Aeolian plain contributes 3.61%. Interestingly, valley fill (2.33%) and Palaeochannel (1.94%) together hold about 4.27% of water bodies. These are potential zone for ground water recharge as Palaeochannels act as a repository of water. On the other hand, hard rock geomorphic units like Pediment (0.87%), Ravine (0.65%), Hill (0.63%) and Buried Pediment (0.02%) have negligible water bodies due to high runoff and steep slope.

Conclusion and Findings

The overlay analysis of geomorphology, land use / land cover and water bodies in watershed reveals a strong geomorphic control on natural resources. The Alluvial Plain which covers 77.65% of the area is the most productive geomorphic unit, supporting 72.07% of the total agricultural land and 82.30%

of the surface water bodies. This indicates that alluvial plains are the most suitable sites for sustainable agriculture and water harvesting structures. Conversely hilly and pediment areas are unsuitable for water storage and cultivation due to high runoff and poor soil depth. The study suggests that watershed management plan should prioritize the conservation of water bodies on alluvial plains and construction of recharge pits along palaeochannels to ensure long term water security.

References

1. Babu, S.K. 2016. Geomorphological mapping using remote sensing and GIS for watershed prioritization. *Journal of Indian Society of Remote Sensing* pp. 75-88.
2. Dhruv, N. 1990. *Watershed Management*, Indian Council of Agricultural Research PUSA, New Delhi.
3. Garg, S.K. 1973. *Water Resource and Hydrology*. Khanna Publishers, New Delhi.
4. Kumar, P., & Singh, R. 2019. Geomorphic Control on Agricultural Land use and Water resources in Haryana region. *International Journal of Geomatics and Geosciences* pp. 345-357.
5. NRSC, 2006. *Manual of National Geomorphological and Lineament Mapping on 1:50,000 Scale*. National Remote Sensing Centre, ISRO, Hyderabad.
6. Singh, K. 1995. *Watershed Management: A case study of Anand Distt. Gujrat*.

