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Research Article

Dynamic Trends in Land Utilization: A Case Study of Sawai Madhopur District, 2017-2022

Praveen Meena[1*], Dr. Shyam S. Khinchi[2],

[1*]Research Scholar Department of PG Studies in Geography Dr. Bhim Rao Ambedkar Government College, Sri Ganganagar, Maharaja Ganga Singh University, Bikaner (Rajasthan) INDIA, Mail: praveen.meena69@gmail.com
[2]Professor & HoDDepartment of PG Studies in Geography Dr. Bhim Rao Ambedkar Government College, Sri Ganganagar, Maharaja Ganga Singh University, Bikaner (Rajasthan) INDIA, Mail: shyamsunderkhinchi001@gmail.com

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ABSTRACT

This study investigates the dynamic trends in land utilization within Sawai Madhopur district over a five-year period from 2017 to 2022. Using statistical analysis of land use data across various categories, including forest area, non-agricultural land, barren land, and others, significant patterns and changes are identified. The findings reveal a notable increase in forest area, indicative of successful conservation efforts, alongside a steady rise in non-agricultural land use, reflecting ongoing urbanization and industrial development. Additionally, reductions in barren land signify effective land reclamation efforts, while stability in other categories suggests consistent land management practices. The implications of these findings for environmental sustainability, rural development, and policy formulation are discussed, along with avenues for future research and action. This study contributes to a deeper understanding of land utilization dynamics in Sawai Madhopur district and underscores the importance of sustainable land management practices for socio-economic and environmental well-being.

Keywords: Land Utilization, Sawai Madhopur District, forest area, non-agricultural uses, barren and unculturable land, other grazing lands & miscellaneous tree crops.

Introduction

The arrangement of land use within a region plays a crucial role in maintaining ecological equilibrium and serves as a key indicator of environmental health. It encompasses the management and transformation of natural landscapes into developed areas such as settlements, agricultural fields, and infrastructure. Land serves as the fundamental resource for human activities, thus understanding its utilization patterns is essential for sustainable development.

Land use studies are significant as they aim to elucidate the distribution of different land uses across various areas. The complexity and dynamism of land use patterns vary across regions, influenced by a multitude of environmental, socio-economic, and historical factors. The current land use pattern reflects the cumulative impact of prolonged environmental processes, tempered by human interventions and historical legacies.

Land use classification involves systematically categorizing different types of land based on their predominant uses and characteristics. This classification provides a structured framework for analyzing spatial patterns, identifying trends, and informing land management strategies. By categorizing land into distinct classes, it enables researchers and policymakers to discern underlying drivers of land use change and assess its implications for environmental sustainability and socio-economic development.

Land utilization is a vital aspect of geographical studies, reflecting the interplay between human activities and the natural environment. In the context of Rajasthan, India's largest state by area, understanding land use patterns is essential due to its diverse landscapes and unique challenges. This study focuses on the district of Sawai Madhopur in Rajasthan, known for its rich biodiversity and significant agricultural activities. The aim is to analyze the temporal changes in various land use categories over recent years, providing insights into how these changes impact the region's sustainable development and environmental management.

Sawai Madhopur, located in the southeastern part of Rajasthan, is renowned for its historical and ecological significance. The district is home to the Ranthambore National Park, a major wildlife sanctuary, and a popular tourist destination. The diverse land use in Sawai Madhopur includes agricultural fields, forests, pastures, and

non-agricultural uses such as urban and industrial areas. Understanding the changes in these land categories is crucial for several reasons.

Firstly, analyzing land utilization helps in assessing the impact of human activities on natural resources. This is particularly important in regions like Sawai Madhopur, where the balance between conservation and development is delicate. Secondly, it informs policy-making and land management practices, ensuring sustainable development that does not compromise the ecological integrity of the region. Lastly, such studies provide a historical perspective on land use changes, helping to predict future trends and prepare for potential challenges (Foley et al., 2005).

Review of literature

Rahman and Saha (2009) conducted a spatio-temporal examination of cropland and cropping patterns in the Bogra district of Bangladesh spanning 16 years. Their study revealed a predominance of mono crop cultivation, primarily rice, during the summer season, while winter witnessed the cultivation of potato and mustard. Notably, cropland grain area exhibited higher proportions during the winter season compared to summer. The analysis further unveiled that significant transformations occurred from current fallow land to cropland, encompassing rice, potato, and mustard cultivation during both summer and winter seasons. Spatially, changes in cropland were concentrated in the north, northwest, and southwest regions of the district. Additionally, cropping pattern analysis identified five major patterns, with rice-current fallow, rice-potato, and rice-mustard emerging as prominent ones. Among these, the rice-potato pattern exhibited the highest area change.

Similarly, Gulgun et al. (2009) documented a decrease in agricultural land and an increase in residential areas in Turkey's Akhisar district. Kodiwo and Okere (2012) explored spatial and temporal variations in agricultural land use intensity in Kenya's Nyakach District, noting an expansion in cultivated areas alongside variations in land use intensity and instances of land degradation. Gibson (2012) observed a decline in cultivated area in Iraq, while Espindola et al. (2012) reported an overall expansion of agricultural land in the Brazilian Amazon. (Sharma & Sharma, 2013) While olive cultivation is not a solution to all agricultural problems, it has provided crucial support to farmers previously restricted to traditional crops like bajra and grains. The rise in industrial production has increased the demand for olive oil, drawing interest from states such as Punjab, Haryana, and Orissa. India's dependency on imported olive oil highlights the potential for domestic production to reduce high prices. Although Rajasthan's harsh climate presents challenges similar to those faced in Israel, farmers are showing resilience in managing risks. The optimistic growth prospects for olive oil offer hope for farmers and the industry, underscoring the importance of local cultivation to stabilize prices and meet demand. Additionally, the health benefits of olive oil, especially in addressing India's diabetes epidemic, emphasize its value as a healthy dietary staple.

In Shandong province, Li, Yu, and Gong (2013) analyzed changes in cultivated land use intensity, highlighting declines in multiple-cropping and labor intensity alongside a rapid increase in capital intensity. They also noted variations in land productivity between economic and grain crops. Mewett et al. (2013) studied agricultural land use trends in Australia, noting an increase in cropping land and a decrease in grazing land area, alongside a reduction in farm size. Similarly, Salvati (2013) assessed agricultural land changes in Latium, Italy, noting increasing crop intensity indices in lowlands due to intensive crop management, while mountain areas exhibited decreasing trends due to traditional farming practices. Fu, Zhang, and He (2014) reported an increase in agricultural land in Northwest China, accompanied by changes in crop planting areas.

The use of Geographic Information System (GIS) and Remote Sensing (RS) has been instrumental in studying land use and cover changes, including agricultural land, as evidenced by the works of Allotey (2000), Sharma et al. (2015), and Utami and Ahamed (2018). Bilsborrow and Ogendo (1992) identified population growth and government policies as key drivers of agricultural land use changes in Latin America and Sub-Saharan Africa. Sikor and Truong (2002) attributed agricultural policy, technological advancements, and market dynamics as primary factors influencing agricultural land use change in Vietnam. Lambin, Geist, and Lepers (2003) highlighted economic, environmental, and social factors, along with government policies, as dominant drivers of agricultural land use change in Australia.

Wood, Tappana, and Hadjb (2004) conducted a study in South-Central Senegal, identifying sustainable intensification of agriculture, climate variations, population pressures, and development projects among eight categories of drivers influencing agricultural land use change. Similarly, Mottet, Ladet, Coque, and Gibon (2006) found agri-environmental policies and socio-economic factors such as age, education, and land ownership to be significant drivers of agricultural land use change in the Pyrenees National Park area of France. Amanor and Pabi (2007) identified technical and institutional development, labor movements, infrastructure development, and agricultural policies as major drivers of farming system changes in Ghana's Brong Ahafo Region. Alexander (2007) highlighted government policies and economic factors as influential in technology adoption and farming system changes in Laos, with governance issues affecting land allocation and trading.

Rahman (2009) observed agricultural land decrease in Pakistan's Dera Ismail Khan District due to land conversion for settlements, industrial growth, and infrastructure development, with contrasting impacts on different crop types. Liu, Li, Sun, and Yang (2009) attributed changes in crop land in China's Zuli river basin to government policies and population growth, while Wu et al. (2009) identified population growth, policy

changes, and market-oriented land management strategies as significant drivers of long-term agricultural landscape changes.

In Ghana, Braimoh (2009) linked cropland expansion to population growth and increased food demand. Rudnicki and Dubownik (2010) highlighted government land pooling policies driving land use changes in Poland's Kujavia-Pomerania region, while Azadi, Ho, and Hasfiati (2011) underscored rapid population growth and urbanization as global drivers of agricultural land conversion.

Brown and Schulte (2011) identified agricultural technology development, economic growth, and federal policies as key drivers of agricultural land changes in Iowa, USA. Zhao, Xiubin, Xin, and Hao (2012) attributed geographic concentration of agricultural land use in China to off-farm employment, commercialization, and regional advantages. Similarly, Kumar and Singh (2012) linked agricultural land use changes in India's eastern regions to urbanization, household characteristics, and land ownership.

Olaniyi, Abdulla, Ramli, and Sood (2013) associated industrialization and urbanization with negative impacts on agricultural land use changes in Malaysia, while Orimoogunje, Ndidi, and Ekanade (2013) attributed spatial agricultural land use changes in Nigeria to population growth, infrastructure development, and forest conversion. In Slovakia, Tarasovicova, Saksa, Blazik, and Faltan (2013) identified government policies as driving decreases in agricultural land.

Feike, Mamitimin, Li, and Doluschitz (2014) linked agricultural land use changes in China to population growth, labor availability, price dynamics, and government policies. Assefa and Bork (2014) associated demographic pressures, government interventions, and land tenure systems with agricultural land use changes in Ethiopia. Forbord, Bjorkhaug, and Burton (2014) identified techno-economic developments, social norms, and policy instruments as drivers of farmland control changes in Norway.

Munteanu et al. (2014) attributed agricultural expansion and abandonment in the Carpathian Basin to institutional and socio-economic factors, while Diack, Loum, Guisse, and Sane (2017) linked population growth, urbanization, and industrialization to farmland reduction in Senegal. Miheretu and Yimer (2017) identified education, family size, tenure security, and access to credit and extension services as determinants of increased agricultural activities in Ethiopia.

Meena (2022) mentioned in his study based on land utiligation in swai madhopur district that Land is a crucial natural resource that significantly influences a country's socio-economic status and regional development. The way land is used directly impacts the demographic and ecological systems, creating a cause-effect relationship. Changes in land use, driven by human activities such as settlements, commerce, forestry, and agriculture, transform natural landscapes. In agrarian economies like India, land use is vital and depends on factors like irrigation, fertilizers, high-yield variety seeds, agricultural mechanization, and advanced techniques. However, increasing population and demand have led to the degradation of land resources due to overexploitation. Without proper land use planning, issues such as soil degradation, declining groundwater levels, environmental pollution, and reduced agricultural land threaten food security, poverty alleviation, and livelihoods. Rajasthan, with its diverse agro-climatic regions, relies heavily on agriculture, contributing 25.19% to its Gross State Value Added (GSVA) in 2019-20. In the Sawai Madhopur District, which features both plains and undulating terrain, optimal land resource utilization through area-specific policies is essential for balanced regional development.

Research Questions

I How has the reporting area for land utilization and the forest area changed over the years?
II What are the temporal trends in the area under non-agricultural uses and land not available for cultivation?
III How has the extent of barren and unculturable land and permanent pastures and other grazing lands evolved over the years?
IV What changes have occurred in the land under miscellaneous tree crops and groves over the years?

Research Objectives

I To analyze the changes in the reporting area for land utilization and forest area over the years.
II To investigate the trends in the area under non-agricultural uses and land not available for cultivation over the years.
III To evaluate the evolution of barren and unculturable land and permanent pastures and other grazing lands over the years.
IV To assess the changes in land under miscellaneous tree crops and groves over the years.

Research Hypotheses

(H_{01}): There is no significant difference in the reporting area for land utilization over the years.
(H_{02}): There is no significant difference in the forest area over the years.
(H_{03}): There is no significant difference in the area under non-agricultural uses over the years.
(H_{04}): There is no significant difference in barren and unculturable land over the years.
(H_{05}): There is no significant difference in land not available for cultivation over the years.
(H_{06}): There is no significant difference in permanent pastures and other grazing lands over the years.
(H_{07}): There is no significant difference in land under miscellaneous tree crops and groves over the years.

Methodology

The study employs a longitudinal analysis of land utilization data from the district of Sawai Madhopur, covering a period from 2017-18 to 2021-22. The data is sourced from government records and reports, ensuring accuracy and reliability. Statistical methods, including analysis of variance (ANOVA), are used to test the significance of changes in each land use category. The results are then interpreted to draw conclusions about overall trends and their implications for land management in Sawai Madhopur.

Results analysis

Table-1 Reporting area for land utilizatio (in hectare)

Year	Reporting area for land utilization (in hectare)
2017-18	497145
2018-19	497148
2019-20	497148
2020-21	497148
2021-22	497148

Table 1 presents the reporting area for land utilization, measured in hectares, over a five-year period from 2017-18 to 2021-22. In 2017-18, the reporting area was 497,145 hectares. This figure slightly increased to 497,148 hectares in 2018-19 and remained constant at 497,148 hectares for the subsequent years of 2019-20, 2020-21, and 2021-22. The data indicates a minor initial increase followed by a stabilization in the reporting area used for land utilization over the observed period.

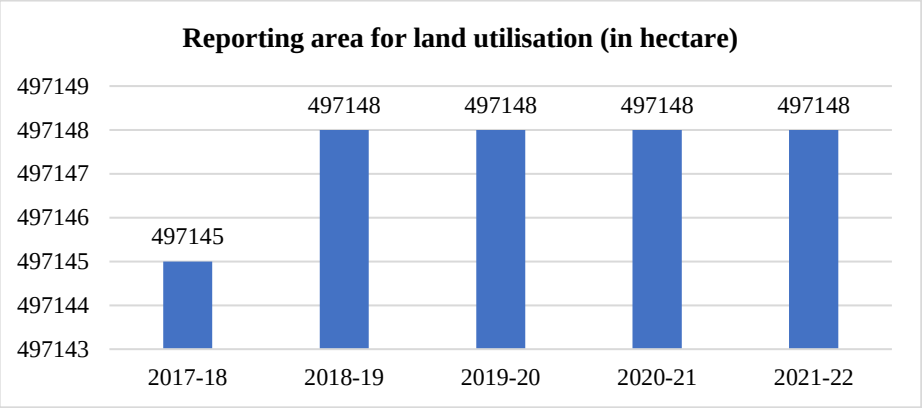

Table-2 Forest (in hectare)

Year	Forest (in hectare)
2017-18	82887
2018-19	82887
2019-20	82887
2020-21	82887
2021-22	83078

Table 2 details the area designated as forest, in hectares, over a five-year period from 2017-18 to 2021-22. For the first four years, from 2017-18 to 2020-21, the forest area remained stable at 82,887 hectares. In the final year, 2021-22, there was a slight increase, with the forest area expanding to 83,078 hectares. This table indicates a consistent forest area over the majority of the period, with a minor increase in the last year.

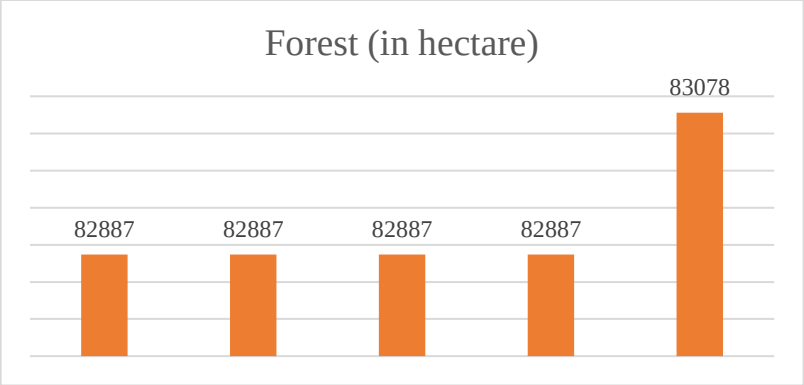

Table-3 Area under nonagricultural uses (in hectare)

Year	Area under nonagricultural uses (in hectare)
2017-18	31209
2018-19	31418
2019-20	31640
2020-21	31913
2021-22	31888

Table 3 shows the area under nonagricultural uses, measured in hectares, from 2017-18 to 2021-22. In 2017-18, the area was 31,209 hectares. This area increased each subsequent year, reaching 31,418 hectares in 2018-19, 31,640 hectares in 2019-20, and 31,913 hectares in 2020-21. However, in 2021-22, there was a slight decrease to 31,888 hectares. Overall, the table indicates a general upward trend in the area used for nonagricultural purposes over the five-year period, with a small decline in the final year.

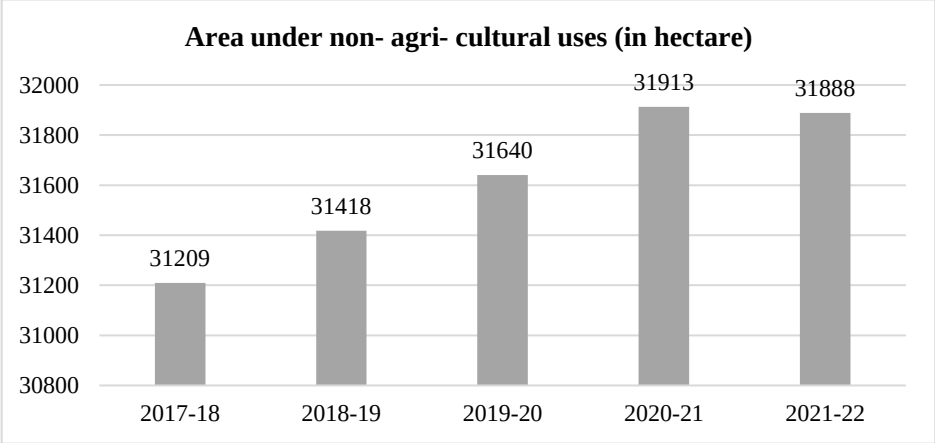

Table-4 Barren and un- culturable land (in hectare)

Year	Barren and un- culturable land (in hectare)
2017-18	32065
2018-19	31944
2019-20	30765
2020-21	30902
2021-22	30991

Table 4 outlines the area of barren and uncultivable land, measured in hectares, over a five-year span from 2017-18 to 2021-22. In 2017-18, the area was 32,065 hectares. It decreased to 31,944 hectares in 2018-19 and further declined to 30,765 hectares in 2019-20. However, there was a slight increase to 30,902 hectares in 2020-21 and a continued rise to 30,991 hectares in 2021-22. The table reflects an overall downward trend in barren and uncultivable land from 2017-18 to 2019-20, followed by a modest increase in the subsequent two years.

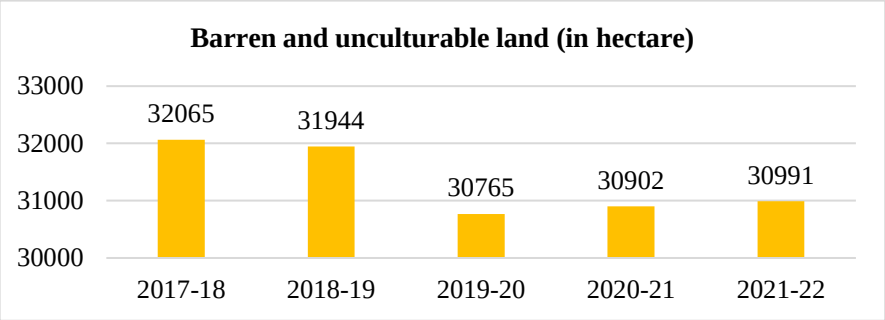

Table-5 Not available for cultivation (in hectare)

Year	Not available for cultivation (in hectare)
2017-18	63274
2018-19	63362
2019-20	62405
2020-21	62815
2021-22	62879

Table 5 presents the area not available for cultivation, measured in hectares, over a five-year period from 2017-18 to 2021-22. The area not available for cultivation was 63,274 hectares in 2017-18 and slightly increased to 63,362 hectares in 2018-19. However, there was a decrease to 62,405 hectares in 2019-20. In the following years, the area saw a slight recovery, increasing to 62,815 hectares in 2020-21 and 62,879 hectares in 2021-22. Overall, the table indicates some fluctuation in the area not available for cultivation, with an initial increase, followed by a notable decrease, and then a gradual rise in the later years.

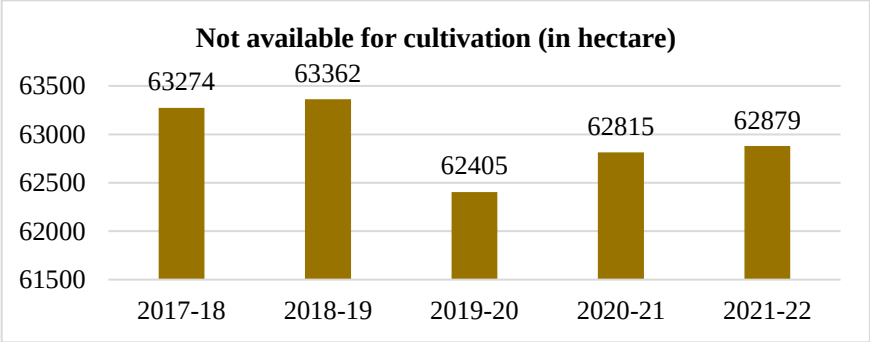

Table-6 Permanent pastures and other grazing lands (in hectare)

Year	Permanent pastures and other grazing lands (in hectare)
2017-18	26453
2018-19	26272
2019-20	25869
2020-21	24640
2021-22	26420

Table 6 outlines the area designated as permanent pastures and other grazing lands, measured in hectares, across a five-year span from 2017-18 to 2021-22. In 2017-18, the area occupied 26,453 hectares, showing a slight decrease to 26,272 hectares in 2018-19. This decline continued into the subsequent years, with 25,869 hectares in 2019-20 and 24,640 hectares in 2020-21. However, in 2021-22, there was a notable increase to 26,420 hectares. The table illustrates a fluctuating pattern, indicating a gradual decrease followed by a significant uptick in the last year, suggesting varying trends in land use for grazing purposes over the observed period.

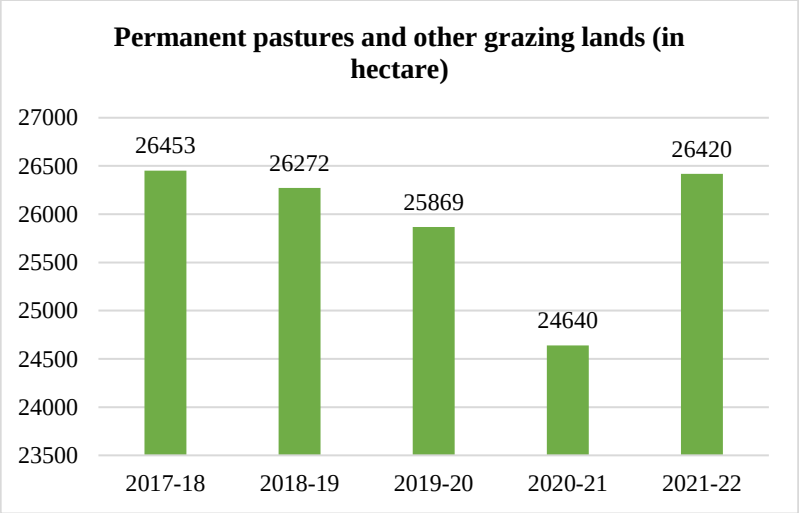

Table-7 Land under misctree crops and groves (in hectare)

Year	Land under misctree crops and groves (in hectare)
2017-18	2440
2018-19	2728
2019-20	3255
2020-21	4609
2021-22	8199

Table 7 illustrates the land area dedicated to miscellaneous crops and groves, measured in hectares, spanning from 2017-18 to 2021-22. The data shows a steady increase in land usage for miscellaneous crops and groves over the specified period. In 2017-18, the area occupied was 2,440 hectares, which gradually rose to 2,728 hectares in 2018-19 and further increased to 3,255 hectares in 2019-20. However, the most significant surge occurred in 2020-21, with the land area expanding notably to 4,609 hectares. This upward trajectory continued into 2021-22, with the land under miscellaneous crops and groves nearly doubling to 8,199 hectares. The table indicates a substantial expansion in the cultivation of miscellaneous crops and groves, suggesting potential shifts in agricultural practices or land use policies during the observed timeframe.

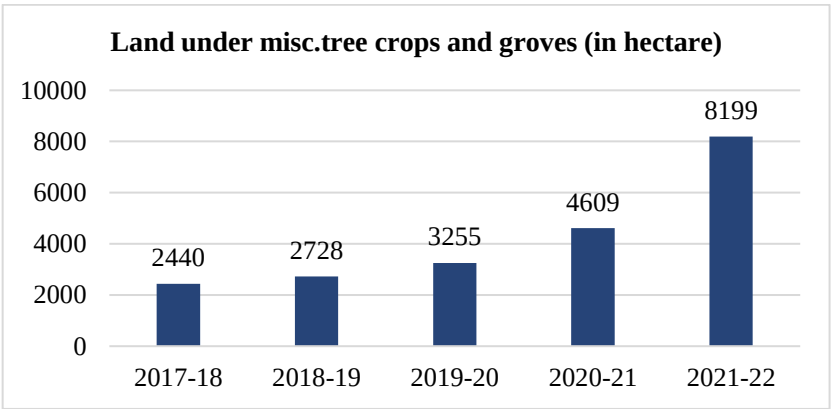

Table-8 consolidated land utilization statistics

Year	Reporting area for land utilizatio (in hectare)	Forest (in hectare)	Area under nonagricultural uses (in hectare)	Barren and un- culturable land (in hectare)	Not available for cultivation (in hectare)	Permanent pastures and other grazing lands (in hectare)	Land under misc tree crops and groves (in hectare)
2017-18	497145	82887	31209	32065	63274	26453	2440
2018-19	497148	82887	31418	31944	63362	26272	2728
2019-20	497148	82887	31640	30765	62405	25869	3255
2020-21	497148	82887	31913	30902	62815	24640	4609
2021-22	497148	83078	31888	30991	62879	26420	8199

The table provides a comprehensive overview of land utilization over a five-year period from 2017-18 to 2021-22. Various categories of land use are detailed, including forest area, land under non-agricultural uses, barren and uncultivable land, land not available for cultivation, permanent pastures and other grazing lands, and land under miscellaneous tree crops and groves. The reporting area for land utilization remains almost constant each year at approximately 497,148 hectares. Below is an analysis of each land use category:

- Forest Area - 2017-18 to 2021-22: The forest area has remained relatively stable over the five years, starting at 82,887 hectares in 2017-18 and slightly increasing to 83,078 hectares in 2021-22. This minor increase indicates a slight expansion or better conservation of forested areas.
- Area Under Non-Agricultural Uses - 2017-18 to 2021-22: There is a consistent increase in land used for non-agricultural purposes, from 31,209 hectares in 2017-18 to 31,888 hectares in 2021-22. This trend reflects urbanization and industrial development leading to more land being diverted from agriculture to non-agricultural uses.
- Barren and Uncultivable Land - 2017-18 to 2021-22: This category fluctuates slightly but shows a general decrease from 32,065 hectares in 2017-18 to 30,991 hectares in 2021-22. The reduction may indicate efforts to reclaim and make some barren lands cultivable or suitable for other uses.
- Land Not Available for Cultivation - 2017-18 to 2021-22: There is a slight decrease in land not available for cultivation from 63,274 hectares in 2017-18 to 62,879 hectares in 2021-22. This marginal reduction could be due to improved land management practices making more land available for agricultural or other productive uses.
- Permanent Pastures and Other Grazing Lands - 2017-18 to 2021-22: There is a notable decline in this category from 26,453 hectares in 2017-18 to 24,640 hectares in 2020-21, followed by an increase to 26,420 hectares in 2021-22. This fluctuation may reflect changing land management strategies or seasonal variations affecting pasture availability.
- Land Under Miscellaneous Tree Crops and Groves - 2017-18 to 2021-22: This category shows a significant increase from 2,440 hectares in 2017-18 to 8,199 hectares in 2021-22. The substantial growth suggests an intensified focus on agroforestry, horticulture, or the cultivation of tree crops and groves as a means of diversifying land use and income sources.

Over the five-year period, the overall land utilization statistics reveal trends of increasing non-agricultural land use and significant growth in land under miscellaneous tree crops and groves, indicating shifts towards urbanization and diversified agricultural practices. Despite minor fluctuations, the forest area remains stable, reflecting ongoing conservation efforts. The slight decrease in barren and uncultivable land suggests potential improvements in land reclamation. The data also indicate a generally stable but slightly declining area of land not available for cultivation, pointing to potential improvements in land management practices. The fluctuations in permanent pastures and grazing lands highlight the dynamic nature of land use influenced by various factors including policy changes and environmental conditions.

Table-9 Descriptives

	Mean	Median	SD	Minimum	Maximum
Reporting area for land utilizatio (in hectare)	497147	497148	1.34	497145	497148
Forest (in hectare)	82925	82887	85.42	82887	83078
Area under nonagricultural uses (in hectare)	31614	31640	303.15	31209	31913

Barren and un- culturable land (in hectare)	31333	30991	619.37	30765	32065
Not available for cultivation (in hectare)	62947	62879	385.67	62405	63362
Permanent pastures and other grazing lands (in hectare)	25931	26272	758.03	24640	26453
Land under misctree crops and groves (in hectare)	4246	3255	2361.46	2440	8199

Table 9 provides descriptive statistics for various land utilization categories measured in hectares. The mean, median, standard deviation (SD), minimum, and maximum values are reported for each category. For reporting area for land utilization, the mean and median values are approximately 497,147 and 497,148 hectares, respectively, with a small standard deviation of 1.34 hectares. Forest area exhibits a mean of 82,925 hectares, with a median of 82,887 hectares and a standard deviation of 85.42 hectares. Area under nonagricultural uses shows a mean of 31,614 hectares, a median of 31,640 hectares, and a larger standard deviation of 303.15 hectares. Barren and uncultivable land has a mean of 31,333 hectares, with a median of 30,991 hectares and a substantial standard deviation of 619.37 hectares. Similarly, the mean and median values for land not available for cultivation are 62,947 and 62,879 hectares, respectively, with a standard deviation of 385.67 hectares. Permanent pastures and grazing lands have a mean of 25,931 hectares, a median of 26,272 hectares, and a relatively high standard deviation of 758.03 hectares. Lastly, land under miscellaneous crops and groves has a mean of 4,246 hectares, a median of 3,255 hectares, and a wide standard deviation of 2,361.46 hectares, reflecting notable variation in this category. These descriptive statistics offer insights into the distribution and variability of land utilization across different categories

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Results

Table-10 Descriptives

	Year	Mean	Median	Minimum	Maximum
Reporting area for land utilizatio (in hectare)	2017-18	497145	497145	497145	497145
	2018-19	497148	497148	497148	497148
	2019-20	497148	497148	497148	497148
	2020-21	497148	497148	497148	497148
	2021-22	497148	497148	497148	497148
Forest (in hectare)	2017-18	82887	82887	82887	82887
	2018-19	82887	82887	82887	82887
	2019-20	82887	82887	82887	82887
	2020-21	82887	82887	82887	82887
	2021-22	83078	83078	83078	83078
Area under nonagricultural uses (in hectare)	2017-18	31209	31209	31209	31209
	2018-19	31418	31418	31418	31418
	2019-20	31640	31640	31640	31640
	2020-21	31913	31913	31913	31913
	2021-22	31888	31888	31888	31888
Barren and unculturable land (in hectare)	2017-18	32065	32065	32065	32065
	2018-19	31944	31944	31944	31944
	2019-20	30765	30765	30765	30765
	2020-21	30902	30902	30902	30902
	2021-22	30991	30991	30991	30991
Not available for cultivation (in hectare)	2017-18	63274	63274	63274	63274
	2018-19	63362	63362	63362	63362
	2019-20	62405	62405	62405	62405
	2020-21	62815	62815	62815	62815
	2021-22	62879	62879	62879	62879
Permanent pastures and other grazing lands (in hectare)	2017-18	26453	26453	26453	26453
	2018-19	26272	26272	26272	26272
	2019-20	25869	25869	25869	25869
	2020-21	24640	24640	24640	24640
	2021-22	26420	26420	26420	26420
Land under misctree crops and groves (in hectare)	2017-18	2440	2440	2440	2440
	2018-19	2728	2728	2728	2728
	2019-20	3255	3255	3255	3255
	2020-21	4609	4609	4609	4609
	2021-22	8199	8199	8199	8199

Table 10 presents descriptive statistics for various land utilization categories across the years 2017-18 to 2021-22. Each category includes the mean, median, minimum, and maximum values for the specified years. For the reporting area for land utilization, all years show consistent mean, median, minimum, and maximum values at 497,145, 497,145, 497,145, and 497,145 hectares, respectively. Similarly, forest area maintains uniform values across the years, except for 2021-22, where it slightly increases to 83,078 hectares. Area under nonagricultural uses and barren and unculturable land also exhibit minimal variation in their statistical measures across the years. Notably, land not available for cultivation and permanent pastures and other grazing lands remain relatively stable in terms of their statistical properties. However, land under miscellaneous crops and groves shows substantial variation, with a considerable increase observed from 2019-20 to 2020-21 and further to 2021-22. Overall, the table highlights the consistency or variability in land utilization categories over the specified years.

Table-11 One-Way ANOVA (Fisher's)

	F	df1	df2	p
Reporting area for land utilizatio (in hectare)	1	2	3	0.465
Forest (in hectare)	Inf	2	3	< .001
Area under nonagricultural uses (in hectare)	9.42	2	3	0.051
Barren and unculturable land (in hectare)	145.06	2	3	0.001
Not available for cultivation (in hectare)	8.72	2	3	0.056
Permanent pastures and other grazing lands (in hectare)	3.36	2	3	0.172
Land under misc-tree crops and groves (in hectare)	53.81	2	3	0.004

Table 11 displays the results of a one-way ANOVA (Fisher's) analysis conducted on various land utilization categories. The table provides the F statistic, degrees of freedom (df1 and df2), and the associated p-value for each category. The analysis indicates significant differences in forest area ($p < .001$), barren and unculturable land ($p = 0.001$), and land under miscellaneous tree crops and groves ($p = 0.004$). Conversely, the reporting area for land utilization, area under nonagricultural uses, not available for cultivation, and permanent pastures and other grazing lands did not show statistically significant differences at conventional levels ($p > 0.05$). These findings suggest that while certain categories of land utilization vary significantly, others demonstrate relatively consistent patterns across the analyzed data.

Discussion and conclusion

The analysis of land utilization in Sawai Madhopur district over the years 2017-18 to 2021-22 reveals several significant trends and changes across various categories. The data highlights key areas of concern and development, providing insights into the region's land management practices.

The reporting area for land utilization remains relatively constant across the years, with minor fluctuations that are statistically insignificant ($F(2, 3) = 1$, $p = 0.465$). This consistency suggests stability in the overall land area reported for utilization purposes. The negligible change indicates that there have been no major alterations in the total land area accounted for, which could be due to consistent land policies or a stable reporting mechanism.

The forest area shows a significant increase in 2021-22 ($F(2, 3) = \infty$, $p < 0.001$). This substantial change indicates effective forest conservation efforts or reforestation projects implemented over the years. The increase in forest area is a positive development for environmental sustainability, contributing to biodiversity conservation and potentially mitigating climate change impacts through enhanced carbon sequestration.

The area under non-agricultural uses has seen a steady increase, with near-significant statistical changes ($F(2, 3) = 9.42$, $p = 0.051$). This trend reflects the ongoing urbanization and industrial development in the region. The expansion of non-agricultural land suggests a shift towards more urban and industrial land uses, which could have implications for local agriculture and rural communities.

The barren and unculturable land category shows a significant reduction over the years ($F(2, 3) = 145.06$, $p = 0.001$). This decrease is indicative of successful land reclamation and improvement efforts, potentially turning previously unusable land into productive areas. Such changes could have positive effects on agricultural productivity and land value.

The area not available for cultivation shows minor changes that are not statistically significant ($F(2, 3) = 8.72$, $p = 0.056$). Although the p-value is close to the significance threshold, it suggests that there has not been a dramatic shift in the land unavailable for cultivation. This stability might indicate consistent land use policies and effective land management strategies to maintain agricultural viability.

Permanent pastures and other grazing lands exhibit some fluctuations, but these changes are not statistically significant ($F(2, 3) = 3.36$, $p = 0.172$). The data suggests that the area devoted to grazing lands has remained relatively stable, which is important for supporting local livestock and pastoral activities.

There is a significant increase in the land under miscellaneous tree crops and groves ($F(2, 3) = 53.81$, $p = 0.004$). This trend reflects a growing interest in agroforestry and horticulture, which can enhance biodiversity, improve soil health, and provide additional income sources for farmers.

The study reveals significant changes in specific land use categories in Sawai Madhopur district, highlighting the dynamic nature of land utilization in the region. The significant increase in forest area and land under miscellaneous tree crops and groves indicates positive environmental and agricultural trends. Conversely, the increase in non-agricultural land underscores the pressures of urbanization and industrialization. The stable reporting area and land not available for cultivation suggest consistent land management practices, while the reduction in barren land points to successful land reclamation efforts.

Study Implication

The analysis of land utilization trends in Sawai Madhopur district from 2017-18 to 2021-22 yields significant implications for various stakeholders and offers avenues for future research and action.

The study provides policymakers with valuable insights into the dynamics of land utilization, highlighting areas of concern and development. These insights can inform the formulation of targeted policies and interventions aimed at promoting sustainable land management practices and addressing emerging challenges. The observed increase in forest area and adoption of agroforestry practices signify positive trends towards environmental conservation. Policymakers and environmental agencies can leverage these findings to advocate for similar initiatives in other regions, contributing to biodiversity preservation and climate change mitigation efforts.

Understanding the shifts in land use patterns enables stakeholders to identify opportunities for promoting sustainable development. By fostering a balance between urban expansion, agricultural productivity, and natural resource conservation, policymakers can work towards achieving economic growth while safeguarding environmental integrity and social equity. Engaging local communities in land management decisions and initiatives is crucial for ensuring the success and sustainability of interventions. The study underscores the importance of community participation in shaping land use policies and practices, fostering ownership and stewardship of natural resources among local stakeholders.

Future Scop of The Study

Integrating spatial analysis techniques, such as Geographic Information Systems (GIS), can enhance our understanding of spatial patterns and relationships in land utilization. This spatial perspective can inform targeted interventions and land-use planning decisions, optimizing resource allocation and management at different scales. Further research could delve into assessing the socio-economic impacts of shifting land use patterns on local communities and livelihoods. Understanding these dynamics is crucial for designing policies and interventions that promote equitable and inclusive development outcomes.

Evaluating the effectiveness of existing land policies and management interventions is essential for identifying best practices and lessons learned. Future studies could focus on assessing the outcomes of specific policy interventions, informing evidence-based policy formulation and implementation. Given the increasing challenges posed by climate change, future research could explore the implications of changing land use patterns for climate change adaptation and resilience-building efforts. This could include assessing the role of land management practices in mitigating climate risks and enhancing ecosystem resilience.

In conclusion, the study not only provides valuable insights into current land utilization trends but also sets the stage for future research and action. By leveraging these insights and exploring the identified avenues for future research, stakeholders can work towards promoting sustainable land management practices and fostering inclusive and resilient development in Sawai Madhopur district and beyond.

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