Physico-cultural determinants and Assessment of Barren Land in Shekhawati Region

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Abstract

The Shekhawati region of Rajasthan, encompassing the districts of Churu, Jhunjhunu, and Sikar, is situated in an arid to semi-arid climatic zone, marked by sandy soils, high evapotranspiration, and irregular rainfall. These physical constraints, combined with anthropogenic pressures such as overgrazing, deforestation, and unsustainable farming practices, have resulted in large tracts of barren land. Understanding long-term trends in barren land distribution is essential for effective land management and sustainable development in the region. This study presents a geographical analysis of barren land trends in the Shekhawati region over the period 2000–2021. Using secondary data from government land use records and satellite-based assessments, the research examines spatial and temporal changes in barren land across the three districts. Trend analysis is conducted to identify both reductions and expansions in barren land area, with attention to district-wise variations and influencing factors such as climatic fluctuations, irrigation expansion, and policy interventions. The findings indicate notable shifts in barren land coverage, reflecting the combined impact of environmental challenges and development initiatives. While certain areas have witnessed a decline in barren land due to afforestation, water harvesting, and agricultural expansion, others show persistence or even growth of wasteland due to desertification, groundwater depletion, and soil degradation. The study highlights the importance of continuous monitoring, integrated land use planning, and climate-resilient strategies to transform underutilized lands into productive assets.

Keywords: Barren land, sustainable land management, spatial analysis, wasteland-reclamation, arid agriculture.

Introduction:

Land is one of the most vital natural resources, forming the basis for agricultural production, settlement, infrastructure, and ecological balance. In arid and semi-arid regions such as Rajasthan, the availability and productive capacity of land are severely constrained by climatic and soil conditions. Within Rajasthan, the Shekhawati region comprising Churu, Jhunjhunu, and Sikar districts is characterized by sandy soils, low organic matter, extreme temperature variations, and erratic rainfall patterns. These conditions, along with anthropogenic factors such as overgrazing, deforestation, and unsustainable cultivation practices, have contributed to the existence of extensive barren and wasteland areas.

Barren land in the Shekhawati region is not merely an indicator of environmental degradation but also a reflection of socio-economic challenges. It represents underutilized potential that, if managed effectively, could contribute significantly to rural livelihoods, agricultural output, and ecological restoration. Conversely, persistent or expanding barren areas indicate the risks of desertification, declining soil fertility, and reduced carrying capacity of the land.

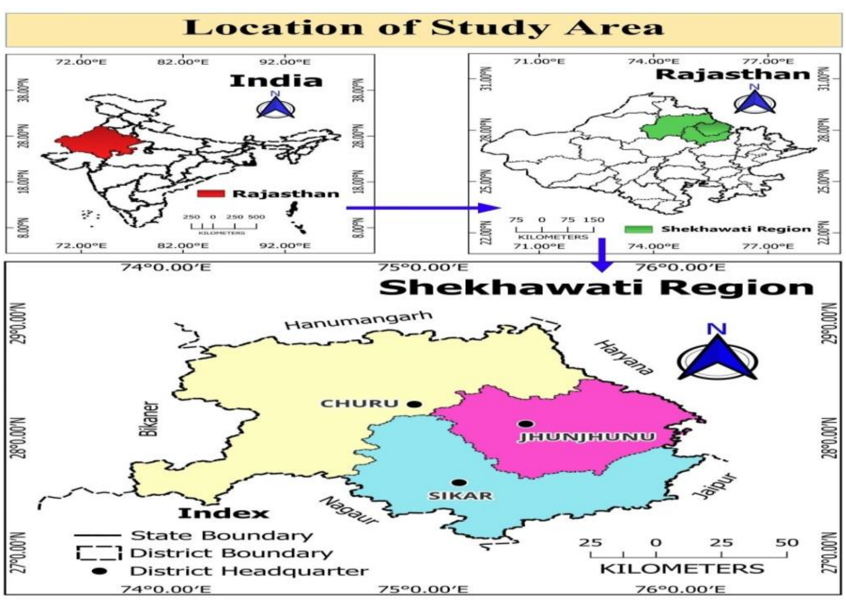
Over the last two decades, a variety of government schemes, non-governmental initiatives, and community-driven efforts — such as watershed development, afforestation, pasture improvement, and irrigation expansion — have aimed to reclaim or reduce barren lands. However, the effectiveness of these efforts can only be evaluated through systematic, long-term trend analysis. Studying changes in barren land coverage over time helps identify spatial patterns, understand the driving factors, and assess the impact of interventions.

Objectives of the Study:

1. To analyze the spatial and temporal trends of barren land
2. To compare district-wise changes in barren land area to examine the potential causes influencing changes in barren land**,**
3. To analyze the Impact of Barren Land in Support to Desertification

Study Area:

Shekhawati region which is located in the north-eastern part of Rajasthan state and the region has geographical extension from 26°26' to 29°20' N latitude and 74°44' to 76°34' E longitude on the map of Rajasthan. The region is covered by the Topographical Seat No. 44D, 44H, 44L, 44P, 45I, 45M, 53D. The region has 23 Panchayat Samitis in all. Thus, the region has 15 tehsils in total with its total 15343 sq. km. geographical area which makes 5.6% of the state's total. At the part of district-wise contribution by area point of view in Shekhawati region it is observed that Churu district contributes 29%, Jhunjhunu district contributes 31% and Sikar by 40% respectively. Shekhawati region contributes 7.02% of the state's total population (according to 2011 census). The region obtains high literacy rate which is about 10% more than Rajasthan state. Shekhawati region records high density 351 persons per sq. km area which is 75.26% more than that of Rajasthan state average density which is 201 persons per sq. km area (according to 2011 census). The natural climatic conditions in the region are very harsh and extreme. The temperature ranges from sub-zero Celsius in winter to more than 50°C in summer. The summer brings hot waves of air called loo. Annual rainfall is very low, around 45 to 60 cm. The ground water is as deep as 200 feet (60 m), and in places water is hard and salty. The people in the region depend on rainwater harvesting.



Barren land:

Stretches of terrain where soil fertility has plummeted and natural vegetation is virtually nonexistent—stands at the epicenter of the desertification crisis. Once a patchwork of grasses, shrubs, and trees anchoring the earth, these areas have been stripped by overgrazing, deforestation, unsustainable farming, or prolonged drought. The removal of that living cover sets off a cascade of degradation: without roots to bind particles, wind and rain relentlessly erode the delicate topsoil layer, washing or blowing away organic matter and essential nutrients that underpin plant growth.

In barren landscapes, rainfall no longer infiltrates to recharge underground aquifers; instead, it runs off in torrents, carving gullies and carrying precious sediments into downstream waterways. The loss of soil structure leads to crust formation—hard, impermeable surfaces that repel even light showers—so subsequent rainfall fails to penetrate at all. Simultaneously, exposed fine particles become airborne on windy days, generating dust storms that not only strip still more soil but also degrade air quality and threaten human health.

The ecological consequences extend far beyond a local patch of land. As bare expanses expand, the microclimate warms and dries: sunbaked soils radiate heat, local humidity falls, and convective rainfall events become less frequent. This self-reinforcing feedback loop ensures that, once a region tips into barrenness, natural recovery is extraordinarily slow or even impossible without human intervention. Native plants struggle to establish in compacted, nutrient-poor soils; invasive species—if they arrive—often lack the deep root systems needed to stabilize the ground.

Economically and socially, the advance of barren land undermines livelihoods. Pastoralists lose grazing grounds, farmers watch crop yields collapse, and rural communities are forced into migration or face deepening poverty. The shift from productive land to wasteland can strain food security, deplete water resources, and heighten conflict over the dwindling fertile areas that remain.

Recognizing barren land as both a symptom and accelerator of desertification is vital. Early, targeted interventions—such as planting drought-resistant vegetation, applying organic soil amendments, constructing contour bunds to slow runoff, or practicing controlled grazing—can arrest erosion and rebuild soil health. By restoring even, a modest vegetative cover, these measures interrupt the degradation feedback loop, improve water retention, and set the stage for natural regeneration. Thus, combating barren land is not merely an ecological imperative but a cornerstone of safeguarding agricultural productivity, community resilience, and the integrity of dryland ecosystems worldwide.

Impact of Barren Land in Support to Desertification:

Loss of Soil Stability and Nutrient Cycling

Barren land lacks the intricate network of plant roots that normally bind soil particles together. In fertile soils, roots weave through pores and aggregate mineral particles with organic glues produced by microbes, creating a stable structure that resists erosion. Once vegetation is gone, raindrops striking bare earth dislodge individual soil grains, initiating sheet and rill erosion that can remove several millimeters of topsoil in a single storm. Concurrently, wind scours the surface, especially when soils are dry and loose, lofting fine clay and silt particles in dust plumes. These processes strip away the most nutrient-rich horizons, depleting nitrogen, phosphorus, potassium, and organic carbon. As nutrient levels fall below thresholds needed for plant germination, biological activity declines further—microbes become scarce, root exudates vanish, and the cycle of nutrient cycling grinds to a halt. Without the continual turnover of organic matter by plants and soil fauna, the land remains locked in a low-fertility state.

Impaired Water Infiltration and Retention

Healthy soils act much like a sponge: their porous structure and organic matter content facilitate the absorption and gradual release of rainfall into deeper layers and aquifers. In contrast, barren soils often develop surface crusts—tight, impermeable layers formed by repeated wetting and drying or impact of raindrops—which repel water. Early rainfall then runs off at high velocity, carving gullies and transporting sediment into waterways. The vast majority of water is lost as overland flow and evaporation rather than replenishing soil moisture. Even when some water infiltrates, compacted subsoils impede its downward movement, forcing it to remain shallow where it quickly evaporates under high temperatures. The net effect is a precipitous drop in available water for plants, compounding aridity and making the land inhospitable to both pioneer and climax vegetation.

Positive Climatic Feedback Loops:

Bare patches of ground absorb more solar radiation than vegetated areas, causing surface temperatures to rise. This excess heat is then reradiated into the lower atmosphere, increasing local air temperatures and reducing relative humidity. Reduced humidity suppresses cloud formation and rainfall, transforming what might have been a transient dry spell into a longer-term drought. As conditions grow hotter and drier, even hardy shrubs struggle to survive; their loss further enlarges the barren area. This self-reinforcing loop—where land degradation promotes climatic drying, which in turn accelerates degradation—is a hallmark of desertification processes. Over time, the altered land–atmosphere interactions can shift regional climate patterns, extending the reach of arid conditions into formerly semi-humid zones.

Ecosystem and Livelihood Impacts:

The biological ramifications of expanding barren land ripple through entire ecosystems. Loss of native grasses and shrubs eliminates habitat and forage for herbivores, from insects to larger mammals, disrupting food webs and pollination networks. Soil moisture deficits hinder the germination of both indigenous and introduced species, reducing biodiversity and ecosystem resilience. Human communities that depend on these landscapes suffer as well. Pastoralists face dwindling grazing grounds and may overuse the remaining green patches, hastening their decline. Farmers experience reduced crop yields and may resort to deeper plowing or more chemical inputs, which can further degrade soil structure and soil life. Economic stress drives rural-to-urban migration, placing pressure on urban infrastructures and services. In extreme cases, competition over the few remaining fertile tracts can spark conflict, turning environmental degradation into a catalyst for social instability.

TOTAL BARREN LAND AREA IN JHUNJHUNU DISTRICT:

Total geographical area of Jhunjhunu district is 591536 hectare. In Jhunjhunu district of Rajasthan, where rainfall is low and temperatures swing between very hot days and cold nights, large patches of land have become unproductive and dry. You'll often find these barren areas as rocky patches with almost no topsoil, sandy stretches that shift with the wind, or salty spots where water has left the soil too harsh for plants. Over the years, heavy grazing by animals, cutting down shrubs for firewood, and letting sand dunes move unchecked have all made the problem worse. Farmers expanding fields without protecting the soil, and a lack of simple measures like bunds or check dams, have stopped the land from healing itself. To bring these lands back to life, people can collect and store rainwater, plant hardy trees and shrubs that survive on little water, and use local wisdom—like growing khejri trees that hold the soil and feed livestock. By mixing these old techniques with new ideas, communities in

Jhunjhunu can restore their land, grow food again, and protect their homes from further desert-like conditions.

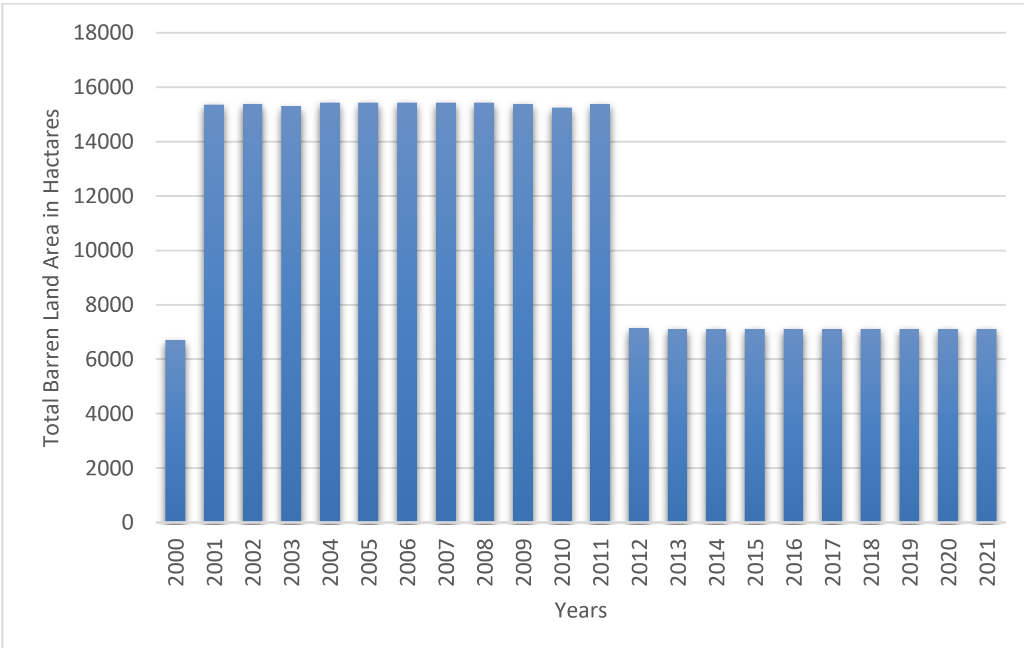
TABLE NO. 01: TOTAL BARREN LAND AREA IN JHUNJHUNU DISTRICT

YEAR	TOTAL AREA OF BARREN LAND	PERCENTAGE OF TOTAL DISRICT AREA
2000	6721	1.14
2001	15360	2.60
2002	15377	2.60
2003	15294	2.59
2004	15438	2.61
2005	15438	2.61
2006	15437	2.61
2007	15435	2.61
2008	15435	2.61
2009	15380	2.60
2010	15245	2.58
2011	15380	2.60
2012	7134	1.21
2013	7112	1.20
2014	7112	1.20
2015	7112	1.20
2016	7112	1.20
2017	7112	1.20
2018	7116	1.20
2019	7114	1.20
2020	7114	1.20
2021	7114	1.20

Source - District Statistical Outline, Jhunjhunu District, 2005,2010,2018,2023

FIGURE NO. 1:

TOTAL BARREN LAND AREA IN JHUNJHUNU DISTRICT



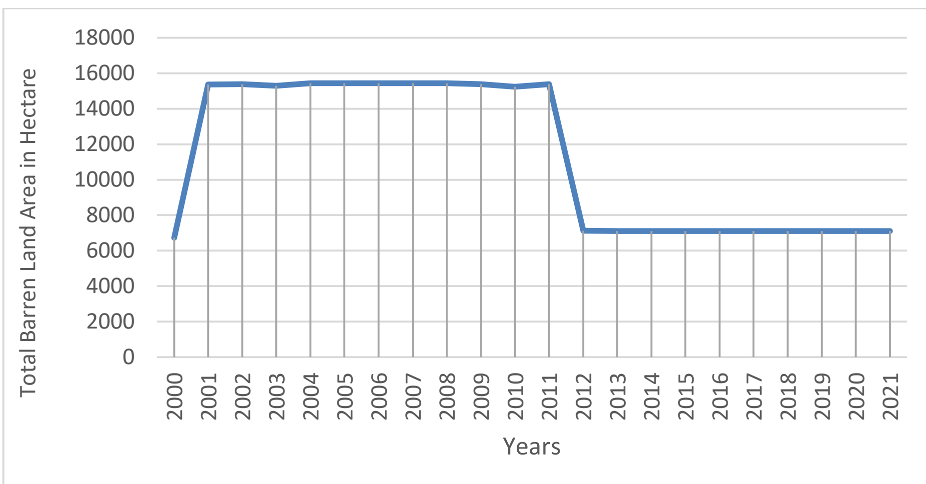
Trends of Barren Land Area in Jhunjhunu District:

The data indicates that in 2000–2001 Barren land more than doubled in one year, from 6721 ha (1.14 %) to 15360 ha (2.60 %). Whereas from 2001–2011 stability Area remained roughly between 15245 ha and 15438 ha, holding at about 2.58 – 2.61 % of the district. In 2012, barren area plunged back to 7134 ha (1.21 %), nearly mirroring the 2000 level. This could reflect a major land-use reclassification, large-scale reclamation efforts, or a data-reporting adjustment in the district statistical outline. From 2012 through 2021, barren land area hovered around 7112 – 7380 ha (1.20 – 1.21 %), indicating no further large-scale expansion of degraded land. The early 2000s surge highlights a critical phase of land degradation—likely driven by overgrazing, deforestation on marginal lands, and poor irrigation. The 2012 decline suggests either effective intervention (check dams, soil-moisture conservation) or a revision in methodology. The prolonged low plateau since 2012 points to a new equilibrium. Continued monitoring and targeted restoration could help reduce even this baseline of 1.2 % barren land. thus, it can be said that Jhunjhunu experienced a dramatic increase in barren land in the early 2000s, stabilizing at high levels through 2011. A sharp reversal in 2012 brought barren area back to just over 7000 ha, where it has remained nearly constant since—indicating either successful reclamation efforts or statistical adjustments in land-use reporting. Continuous interventions will be needed to drive the barren land percentage below this 1.2 % plateau.

Scene of barren land in Jhunjhunu district village Mandawara

FIGURE NO. 2:

Trends of Barren Land Area in Jhunjhunu District



TOTAL BARREN LAND AREA IN SIKAR DISTRICT:

Total Geographical area of the Sikar District is 773244 hectares. Barren land covers about 1.15% of Sikar's total area—approximately 8,900 hectares—amidst a largely agricultural landscape of 7,732 km². These uncultivable patches include rocky outcrops, saline/alkaline soils, and wind-blown sands, predominantly in western and north-western tehsils and along eroded drainage channels. Key factors expanding barren land are overgrazing, deforestation of marginal lands, poor irrigation leading to salinization, and wind erosion on loose soils. Loss of nearly 9,000 ha of productive land increases desertification risk, reduces groundwater recharge, and strains rural livelihoods through crop failures and potential migration. Reclamation efforts focus on afforestation with drought-tolerant species, soil-moisture conservation structures (bunds, check dams, ponds), salinity control (drainage, gypsum application), and regulated grazing to restore vegetation cover.

TABLE NO. 02:

TOTAL BARREN LAND AREA IN SIKAR DISTRICT – 2000-2021

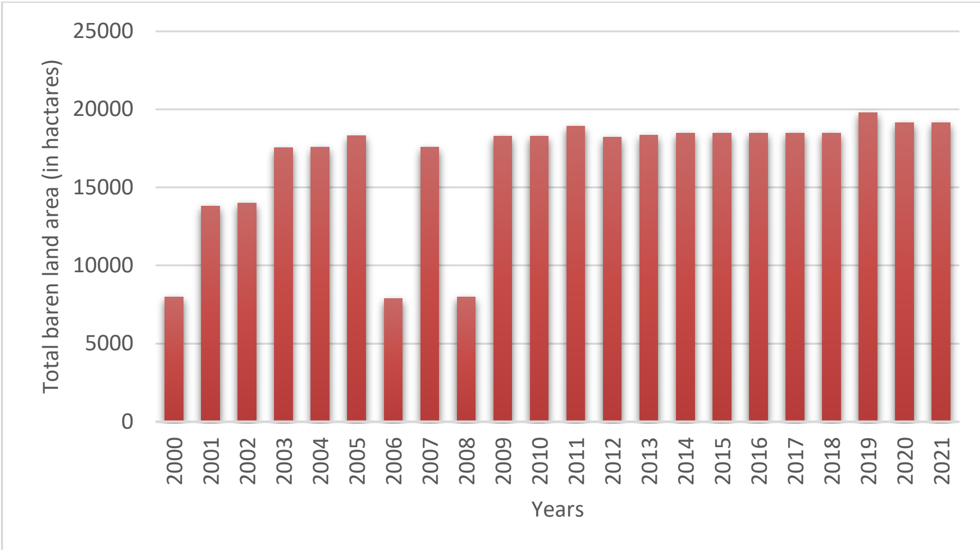
YEAR	TOTAL AREA OF BARREN LAND	PERCENTAGE OF TOTAL DISRICT AREA
2000	7990	1.03
2001	13807	1.78
2002	13986	1.81
2003	17537	2.27
2004	17569	2.27
2005	18299	2.36
2006	7875	1.02
2007	17578	2.27
2008	7990	1.03
2009	18291	2.36
2010	18291	2.36
2011	18915	2.44
2012	18200	2.35
2013	18350	2.37
2014	18472	2.39
2015	18471	2.39
2016	18483	2.39
2017	18481	2.39
2018	18481	2.39
2019	19785	2.5
2020	19148	2.4
2021	19147	2.4

Source - District Statistical Outline, Sikar District, 2005, 2010, 2018

Agriculture Statics of Rajasthan, 2018-19, 2020-21, 2022-23

FIGURE NO. 03:

TOTAL BARREN LAND AREA IN SIKAR DISTRICT – 2000-2021



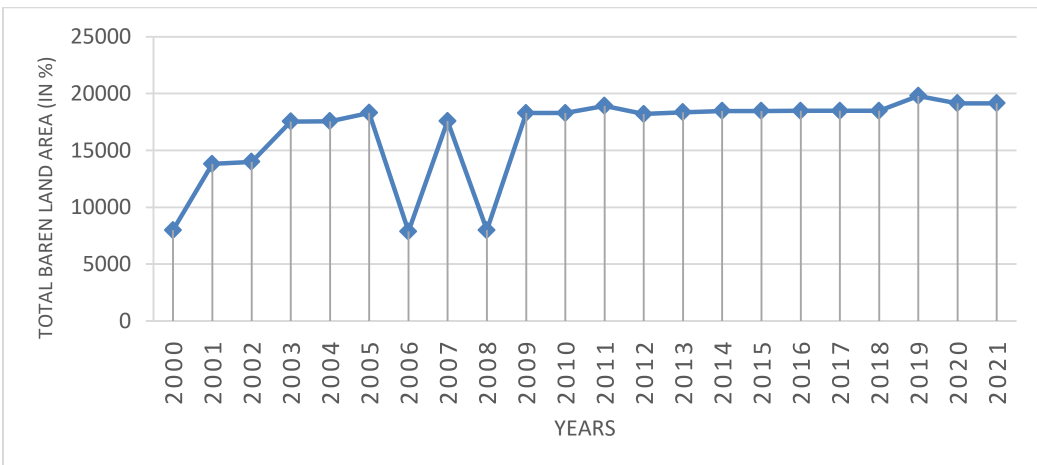
Trends of Barren Land Area in Sikar District:

In 2000, barren land covered just 7990 ha (1.03 % of the district). By 2017 it had more than doubled to 18481 ha (2.39 %), an increase of 131 % in absolute area and over 1.3 percentage points in relative terms. The most dramatic rise occurred between 2000 and 2005, when area grew from 7990 ha (1.03 %) to 18299 ha (2.36 %). This five-year span saw an average annual increase of roughly 2100 ha (≈0.26 % of total area) per year. In 2006 there is a pronounced dip to 7875 ha (1.02 %), nearly reverting to the 2000 level. This appears to be a data or land-use anomaly, as immediately in 2007 the figure rebounds to 17578 ha (2.27 %). From 2010 onward, barren land area levels off between 18 291 ha and 18915 ha, with the percentage fluctuating narrowly from 2.36 % to 2.44 %. By 2017, the district registers 18481 ha (2.39 %), indicating a plateau in degradation at roughly 18500 ha. The sharp rise in barren land through the early 2000s signals accelerating desertification pressures—likely driven by overgrazing, poor irrigation practices, and soil salinization. The stabilization after 2010 may reflect limits to further land degradation or the effect of reclamation measures (e.g., bunds, check dams, regulated grazing) taking hold. Thus, we can say that Sikar District has experienced a more than two-fold increase in barren land area over the last two decades, with most of that increase occurring before 2006. Since 2010, however, the total has remained relatively constant at around 18500 ha (≈2.4 % of the district), suggesting that while desertification remains a serious challenge, recent interventions may be helping to arrest its advance.

Scene of Barren Land at Sikar District, Palsana

FIGURE NO. 04:

Trends of Barren Land Area in Sikar District – 2000-2021



TOTAL BARREN LAND AREA IN CHURU DISTRICT:

Churu district, located in the Shekhawati region of Rajasthan, lies within an arid climatic zone where sandy soils, extreme temperature variations, and low rainfall contribute to the prevalence of barren land. Out of the district's total geographical area of 1,683,000 hectares, barren land has consistently occupied a notable proportion over the past two decades. The data for the period 2000–2021 reveals both fluctuations and periods of stability in the extent of barren land, indicating the influence of climatic conditions, land use practices, and reclamation efforts. Highest recorded barren land area was in 2000 at 59,885 ha, accounting for approximately 3.56% of the district's total geographical area. Lowest recorded value was in 2020 at 44,545 ha (2.65% of total area), indicating a notable decline from the initial year. Over the 21-year period, there is a net reduction of 11,227 ha in barren land area, representing an overall decrease of 18.75% compared to 2000. In the district 2000–2003

Continuous decline from 59,885 ha to 47,625 ha, possibly due to improved rainfall, afforestation drives, or temporary agricultural expansion. In 2004–2009 there was a Moderate fluctuation between ~47,900 ha and ~48,550 ha, suggesting a period of relative stability with minor seasonal influences. We can see that in 2015–2019 there was Slight fluctuations, with a dip to 47,258 ha in 2015 and again to 44,545 ha in 2020, pointing to possible reclamation projects, water harvesting initiatives, or favorable climatic years. And in 2021 an Increase to 47,658 ha, indicating a partial reversal of the decline witnessed in 2020, possibly due to drought conditions or crop failure leading to temporary abandonment of cultivated land.

TABLE NO. 02:

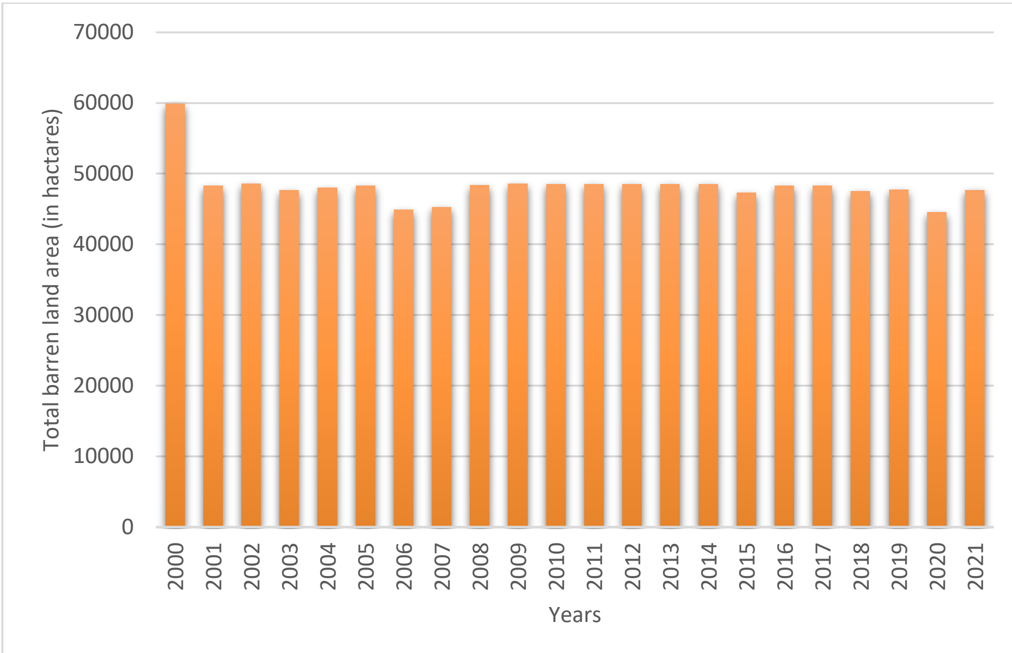
TOTAL BARREN LAND AREA IN CHURU DISTRICT – 2000-2021

YEAR	TOTAL AREA OF BARREN LAND	PERCENTAGE OF TOTAL DISRICT AREA
2000	59885	3.56
2001	48252	2.87
2002	48544	2.88
2003	47625	2.83
2004	47985	2.85
2005	48257	2.87
2006	44896	2.67
2007	45247	2.69
2008	48324	2.87
2009	48551	2.88
2010	48521	2.88
2011	48521	2.88
2012	48521	2.88
2013	48521	2.88
2014	48521	2.88
2015	47258	2.81
2016	48258	2.87
2017	48258	2.87
2018	47498	2.82
2019	47698	2.83
2020	44545	2.65
2021	47658	2.83

Source **-** District Statistical Outline, Sikar District, 2005,2010
Agriculture Statics of Rajasthan, 2018-19, 2020-21, 2022-23

FIGURE NO. 05:

TOTAL BARREN LAND AREA IN CHURU DISTRICT – 2000-2021

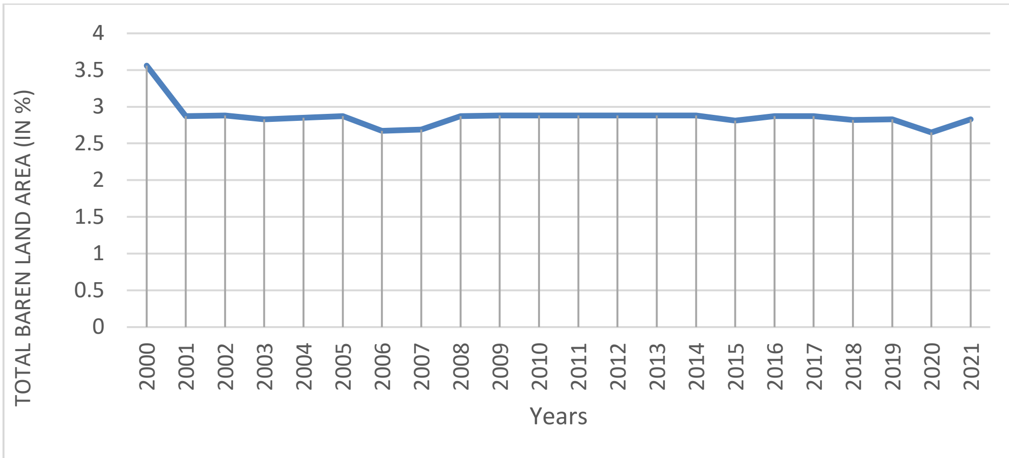


Trends of Barren Land Area in Churu District:

Between 2000 and 2021, Churu district saw a gradual but clear reduction in barren land, amounting to nearly one-fifth of its 2000 level. This suggests some success in land utilization initiatives, afforestation, and irrigation development. However, occasional increases in barren land, as seen in 2021, point to the vulnerability of the district to climatic shocks and the need for sustained, climate-resilient land management strategies. From 2000 to 2021, the extent of barren land in Churu district exhibited a generally declining trend with intermittent fluctuations. In 2000, barren land covered 59,885 hectares, accounting for about 3.56% of the district's total geographical area. A marked reduction occurred in the early years, falling to 47,625 hectares by 2003, likely due to improved rainfall conditions or temporary agricultural expansion. Between 2004 and 2009, the figures fluctuated moderately around 48,000 hectares, followed by a period of remarkable stability from 2010 to 2014, when the recorded area remained constant at 48,521 hectares. The subsequent years saw minor declines, reaching the lowest value of 44,545 hectares in 2020, reflecting an overall decrease of nearly 18.75% compared to 2000. However, 2021 registered a rise to 47,658 hectares, indicating a partial reversal of the previous year's decline, possibly due to drought conditions or land abandonment. Overall, the two-decade data indicate a gradual reduction in barren land, suggesting some success of reclamation and land management measures, though the district remains vulnerable to climatic variability.

FIGURE NO. 06:

Trends of Barren Land Area in Churu District – 2000-2021



Comparative analysis of all three district:

The barren land percentage data for the districts of Sikar, Churu, and Jhunjhunu over the period 2000–2021 reveals distinct spatial and temporal patterns, reflecting differences in physical geography, climate, and land management practices. Across the 22-year span, the combined trends suggest that while all three districts experience barren land as a notable land-use category, the extent, fluctuations, and long-term changes vary significantly. In the initial years (2000–2005), Churu recorded the highest barren land share, starting at 3.56% in 2000, far surpassing Sikar (1.03%) and Jhunjhunu (1.14%). This aligns with Churu's arid desert-like environment and sandy soils, which inherently limit intensive agriculture. During the same period, Sikar showed a notable upward shift, moving from 1.03% in 2000 to around 2.36% by 2005, suggesting possible climatic stress or declining soil productivity. Jhunjhunu's barren land percentage remained around 2.60%, indicating a stable but relatively higher share than Sikar in the early 2000s.

From 2006 to 2011, all three districts displayed distinctive trajectories. Sikar experienced sharp fluctuations, dropping to 1.02% in 2006 and rebounding above 2.3% in subsequent years, reflecting alternating land degradation and recovery phases. Churu maintained remarkable stability, with minor variations between 2.67% and 2.88%, reinforcing its status as a naturally barren-prone district. Jhunjhunu continued to hover between 2.58% and 2.61%, maintaining consistent barren land coverage, likely due to slow-changing land use and climatic influences.

A dramatic shift occurred in 2012 for Jhunjhunu, where barren land percentage plunged from 2.60% in 2011 to just 1.21% in 2012, a change sustained through 2021. This abrupt and permanent reduction indicates significant land reclamation efforts, possibly through irrigation expansion, afforestation programs, or conversion to agricultural or settlement land. This change is unique among the three districts, as neither Sikar nor Churu experienced such a long-term drop.

Between 2012 and 2021, Sikar's barren land percentage stabilized around 2.35%–2.40%, peaking at 2.50% in 2019. This stability suggests that while Sikar faces periodic climatic constraints, improved land-use management may have prevented further increases in barren land. Churu continued its long-standing trend of stability, fluctuating narrowly around 2.80%–2.88%, with only minor dips such as 2.65% in 2020. Jhunjhunu's post-2012 level remained at 1.20%, making it the district with the lowest barren land share in the last decade.

When viewed collectively, the average barren land percentage over the entire period clearly positions Churu at the top, Sikar in the middle, and Jhunjhunu at the bottom (post-2012). Churu's consistently higher values highlight the challenges of desert district land management, where climate limits the scope of large-scale reclamation. Sikar's moderate but fluctuating pattern indicates greater sensitivity to short-term climatic events. Jhunjhunu's sudden and sustained drop represents a rare example of large-scale and effective barren land reduction in a relatively short timeframe.

Statistical Analysis of Barren Land Data of all three Districts-

Variables: Barren land area (hectares) for **Churu, Sikar, Jhunjhunu** (2000–2021).

Descriptive statistics (per district):

- Mean – $\mu_\gamma = (\Sigma X_i) / N$

  Where Xi = individual data values, N = total number of observations
- Range – **Max-Min**
- Standard deviation (sample) $\sigma_\gamma = \sqrt{[\Sigma (X_i - \bar{X})^2 / (N - 1)]}$
- Coefficient of variation **(CV)** = $100 \times \sigma_\gamma / \mu_\gamma$ **(%)**
- **Linear trend (slope)**: Ordinary least squares of Area on Year (ha/year).

Standardization (comparative analysis across districts):

- For each **year**, compute a **Z-score** for each district:

$$Z_{dy} = (X_{dy} - \mu_\gamma) / \sigma_\gamma$$

where μ_γ and σ_γ are the mean and (population) SD **across the three districts in that year**.

- **Gross value** (district) GV = $\Sigma_\gamma Z_{dy}$ (sum of year-wise Z's over 2000–2021).
- **Composite Index (0–100):** Min–max normalize the three Gross values and scale to 0–100:

$$CI_d = 100 \times \frac{GV_d - \min(GV)}{\max(GV) - \min(GV)}$$

TABLE NO. 03 –STANDARDIZATION COMPARATIVE ANALYSIS ACROSS DISTRICTS

District	Years (N)	Mean (ha)	Median (ha)	Min–Max (ha)	Std. Dev. (ha)	CV %	Trend slope (ha/yr)
Jhunjhunu	22	11,984	11,113	6,721–15,438	3,966	33.1	−400
Sikar	22	16,882	18,291	7,875–19,785	4,123	24.4	+423
Churu	22	47,888	48,521	44,545–59,885	2,946	6.1	−850

TABLE NO. 04 –COMPARATIVE STANDARDIZED RESULTS USING THREE-DISTRICT TABLE

District	Gross Z (sum of Z-scores)	Composite Index (0–100)
Churu	**30.475**	**100.0**
Sikar	−11.711	14.32
Jhunjhunu	−18.764	0.0

Conclusion:

The present study focuses on analyzing trends in barren land across Churu, Jhunjhunu, and Sikar districts between 2000 and 2021. By examining both district-level and overall regional trends, the research seeks to identify areas of improvement as well as regions where degradation persists. The findings are expected to provide valuable insights for policymakers, planners, and environmental managers seeking to optimize land use, promote sustainable agriculture, and combat land degradation in the Shekhawati region. Findings reveal that while the physical constraints are formidable, the potential for productive utilization of barren lands is substantial if approached through integrated land management strategies, community participation, and climate-resilient practices. The study underscores the urgent need for policy support, institutional coordination, and awareness among local communities to ensure long-term ecological balance, economic viability, and food security. By offering a spatially informed and policy-oriented perspective, this research provides a framework that can be replicated in other semi-arid regions facing similar land resource challenges.

From 2000 to 2021, Churu district had the highest barren land area among the three districts. Its values stayed fairly stable over the years, with very small changes from year to year (low standard deviation = 2,946 ha, CV = 6.1%). There was also a slow decrease in barren land each year (trend = −850 ha/year). This shows that Churu is slowly improving, possibly because of better land management or reclamation work. In the standardized results, Churu always stayed above the average, giving it the highest Gross Z score and a Composite Index of 100, which means it ranks first among the three districts for barren land.

Sikar district showed a clear increase in barren land over the years. Its barren land more than doubled from 2000 to 2021. The year-to-year variation was moderate (standard deviation = 4,123 ha, CV = 24.4%). The positive trend (+423 ha/year) shows that the problem of barren land is growing steadily. However, even though it is increasing, Sikar mostly stayed below Churu in actual values. Its Gross Z score is negative (−11.71), and its Composite Index is 14.32, which shows that Sikar is second, but far behind Churu.

Jhunjhunu district had high variation in barren land over time (standard deviation = 3,966 ha, CV = 33.1%). From 2000 to 2011, the barren land stayed around 15,000 ha, but from 2012 onward, it suddenly dropped to about 7,100 ha and stayed flat. This sudden change could be due to large-scale reclamation work or a change in how data was measured. Jhunjhunu's Gross Z score is the lowest (−18.76), and its Composite Index is 0, showing that it stayed below the average most of the time.

Thus, in Overall Churu has the largest barren land but is slowly improving, Sikar is getting worse with a steady rise in barren land, and Jhunjhunu shows a sudden change that needs further study to understand the reason.

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