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From Green Revolution to Growing Crisis: A Temporal Analysis of Population Pressure and Land Depletion in India (1950-Present)

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Abstract
India's population in 1950 was around 0.36 billion and is projected to reach approximately 1.46 billion people by 2025 that expanding urban areas have placed immense pressure on its land resources, leading to significant depletion and environmental concerns. The main objective of the present study is to conduct a temporal analysis to examine the relationship between population growth and land resource depletion across different regions of the country. It explores how increasing population density, urbanization and industrial expansion have altered land resources degradation and other environmental concerns. The present study is analyzed based on the secondary database downloaded from the Census of India (2011), United Nations Population Division (2022), Statistical Abstract of India (2024) and ICAR -NBSS & LUP (2021) with the help of various mapping and statistical tools. By integrating these diverse datasets, the study provides a comprehensive temporal analysis from the era of green revolution to present how increasing population pressure has influenced land degradation, land erosion and deforestation across different parts of India.
Furthermore, this paper assesses the long-term implications of these trends, emphasizing the urgent need for sustainable land management strategies to mitigate the ongoing crisis and ensure future ecological security. Strengthening of land management policies and improving data-driven decision-making are crucial for long-term environmental sustainability.
Key words*: Population pressure, Land resource depletion, Temporal analysis, Green revolution, Deforestation, Soil erosion and Sustainable land management.*

Objectives
- To analyze the impact of population pressure on land use in India from 1950 to the present.
- To understand the spatial variation and impact of population pressure on land resources.
- To analyze past trends and present challenges to suggest better methods of sustainable land management in the future.

I. Introduction

In India, land resources are under ever-increasing pressure because of the ever-growing population. Agricultural activities like urban settlements and industrialization have all risen with increasing demand for food, housing and industries which resulted in deforestation, soil degradation and overuse of natural resources. Rapid population growth has posed more and more pressure on agricultural activities and urban settlement expansion and industrialization over the decades often at the cost of fertile land. Population density stood at 117 persons per sq. km in 1951 while 488 persons per square kilometre in 2024 that increased more than four times during the period of 74 years. With such population growth at an alarming rate, land resources are under immense strain. The Green Revolution did boost agricultural production but also led to extreme excess use of fertilizers and exploitation of groundwater and soil in areas like Punjab, Haryana and Uttar Pradesh. The aims of the research study are, first to analyze how the population pressure in India contributed to land degradation from 1950 to present. The study mainly concentrates on temporal historical trends, spatial patterns and state-wise changes and makes clear the link between population density and land degradation. Such an understanding is critical in formulating sustainable land management strategies with environmentally sound and judicious use that achieve a balance between population needs and conservation. As per the appraisal of the present scenario, the land degradation is an environmental necessity and also a beginning to secure India's future for generations ahead.

Database: The present study is conducted based on the secondary database to analyse the population pressure, agricultural expansion and land erosion effects on India's resources from 1950 to the present. Data of India's total land area and its distribution across different states has been taken from the Statistics Times (2020). Projected population data of 2024 is also taken from Statistics Times (2025). These data are used to calculate the population density for the year 2024 to analyse the increased population pressure on land resources. India state wise population density data from 1951 to 2011 has been taken from Handbook of Statistics on Indian States, RBI (2024). Land degraded and wasteland data is obtained from Desertification and Land Degradation Atlas of India, 2021 published by Space Applications Centre, Ahmedabad for the year 2002-03 and 2018-19.
Software Used: ArcGIS Desktop 10.3 software is used for the preparation of population density changes map, land degradation changes map and various geometrical calculations.

II. Methodology

The study employs a comparative research methodology by using secondary data sources to analyze the impact of population pressure on land degradation in India from 1950 to the present. To understand the changes ArcGIS Desktop (ArcMap) is used to create spatial maps of India, representing the state-wise population density change between 1951 to 2024 and land degradation change between 2003-05 to 2018-19. The maps clearly show which states have had high population growth in the last decade and have also seen more land degradation. This analysis clarifies the relationship between population growth and land degradation and highlights the states where land conservation policies should be implemented. Methodology Flow chart (Figure-1) provides a clear structured overview of tasks, interconnection and execution of present study.

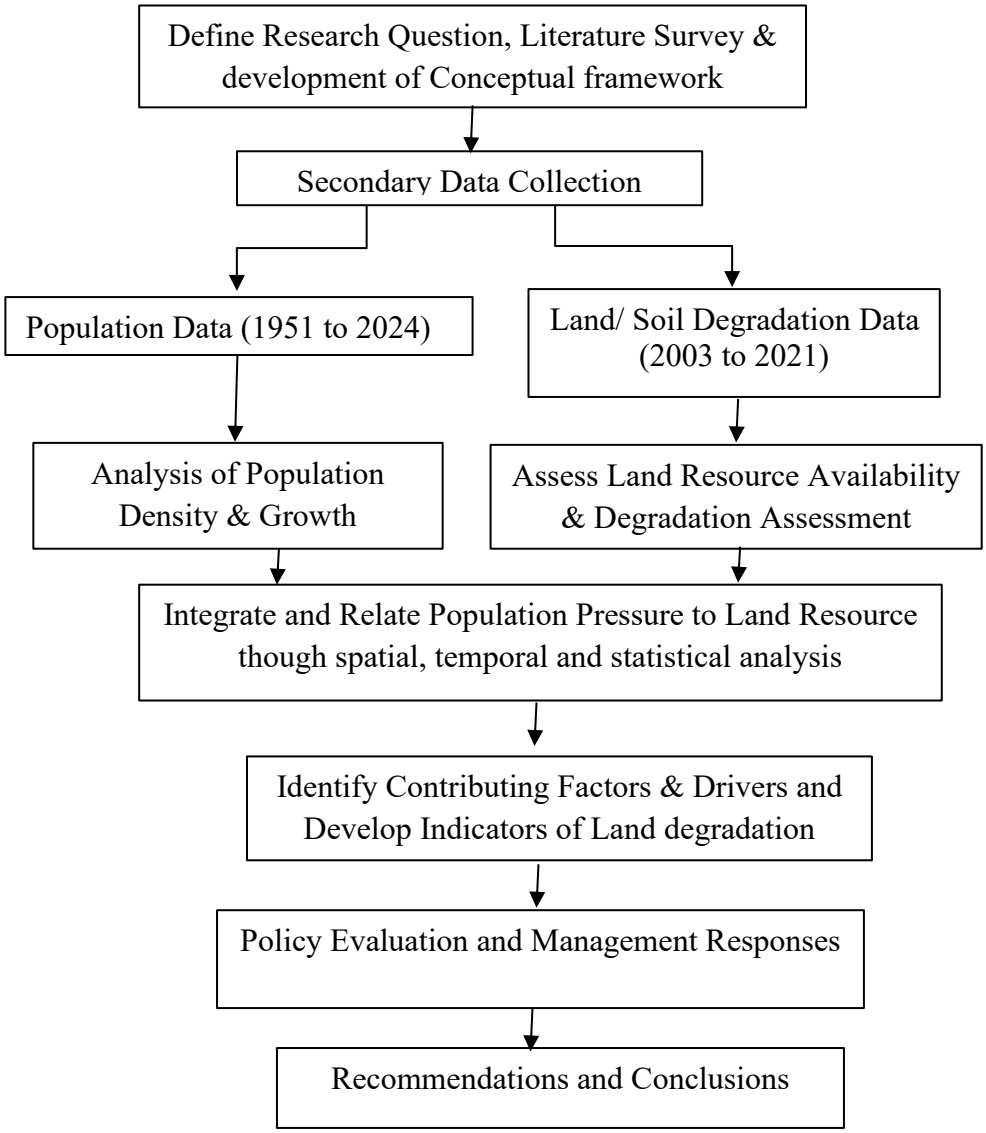

Figure-1 Methodology Flow Chart

Study Area: The present study is focused on India that is situated between $8^{O}4'$ N latitude and $37^{O}6'$ N latitude above the equator and $68^{O}7'$ E long to $97^{O}25'$ E longitude. India ranks seventh in the World by area, with an approximate area of 3, 87,263 km². However, the most densely populated country in the World whose population could exceed 1.45 billion by 2024. Agriculture keeps India economically afloat because it covers around 50% of the total land area. However, as population pressure, urbanization and intensive cultivation increases, agricultural lands shrink and soil fertility declines. Areas such as Punjab and Haryana which are at the epicenter of the Green Revolution are also squawking depletion of underground water because of excessive application of chemical fertilizers, pesticides and over irrigation. China's population almost equals that of India (1.41 billion), but its area is about 9.5 million square kilometers, or almost three times more than that of India, which makes its population pressure a little more tolerable. Hence, this makes it clear that the blatant degradation of land in India surpasses what is meted out in this regard in some other major countries.

III. Result and Discussion:

Population pressure (1951 to 2024)

In 1951, India's population was approximately 376 million and at that time food production was very low. There was a lack of food security in the country and the country had to depend on imports. To solve this problem, the green revolution came to India in the decade of 1960-1970 in which food production increased by using high yield varieties seeds, fertilizers and pesticides. But along with this, excessive use of fertilizer, groundwater depletion and deforestation have contributed to the land degradation and an imbalance in soil fertility.

Due to the rapid increase in population, the demand for land resources also started increasing. Until 1951, the country's overall population density was low, yet some states experienced considerable population pressure. In the last few decades, the population density of India which was 117 persons per square km in 1951; increased to 488 in 2024. This reflects rapid development and also increasing stress on land resources. Increasing demands to ensure food security and accommodation have led to major changes in agriculture, urbanization and industrial expansion, accelerating land degradation in many states. Bihar has a high population density which is projected to increase from 309 persons per square km in 1951 to 1372 persons per square in 2024. This makes it India's most populous state and as a result, there is very intense land use and agricultural over-exploitation. Similarly, West Bengal (296 to 1,124) and Kerala (349 to 926) are some of the states showing steep slopes in terms of population pressure on arable land and water resources. Land depletion due to urban expansion is occurring while less population density states face the problems related to desertification and deforestation. To conduct the present study changes in population density during the period 1951 to 2024 was calculated and categorised into 5 classes that are below 200, 200 to 400, 400 to 600, 600 to 800 and above 800 persons per square kilometre. On the basis of these classes a choropleth map was prepared in ArcGIS desktop software that is presented in Figure -2. Bihar and West Bengal noticed the highest changes (more than 800 and Rajasthan, Himachal Pradesh, Chhattisgarh and North East states except Assam noticed the lowest changes (below 200) during the period of 1951 to 2024. Between this period, population explosion create a pressure on the existing resources and presently the situation is above the carrying capacity that is resulted as deforestation, soil erosion, desertification, impacting agricultural productivity and ecosystem health.

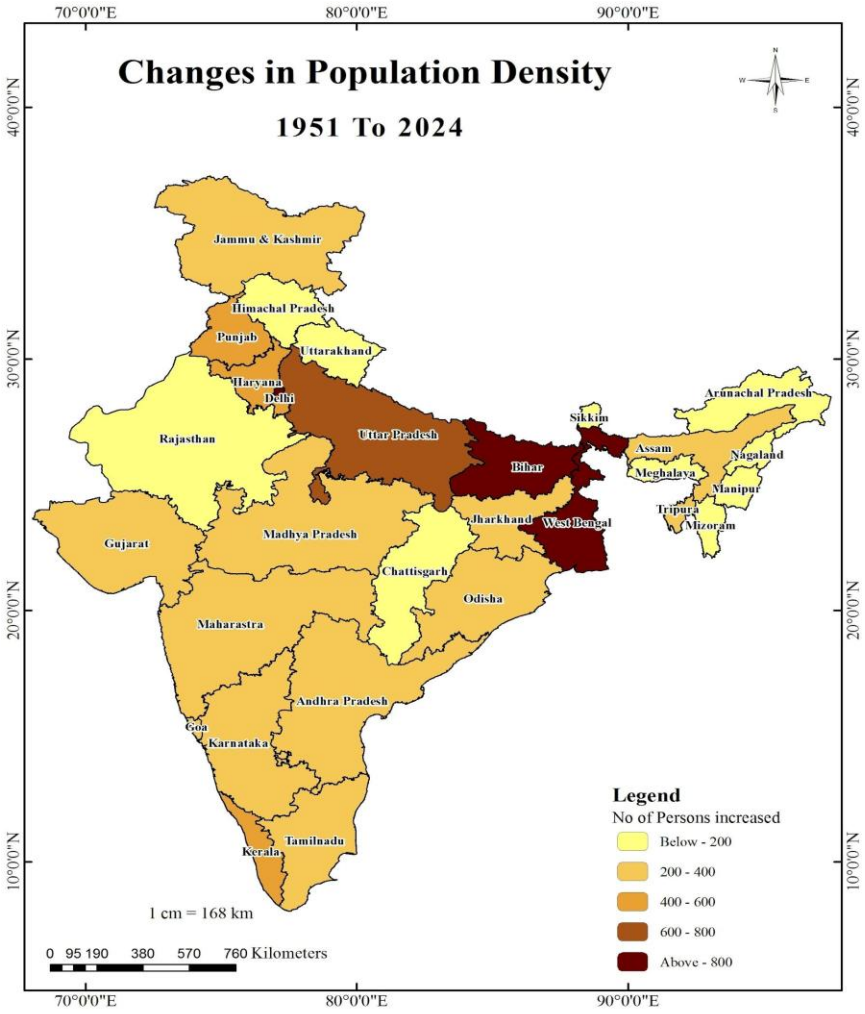

Figure 2

Temporal Analysis of Land Degradation :

Land degradation is a significant problem in India that affects both agriculture output and the environment. Over the years, there has been an increase in the amount of land degradation and loss of soil fertility. In 2003-05, approximately 94.53 million hectares of land were observed as degraded land which is 28.76% of India's total land area. In 2018-19, it grew by 97.85 million hectares, which accounted for 29.57% of India's total land area. The steady increase in land degradation indicates that the land is being damaged at a concerning rate and it is more challenging for farmers to get sufficient agricultural production and for ecosystems to remain balanced. Presently some states are experiencing severe land degradation. The most degraded land observed in 2028-19 is in Jharkhand with 68.77%, while other states like Rajasthan (62.06%), Delhi (61.73%), Goa (52.64%), Nagaland (50%), and Gujarat (52.22%) have serious environmental concerns. This increase has been caused by deforestation, desertification, soil erosion, mining activities, urbanization, and overexploitation of water resources. On the other hand, Uttar Pradesh has shown improvement, where wasteland has reduced from 7.62% in 2003-05 to 6.43% in 2018-19. This indicates that successful soil conservation efforts and afforestation programmes have improved land management practices in the state. Similarly, Rajasthan has seen a marginal reduction in wasteland from 63.19% to 62.06%, which indicates that desertification control measures and sustainable land use practices made a positive impact.

Pressure on agricultural land is increasing in states with high population density such as Bihar and West Bengal. Bihar's degraded land increased from 659,539 hectares in 2003-05 to 746,586 hectares in 2018-19 Similarly, West Bengal's wasteland increased from 1,682,181 hectares to 1,784,345 hectares, indicating deforestation and soil exhaustion due to excessive cultivation.

Table 1 State wise temporal analysis of degraded land

State	2003-05		2018-19		Change in Degraded Land (%)
	Degraded Land (ha)	Degraded land (%)	Degraded Land (ha)	Degraded land (%)	
Andhra Pradesh	2267728	14.16	2378042	14.84	4.86
Arunachal Pradesh	136686	1.63	200683	2.40	46.82
Assam	572215	7.3	834530	10.64	45.84
Bihar	659539	7	746586	7.93	13.19
Chattisgarh	2176388	16.1	2306531	17.06	5.97
NCT of Delhi	73514	49.57	91543	61.73	24.52
Goa	186458	50.37	194877	52.64	4.57
Gujarat	10077455	51.35	10248057	52.22	1.69
Haryana	314583	7.12	364154	8.24	15.75
Himachal Pradesh	2141366	38.46	2400300	43.11	12.09
Jammu and Kashmir	966795	17.86	1129503	20.86	16.82
Jharkhand	5418657	67.97	5482260	68.77	1.17
Karnataka	690943	36.19	6959847	36.29	0.27
Kerala	370512	9.54	422299	10.87	13.97
Ladakh	6578653	39.14	7111968	42.37	8.10
Madhya Pradesh	3771853	12.24	3859735	12.52	2.32

Maharashtra	13348604	43.38	14306029	46.49	7.17
Manipur	593093	26.56	612566	27.44	3.28
Meghalaya	478825	21.35	557576	24.86	16.44
Mizoram	95873	4.55	275827	13.08	187.70
Nagaland	642304	38.74	828943	50	29.05
Odisha	5321903	34.18	5359014	34.42	0.69
Punjab	93115	1.85	167989	3.34	80.41
Rajasthan	21625604	63.19	21237665	62.06	-1.79
Sikkim	78482	11.06	84610	11.92	7.8
Tamil Nadu	1516660	11.66	1599981	12.30	5.49
Telangana	3658482	31.86	3638508	31.68	-0.54
Tripura	327302	31.21	447378	42.66	36.68
Uttar Pradesh	1835263	7.62	1549608	6.43	-15.56
Uttrakhand	581241	10.87	673894	12.60	15.94
West Bengal	1682181	18.95	1784345	20.10	6.07
Total	94532276	28.76	97854851	29.77	3.51

Source: Desertification and Land Degradation Atlas of India, 2021. Space Applications Centre (SAC), ISRO, Ahmedabad, India.

Punjab and Haryana have less total degraded land than other states but show a continuous increase in land degradation due to intensive agriculture. Haryana's degraded land increased from 7.12% to 8.24% , reflecting a steady increase due to excessive use of fertilizers, salinity problems and decline in organic matter in the soil. The Green Revolution promoted intensive farming in Punjab and Haryana, but excessive fertilizer use and excessive irrigation have led to soil salinization, waterlogging and decline in fertility. These states, once known for their agricultural prosperity, are now facing serious environmental challenges due to unsustainable land use practices. Figure 3 and Table 1 justify that Rajasthan and Uttar Pradesh Recorded a positive change in land degradation 1.13 and 1.19 percentage respectively. Arunachal Pradesh and Assam categorised into the class having land degradation increased between 40 -60 percent while Nagaland state categorised into land

degradation increased class 20 -40 percent. Punjab state observed an increase in the degraded land between 60 to 80 percent and highest degraded land increasing observed in Mizoram.

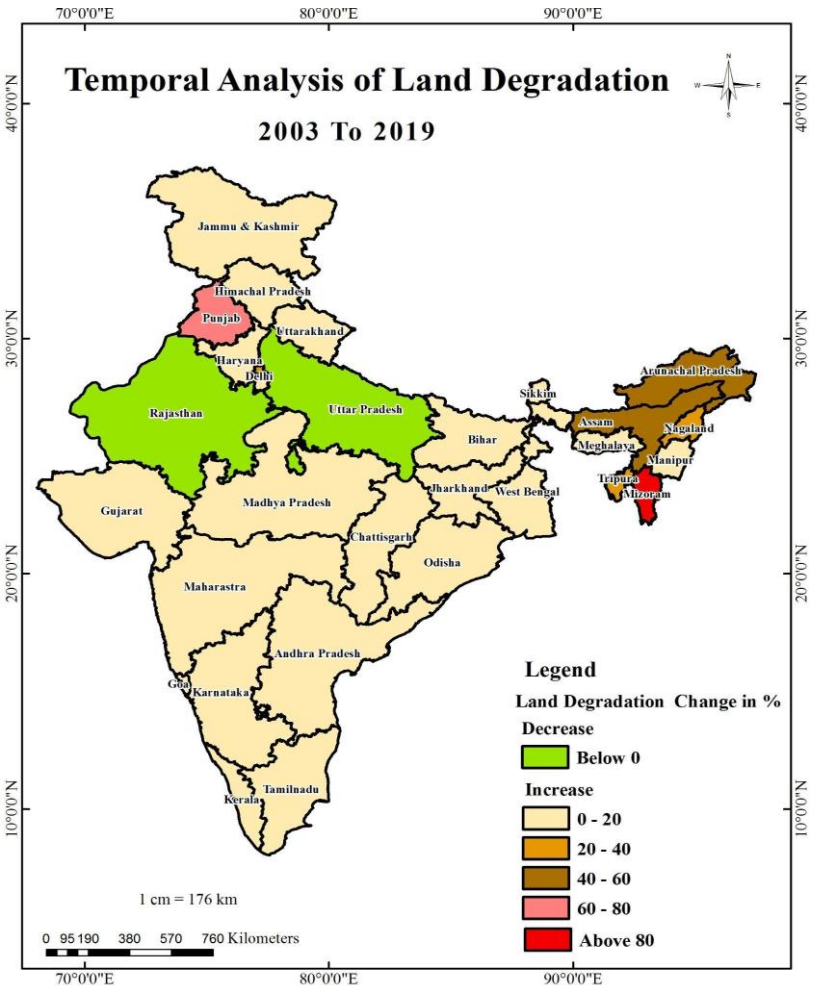

Figure 3

However, the overall trends indicate the need for afforestation programmes, soil conservation measures and sustainable land use policies to reduce further land degradation and ensure long-term environmental sustainability.

Land Degradation Dynamics: Green Revolution and Population Pressure

Land degradation in India presents a complex, state-wise scenario influenced significantly by the Green Revolution and burgeoning population pressures. States like Rajasthan, Maharashtra and Gujarat, characterized by arid and semi-arid conditions faces severe desertification and wind erosion. The intensive agricultural practices associated with the green revolution, while boosting yields, have led to soil depletion and salinization, particularly in states like Punjab and Haryana. In the Himalayan region, including states like Uttarakhand and Himachal Pradesh, deforestation and unsustainable land use contribute to increased soil erosion and landslides. Eastern states such as Odisha and Jharkhand experience land degradation due to mining activities and deforestation. Furthermore, the high population density across the Indo-Gangetic plains exacerbates the problem are leading to over-cultivation and depletion of soil nutrients. In southern states like Karnataka and Andhra Pradesh water erosion and improper agricultural practices are major concerns. Essentially, the combination of intensive agriculture, deforestation, and the sheer pressure of a large population results in diverse patterns of land degradation across India's varied landscapes.

IV. Recommendations:

The pressure on our land is ever increasing, due to an ever-growing population and ever-changing patterns of land usage. Soil degradation and fall in production from agricultural activities are likely to worsen, as will poor environmental conditions. This situation will worsen if we do not act right now. Hence, if the future is to be secured in the balance, it is necessary to restore land while fulfilling the needs of a growing population.

- In Punjab, Haryana, and Uttar Pradesh agricultural lands are being depleted. In order To tackle this problem farmers should adopt some methods like agroforestry, organic composting, lesser use of chemicals and crop rotation to revitalize soil health.

- In some states like Nagaland, Goa and Rajasthan land degradation is becoming alarming. Through large scale afforestation with community based conservation efforts, restore forest-grasslands and lost biodiversity it is possible to restore land degradation.

- Groundwater is declining steadily, particularly in Punjab, Haryana and Rajasthan, where fertile fields have already done away with their foliage and cracked dry land is exposed. Rainwater harvesting and drip irrigation, as well as groundwater recharge, will take care of every drop and safe from making the land barren.

- Government action should involve implementing forest conservation laws aggressively, promoting sustainable agriculture, enforcing strict land use regulations, to preserve land. States like Jharkhand, Odisha and Chhattisgarh need immediate action due to increased rates of mining, deforestation and land degradation.

- With the help of modern technologies we can monitor land use changes in real time. By utilizing satellite mapping, soil analysis, and smart irrigation techniques, we can make proper decisions to protect land while maintaining a balance with development.

Land is our most valuable resource as it gives us food, water, and shelter. If we don't save it now then our future generations will suffer. If we implement better farming methods, systematic urban development, afforestation, and water conservation, we can stop land degradation and pave the way for a healthy and green India for the future.

V. Conclusion:

The rise in population and urbanization put intense pressure on land resources and lead to land degradation. High-density states like Bihar, West Bengal, and Uttar Pradesh have faced extreme land use and soil depletion. States like Punjab and Haryana take benefits from the Green Revolution but have seen long-term soil fertility loss and water table depletion. These variations highlight the need of land management strategies to balance development and environmental conservation. Major factors that contribute to soil degradation are overexploitation of agricultural lands, deforestation, chemical fertilizers and depletion of groundwater levels. These factors highlight the environmental problems like soil erosion, low fertility, degraded land expansion etc. In order to compensate these problems, Sustainable land management practices like tree plantation, organic farming, control on urban expansion and strict land use policy should be employmented. High-tech instruments like GIS mapping and land monitoring would also help to manage resources systematically and monitor land use changes. The rising population explosion and increasing pressure on land will lead to low food production and environmental degradation. To prevent this, we need a smart plan that uses science, strict policies and community efforts to protect land while supporting future generations.

References:

[1]. Reserve Bank of India. (2021). *Handbook of statistics on Indian states 2021-22*. RBI.
[2]. Space Applications Centre (SAC). (2021). *Desertification and Land Degradation Atlas of India (Assessment and analysis of changes over 15 years based on remote sensing).* Space Applications Centre, ISRO. Ahmedabad, India.
[3]. Sreedevi, T. K., Wani, S. P., Osman, M., & Tiwari, S. (2010). Rehabilitation of degraded lands in watersheds. *International Crops Research Institute for the Semi-Arid Tropics* (ICRISAT).
[4]. Garg, S. (2017). Impact of overpopulation on land use pattern. In R. P. Singh, A. Singh, & V. Srivastava (Eds.), *Environmental issues surrounding human overpopulation* (pp. 137-154). IGI Global.
[5]. Ray, S., & Aditya, I. (2011). Impact of population growth on environmental degradation: Case of India. *Journal of Economics and Sustainable Development, 2*(8), 72-77.
[6]. Jambagi, R. P. (2021). Analysis of land use pattern in India. *AgriAllis, 5*(5), 1-6.
[7]. Deen, S., & Kumar, S. (2019). Impact of overpopulation on land use pattern: A contextual analysis of sustainable natural resources. *History Research Journal, 5*(5), 1718-1727.

[8]. Arya, V. S., Kumar, S., Singh, H., Kumar, A., & Hooda, R. S. (2020). Wastelands change analysis using multi-temporal satellite data in arid zone of Haryana. *Current Trends in Technology and Science, 3*(1).
[9]. Holden, S. T., & Sankhayan, P. L. (1998). Population pressure, agricultural change, and environmental degradation in the Western Himalayan region of India. *Forum for Development Studies, 25*(2), 271-296.
[10]. Mech, A. (2018). Agrarian crisis in India. *Social Science Journal of Gargaon College, 6,* (2320-0138).
[11]. Kumar, P. (2017). Green revolution and its impact on environment. *International Journal of Research in Humanities & Social Sciences, 5*(3), 54-57.
[12]. Ray, S., & Ray, I. A. (2011). Impact of population growth on environmental degradation: Case of India. *Journal of Economics and Sustainable Development, 2*(8), 72-77.