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Geography for A Sustainable Future: Land, Climate and Water

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GEOGRAPHY FOR A SUSTAINABLE FUTURE: LAND, CLIMATE AND WATER

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Preface

We are happy to welcome the idea of publishing a book on relevant topic, "Geography for A Sustainable Future: Land, Climate and Water". Further, it is good that the articles from various sub-disciplines are included in the book. The scholars from Geography or Environmental science have attempted to identify the current trend and to provide ideas to doing the recent study.

The discipline of geography encompasses both natural and social sciences and has the natural advantage of enabling the study of sustainability from a transdisciplinary perspective. There are great opportunities for geographers to participate in sustainability research. However, while geographers have set sustainability goals, they have rarely clarified the details for reaching those goals. Current knowledge on the relationship between humans and the environment and the methodologies for studying this relationship are inadequate to solve the transdisciplinary questions in sustainability science. Five research areas: geographical processes; ecosystem services and human wellbeing; human-environmental systems; sustainable development; and geo-data and modelling for sustainability are proposed as those needed to help geography achieve sustainability.

This exhibits how variety of topics have been discussed in the book. The book provides open forum for the scholars and even graduate students to discuss further so that they can think about strategic planning to use emerging strategies in sciences.

Renowned researchers, scientists, educators, and business professionals have contributed pieces to the book. We would especially want to express our gratitude to the researchers and specialists whose contributions have made this book better.

Date: *30 October 2024*

Editors

Geography For A Sustainable Future: Land, Climate and Water

Table of Content

Geography For A Sustainable Future: Land, Climate and Water

ISBN: 978-81-981142-0-4| Year: 2024 | pp: 01 - 09 |

Sustainable Land and Water Management: Strategies for Climate Resilience

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Abstract

Sustainable land and water management is critical for mitigating the adverse effects of climate change while ensuring environmental and economic sustainability. This study explores a comprehensive model that integrates traditional knowledge, modern technology, and multi-tiered governance to address the growing challenges of resource depletion and climate resilience. It highlights the role of community participation, smart irrigation systems, geospatial technologies, and climate-smart agricultural practices in optimizing land use and water conservation. The model emphasizes the need for policy enforcement, legal frameworks, and education to promote long-term sustainability. Additionally, it advocates for the integration of modern water recycling technologies and traditional water management practices to ensure equitable access and usage. The study underscores the importance of a data-driven decision-making process and continuous monitoring to adapt to changing environmental conditions. Overall, this model provides a roadmap for sustainable resource management while addressing both local needs and global sustainability goals.

Keywords: sustainable land management, water conservation, climate resilience, traditional knowledge, climate-smart agriculture

Introduction

Sustainable land and water management is critical for enhancing climate resilience in the face of growing environmental challenges. As climate change exacerbates water scarcity, soil degradation, and unpredictable weather patterns, the need for integrated approaches to managing natural resources has become more urgent than ever (FAO, 2021). Effective land and water management practices can help mitigate the impacts of climate change by promoting efficient water use, restoring degraded ecosystems, and improving agricultural productivity (UNEP, 2020). These strategies include sustainable agricultural practices such as agroforestry, rainwater harvesting, and precision farming, which aim to optimize water use and maintain soil health while reducing carbon emissions (Smith et al., 2019). Additionally, policies that promote ecosystem-based management and community-based approaches to resource conservation can further bolster climate resilience by empowering local stakeholders to participate in the stewardship of their natural environments (IPCC, 2022). By focusing on adaptive strategies, sustainable land and water management can not only help safeguard food security and livelihoods but also support broader climate mitigation goals, making it an essential component of a resilient and sustainable future. The integration of such practices into national and global climate action plans is increasingly recognized as a crucial step towards achieving sustainable development goals (SDGs) (World Bank, 2021).

Need for the study

The study of sustainable land and water management in the context of climate resilience is crucial as environmental challenges intensify globally. Climate change has significantly disrupted ecosystems, leading to increased instances of droughts, floods, and soil degradation, which directly impact agricultural productivity and water availability. These changes pose severe threats to food security, biodiversity, and rural livelihoods, especially in vulnerable regions (FAO, 2021). Sustainable land and water management practices provide a framework for addressing these challenges by fostering resilience and adaptability in ecosystems and human communities.

This type of study is essential because it provides evidence-based strategies for policymakers and practitioners to integrate sustainable practices into national and global environmental agendas. It supports the achievement of **Sustainable Development Goals (SDGs)**, particularly Goal 6 (clean water and sanitation), Goal 13 (climate action), and Goal 15 (life on land) (UN, 2020). Furthermore, sustainable land and water management enhance the resilience of both natural systems and human communities, ensuring long-term economic and environmental stability. This research is not only a pathway to environmental conservation but also a critical measure for reducing the vulnerability of communities and ecosystems to the ongoing and future impacts of climate change.

Ancient Traditional Indian Knowledge Systems and Their Contribution to Land and Water Management

Ancient India possessed rich traditional knowledge systems that were deeply rooted in sustainable land and water management practices, significantly contributing to the resilience and prosperity of communities across diverse ecological landscapes. Indigenous techniques, shaped by centuries of observation and interaction with nature, offered holistic solutions to managing natural resources in a sustainable manner. Water management in ancient India, for instance, was characterized by the creation of highly sophisticated systems, including stepwells, tanks, and canals, which efficiently conserved and distributed water, especially in arid regions. The baolis (stepwells) of Rajasthan and Gujarat and the tanks in southern India are renowned examples of community-driven water harvesting structures that ensured water availability year-round, fostering agricultural productivity and resilience against droughts (Sharma & Sharma, 2020). Additionally, the construction of johads (rainwater harvesting structures) and the Karez system, which involved subterranean channels for transporting water in desert areas, exemplify India's expertise in maximizing limited water resources through eco-friendly designs.

In terms of land management, ancient Indian agricultural practices emphasized soil conservation, crop rotation, and organic farming, all of which are now recognized as sustainable practices essential for maintaining soil fertility. The Vrikshayurveda (science of plant life), an ancient Indian treatise on agriculture, detailed organic fertilization, plant breeding, and agroforestry techniques that promoted biodiversity and ecological balance (Nene, 2006). Similarly, traditional Indian irrigation systems, such as the Phad system in Maharashtra, relied on collective community management, allowing equitable distribution of water and sustainable farming. These systems were not only technologically advanced but also imbued with a strong ethical and spiritual connection to nature, as seen in the reverence for rivers like the Ganga and Yamuna, which were considered lifelines for civilization and treated with great care.

These ancient knowledge systems continue to offer valuable insights in the context of modern environmental challenges, particularly as climate change exacerbates water shortages and land degradation. Reviving and integrating these time-tested techniques into contemporary land and water management policies could lead to more sustainable and adaptive solutions. Moreover, the participatory nature of traditional Indian practices, which involved local communities in decision-making and management, can inspire modern governance models that promote community-driven conservation efforts, thus enhancing climate resilience and sustainability.

Present Global Scenario of Land and Water Management

Land and water management have emerged as central concerns in the face of rapid urbanization, population growth, and the increasing impacts of climate change. The world today faces unprecedented challenges regarding resource sustainability, as over-exploitation of natural resources threatens ecosystems and the livelihoods of billions. Global trends indicate that inefficient water use, deforestation, desertification, and soil degradation are growing problems that, if left unchecked, will exacerbate food insecurity, water scarcity, and socio-economic inequalities.

Global Land Management Trends

The demand for land has grown exponentially, driven by the need for agricultural expansion, urban development, and industrial activities. However, this increased demand has led to land degradation and the destruction of natural ecosystems. According to the **United Nations Convention to Combat Desertification (UNCCD)**, approximately 24 billion tons of fertile soil are lost each year due to erosion, deforestation, and unsustainable agricultural practices. As a result, more than 1.5 billion people globally are directly affected by land degradation, which contributes to poverty, displacement, and biodiversity loss.

The transition from traditional agricultural methods to modern, industrialized farming systems has significantly altered land use patterns. While this shift has increased productivity, it has also contributed to environmental degradation through excessive use of chemical fertilizers and pesticides, deforestation, and monoculture practices. The following table highlights the major causes of land degradation and their associated impacts.

Table 1: Major Causes of Land Degradation Globally

Cause	**Percentage Contribution**	**Impact on Environment**
Deforestation	25%	Loss of biodiversity, increased carbon emissions
Unsustainable Agricultural Practices	28%	Soil erosion, nutrient depletion
Urbanization and Infrastructure Development	15%	Loss of arable land, habitat destruction
Overgrazing	11%	Soil compaction, vegetation loss
Industrial Pollution	7%	Soil contamination, water pollution
Climate Change	14%	Desertification, increased droughts

Source: United Nations Convention to Combat Desertification (UNCCD), 2021.

Efforts to counter land degradation through **sustainable land management (SLM)** are increasingly being promoted. SLM practices include agroforestry, crop rotation, conservation tillage, and the integration of biodiversity-friendly farming techniques. These methods not only help maintain soil fertility but also contribute to climate change mitigation through carbon sequestration.

Global Water Management Challenges

Water resources around the world are under severe stress due to increasing demand and climate change. The World Water Development Report 2021 by UNESCO revealed that about 2.2 billion people lack access to safe drinking water, while over 4 billion people experience severe water scarcity for at least one month a year. Water scarcity affects many regions, with developing nations in Africa, South Asia, and the Middle East being particularly vulnerable.

Table 2: Global Freshwater Availability and Usage

Region	**Freshwater Availability per Capita (m^3/year)**	**Percentage of Water Used for Agriculture**
North America	9,000	50%
Europe	4,500	40%
Sub-Saharan Africa	2,400	80%
South Asia	1,600	90%
Middle East & North Africa	1,200	85%
East Asia & Pacific	3,200	70%

Source: UNESCO World Water Development Report, 2021.

Industrial agriculture consumes nearly 70% of the global freshwater supply, with inefficiencies in irrigation systems accounting for significant water wastage. Additionally, pollution from agricultural runoff, industrial effluents, and improper waste disposal has further degraded water quality, making it unusable for consumption and agricultural purposes.

The following table presents an overview of global freshwater availability and usage.

To address these challenges, water management solutions such as drip irrigation, rainwater harvesting, wastewater recycling, and the protection of natural water catchments have been implemented in various parts of the world. These efforts are aimed at reducing water wastage and improving water-use efficiency. However, many countries still face barriers, including a lack of funding, inadequate infrastructure, and insufficient policies to protect water resources.

Impact of Climate Change on Land and Water Resources

Climate change is amplifying the stress on global land and water resources. Rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events such as floods and droughts are intensifying the degradation of both land and water systems. The **Intergovernmental Panel on Climate Change (IPCC)** estimates that by 2050, up to 50% of the world's population could face high water stress due to climate change, with large portions of arable land becoming unsuitable for cultivation due to desertification and soil salinization.

Coastal areas are particularly vulnerable to rising sea levels, which threaten freshwater supplies through saltwater intrusion and increase the risk of land loss. Many low-lying islands and coastal regions are already experiencing the detrimental effects of climate-induced land degradation and water scarcity, forcing migration and placing pressure on urban infrastructure.

The following table summarizes projected climate change impacts on water and land resources by region.

Table 3: Projected Climate Change Impacts on Water and Land Resources by 2050

Region	Projected Temperature Rise (°C)	Impact on Water Resources	Impact on Land Resources
Sub-Saharan Africa	+2.5	Severe water scarcity	Increased desertification
South Asia	+2.3	Erratic monsoons, droughts	Soil erosion, reduced yields
Middle East	+3.0	Reduced groundwater levels	Loss of arable land
Europe	+1.8	Increased flooding	Soil erosion, forest fires
North America	+2.0	Water shortages in the west	Land degradation in arid areas
Pacific Islands	+1.5	Saltwater intrusion	Coastal land loss

Source: IPCC Sixth Assessment Report, 2022.

The present global scenario in land and water management is one of significant concern but also opportunity. While the challenges posed by land degradation, water scarcity, and climate change are severe, the global response has begun to take shape. Sustainable land and water management practices are gaining momentum, as evidenced by community-based conservation efforts, the promotion of climate-resilient agriculture, and the increased investment in water-saving technologies. However, to achieve lasting change, international cooperation, stronger governance, and innovative policies will be crucial. Governments, industries, and communities must collaborate to create resilient systems that preserve natural resources for future generations while meeting the demands of today's growing population.

Conceptual Model

In response to the challenges surrounding land and water management and the increasing pressures from climate change, a **Sustainable Land and Water Resource Management (SLWRM)** Model can be developed. This model would integrate traditional knowledge systems, modern technology, and community participation to create a comprehensive framework for resource management that promotes climate resilience and environmental sustainability. The SLWRM Model could be designed with the following key components:

1. Multi-Tiered Management System

The model should operate at multiple levels—local, regional, and national—ensuring that governance and resource management are tailored to the specific ecological and social needs of each region. Each level would have specific roles and responsibilities, with data sharing, collaboration, and coordination as core principles.

a. Local Level:

Community-Based Resource Management (CBRM):

Encourage local communities to actively participate in the management of their natural resources, drawing on indigenous practices such as rainwater harvesting, agroforestry, and crop rotation. Establish local committees for decision-making and monitoring.

Farmer-Managed Systems:

Implement water-efficient agricultural practices like drip irrigation and conservation tillage, while incorporating organic farming methods that prevent land degradation.

b. Regional Level:

Watershed Management: Implement integrated watershed management that includes soil conservation, water conservation, and afforestation efforts in a coordinated manner to ensure water availability and prevent soil erosion.

Zoning and Land Use Planning: Develop regional land use plans that delineate areas for agriculture, urbanization, conservation, and industrial development based on sustainability principles. Identify climate-sensitive zones and create buffer areas to mitigate land degradation.

c. National Level:

Policy Formulation and Enforcement: Governments should enforce strict policies on land use, deforestation, and water management. These could include subsidies for sustainable farming, penalties for overuse of water resources, and reforestation targets. National bodies can also facilitate funding for sustainable development initiatives.

Climate Resilience Programs: Launch national programs aimed at enhancing the resilience of vulnerable regions through the deployment of climate-smart technologies, financial support for adaptation measures, and development of early warning systems for droughts or floods.

2. Integration of Modern Technology

Modern technology can significantly improve the efficiency and effectiveness of land and water management systems. Key areas include:

a. Geospatial Mapping and Remote Sensing:

Utilize satellite data and **Geographic Information Systems (GIS)** to monitor land use, deforestation, water bodies, and agricultural patterns. These tools can help identify areas at risk of desertification, soil degradation, or water scarcity, enabling proactive interventions.

b. Smart Irrigation Systems:

Integrate IoT-based (Internet of Things) smart irrigation systems that monitor soil moisture, weather conditions, and water availability to optimize water use in agriculture. These systems can help reduce wastage and improve water use efficiency, especially in drought-prone regions.

c. Water Recycling and Desalination:

Promote the use of technologies for wastewater recycling, greywater reuse, and desalination to address water scarcity in areas where freshwater is limited. These methods provide sustainable alternatives to depleting groundwater resources.

3. Climate-Smart Agriculture (CSA)

The SLWRM model should focus heavily on climate-smart agricultural practices that simultaneously address food security, climate change adaptation, and mitigation. These practices include:

Agroforestry: Integrating trees with crops to improve soil fertility, increase carbon sequestration, and provide shade for crops, thus enhancing climate resilience.

Conservation Tillage:

A technique that minimizes soil disturbance, helping to maintain soil structure, reduce erosion, and improve water retention.

Crop Diversification:

Encourage farmers to adopt diversified cropping systems, including drought-resistant and climate-resilient crop varieties, which can withstand unpredictable weather patterns.

4. Water Resource Management

Water management within the model should be comprehensive and community-centered, incorporating both traditional and innovative methods for maximizing water conservation and equitable distribution:

a. Water Harvesting Systems:

Expand traditional water harvesting systems like johads, baolis, and tanks, while integrating modern techniques such as rooftop rainwater harvesting, urban stormwater management, and aquifer recharge.

b. Efficient Irrigation:

Promote micro-irrigation techniques like drip and sprinkler systems to reduce water usage in agriculture while ensuring sufficient hydration for crops. This should be coupled with real-time monitoring of water levels and automatic irrigation schedules using smart technology.

c. Watershed and River Basin Management:

Implement integrated watershed management programs that focus on soil conservation, water conservation, and afforestation. Collaborate with local communities to maintain rivers and lakes by minimizing pollution and optimizing water flow for agricultural and domestic use.

5. Legal and Institutional Framework

Strong legal and institutional frameworks are crucial to the success of the SLWRM model. This includes:

Clear Land and Water Rights:

Define property rights over land and water resources to prevent conflicts and over-exploitation. Create equitable access to these resources, especially for marginalized communities.

Incentive Programs:

Provide financial incentives for adopting sustainable practices, such as tax breaks for water-efficient technologies or subsidies for organic farming inputs.

Environmental Laws and Enforcement:

Strengthen existing environmental protection laws to ensure compliance with sustainable land and water use policies. Establish penalties for non-compliance and mechanisms for monitoring enforcement.

Conclusion

In conclusion, the Sustainable Land and Water Resource Management (SLWRM) Model provides a holistic framework to address the pressing issues of resource depletion and climate change. By integrating traditional knowledge with modern technologies and involving stakeholders at every level, the model promotes sustainable practices, enhances resilience, and ensures equitable resource distribution. Its multi-tiered approach, coupled with legal, institutional, and community engagement mechanisms, fosters a long-term solution for managing land and water resources. This model not only safeguards the environment but also supports economic growth and social well-being, ensuring sustainability for future generations.

References

1. Aggarwal, P. K., & Mall, R. K. (2002). Climate change and rice yields in diverse agro-environments of India. Environmental Management, 48(4), 606–615. https://doi.org/10.1007/s00267-011-9692-1
2. Dutta, S. K., & Parihar, S. S. (2009). Traditional water management systems of India. Water Resource Management, 23(10), 2113–2137. https://doi.org/10.1007/s11269-008-9369-9
3. Gupta, A., & Deshpande, R. (2004). Water harvesting and sustainable development: Ancient practices and current challenges. Environmental Science & Policy, 7(5), 487–498. https://doi.org/10.1016/j.envsci.2004.08.002
4. Jain, M., & Singh, S. (2010). Watershed development and management in India: A critical review. Journal of Environmental Planning and Management, 53(1), 1–23. https://doi.org/10.1080/09640560903392198
5. Kumar, S., & Sharma, S. (2017). Indigenous water conservation techniques and sustainable agriculture in India. Journal of Agricultural Sciences, 59(4), 503–514.

https://doi.org/10.2298/JAS1704503K

6. Singh, R., & Chauhan, D. S. (2018). Exploring ancient Indian water management practices for sustainable development. Journal of Hydrology and Environment Research, 6(3), 145–156.

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Geo AI solutions for Sustainable Development

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Abstract

This paper explores the transformative potential of Geo AI technologies in enhancing community engagement for environmental management and conservation efforts. By integrating geographic information systems (GIS), remote sensing, and artificial intelligence, Geo AI provides accessible tools that empower local communities to participate actively in decision-making processes concerning their natural resources. This study highlights various applications of Geo AI, including participatory mapping, real-time environmental monitoring, and the integration of local knowledge into conservation strategies. By facilitating transparency and collaboration among stakeholders, Geo AI fosters a sense of ownership and responsibility within communities, which is crucial for effective resource management. The findings indicate that community involvement not only improves the relevance and effectiveness of conservation initiatives but also promotes sustainable practices aligned with local needs. As climate change and biodiversity loss continue to pose significant challenges, leveraging Geo AI for enhanced community engagement emerges as a critical strategy for achieving long-term environmental sustainability. This paper contributes to the growing body of literature emphasizing the importance of participatory approaches in conservation and underscores the need for integrating advanced technologies in community-based resource management.

Keywords Geo AI, community engagement, environmental management, conservation, participatory mapping.

Introduction

The intersection of Geo AI and sustainable development presents a transformative approach to addressing complex global challenges. Geo AI, which combines geographic information systems (GIS), remote sensing, and artificial intelligence, enhances our ability to analyze spatial data, leading to more informed decision-making in various sectors. Sustainable development requires a holistic understanding of environmental, social, and economic factors, making Geo AI an invaluable tool (Müller et al., 2020). As urbanization accelerates and climate change impacts intensify, integrating Geo AI can facilitate effective urban planning, resource management, and disaster response (Liu et al., 2021). For instance, remote sensing technologies enable real-time monitoring of land use changes, aiding policymakers in implementing sustainable practices (Kumar & Jain, 2019). Furthermore, Geo AI can empower communities by providing accessible data that fosters participatory planning and governance (Zhang et al., 2022).

This chapter explores various applications of Geo AI in sustainable development, highlighting its potential to drive innovative solutions and enhance resilience. By leveraging spatial intelligence, stakeholders can better navigate the complexities of sustainable development and work toward a more equitable and sustainable future.

Remote Sensing for Environmental Monitoring

Remote sensing plays a crucial role in environmental monitoring by providing comprehensive data for assessing and managing natural resources. Utilizing satellite and aerial imagery, remote sensing enables the observation of land cover changes, vegetation health, and water resources over vast areas and periods (Turner et al., 2015). This technology is particularly valuable in tracking environmental changes related to climate variability, deforestation, and urbanization. For instance, studies have shown that satellite-based remote sensing can effectively detect deforestation rates and forest degradation, offering essential insights for conservation efforts (Hansen et al., 2013).

One of the significant advantages of remote sensing is its ability to deliver real-time data, allowing for timely responses to environmental challenges. For example, remote sensing has been instrumental in monitoring water quality and availability, which is critical in regions experiencing drought or pollution (Huang et al., 2016). By analyzing surface temperatures, chlorophyll concentrations, and sediment levels, researchers can assess aquatic ecosystems' health and make informed decisions about resource management. Moreover, remote sensing contributes to disaster management by enabling early warning systems for natural disasters such as floods, wildfires, and hurricanes (Bhowmick et al., 2019). By integrating remote sensing data with predictive models, authorities can enhance preparedness and response strategies, ultimately saving lives and minimizing economic losses.

Geographic Information Systems (GIS) in Urban Planning

Geographic Information Systems (GIS) have emerged as essential tools in urban planning, enabling planners to analyze spatial data and make informed decisions that promote sustainable development and efficient resource management. By integrating various data layers, GIS allows for the visualization and analysis of geographic information, facilitating a comprehensive understanding of urban dynamics and trends. This capability is vital in addressing the multifaceted challenges faced by cities, such as population growth, environmental degradation, and infrastructure development (Bhatta, 2010).

One of the primary applications of GIS in urban planning is land-use analysis. Planners can utilize GIS to assess current land use patterns, identify areas suitable for development, and evaluate the potential impacts of proposed projects. For instance, GIS can highlight areas vulnerable to flooding or pollution, ensuring that new developments are strategically located to minimize environmental risks (Troy & Grove, 2008). By mapping and analyzing demographic data, planners can also identify underserved communities, ensuring that infrastructure investments promote equitable access to resources and services. Furthermore, GIS enhances the planning process by enabling scenario modeling and simulation. Planners can create various urban development scenarios to forecast potential outcomes based on different land use and policy decisions. This predictive capability is crucial in assessing the impacts of zoning regulations, transportation projects, and public amenities (Zhao et al., 2018). For example, GIS can simulate traffic patterns and congestion levels, aiding in the design of more efficient transportation systems that reduce travel times and emissions.

Public participation is another critical aspect of urban planning that GIS facilitates. By utilizing web-based GIS platforms, planners can engage communities in the decision-making process, allowing residents to visualize proposed changes and provide feedback. This participatory approach fosters transparency and collaboration, ultimately leading to more socially inclusive planning outcomes (Boulos et al., 2011). Tools such as story maps and interactive dashboards can help convey complex spatial information to the public in an accessible manner, empowering citizens to contribute to the planning process actively. Moreover, GIS plays a pivotal role in managing urban infrastructure. Asset management systems that leverage GIS technology allow municipalities to track and maintain infrastructure such as roads, utilities, and public facilities efficiently. This capability is crucial for ensuring the sustainability and reliability of urban services, as it enables planners to prioritize maintenance and investments based on data-driven insights (Chien et al., 2010). For instance, GIS can help identify areas with aging infrastructure that require immediate attention, optimizing resource allocation and reducing operational costs.

As cities increasingly face the challenges posed by climate change, GIS provides valuable tools for assessing vulnerability and resilience. Planners can analyze spatial data related to climate risks, such as rising sea levels or extreme weather events, to develop adaptive strategies. For example, GIS can help identify locations where green infrastructure, such as parks or green roofs, can mitigate flooding and improve urban resilience (Miller et al., 2016). By integrating environmental data with urban planning processes, GIS contributes to the development of sustainable cities that can thrive in the face of change. GIS has revolutionized urban planning by providing tools for data analysis, visualization, and public engagement. Its ability to integrate diverse datasets and facilitate informed decision-making makes it indispensable in creating sustainable and resilient urban environments. As technology continues to advance, the potential for GIS to enhance urban planning practices will only grow, offering new opportunities to address the complex challenges of modern cities.

Data-Driven Approaches to Climate Change Mitigation

Data-driven approaches to climate change mitigation are increasingly recognized as essential for formulating effective strategies to combat global warming. These approaches leverage vast amounts of data generated from various sources, including satellite observations, climate models, and socio-economic indicators, to inform decision-making and policy development. By utilizing advanced analytical techniques, such as machine learning and big data analytics, stakeholders can identify patterns, predict future scenarios, and evaluate the effectiveness of mitigation strategies (Pahlow et al., 2019). One of the key benefits of data-driven approaches is the ability to monitor greenhouse gas emissions in real-time. Remote sensing technologies, for instance, allow for continuous tracking of emissions from various sources, including industrial facilities and transportation systems. This capability not only enhances transparency but also enables governments and organizations to hold polluters accountable (Zhang et al., 2018). By integrating emission data with geographic information systems (GIS), policymakers can visualize emission hotspots and target specific areas for intervention, optimizing resource allocation for emission reduction efforts.

Furthermore, data-driven methods can facilitate the assessment of the potential impacts of climate change across different sectors. By employing climate models that incorporate historical data and projected climate scenarios, researchers can analyze how various industries—such as agriculture, energy, and transportation—will be affected by climate change (Olesen & Børgesen, 2007). This information is crucial for developing sector-specific adaptation and mitigation strategies. For instance, data-driven analyses can help farmers determine the best crop varieties to plant under changing climatic conditions, thereby improving food security while minimizing environmental impact. In addition to emissions monitoring and impact assessment, data-driven approaches enable the evaluation of mitigation strategies' effectiveness. By analyzing data on renewable energy adoption, energy efficiency improvements, and transportation shifts, researchers can quantify the actual reductions in emissions resulting from specific policies or programs (McCollum et al., 2018). This evaluative capacity is essential for refining existing strategies and ensuring that future initiatives are based on empirical evidence.

Spatial Analysis for Resource Management

Spatial analysis is a critical tool in resource management, providing insights into the distribution, utilization, and sustainability of natural resources. By applying various analytical techniques to geographic information systems (GIS), resource managers can effectively visualize and interpret spatial patterns and relationships. This capability is particularly valuable in fields such as forestry, water management, and land use planning, where understanding the spatial dynamics of resources is essential for informed decision-making (Fischer et al., 2018).

In forestry, for example, spatial analysis enables the assessment of forest cover, biodiversity, and the impact of human activities. By mapping forest resources and analyzing data on tree species distribution, managers can identify areas that require conservation efforts or sustainable harvesting practices (Köhl et al., 2015). Similarly, in water resource management, spatial analysis helps to model watershed dynamics, evaluate water quality, and optimize the allocation of water supplies. This is crucial in regions facing water scarcity, as it allows for the identification of potential conservation areas and efficient distribution of resources (Vörösmarty et al., 2010). Additionally, spatial analysis supports land use planning by integrating socio-economic data with environmental factors. This integration enables planners to identify suitable locations for development while minimizing environmental impacts, thereby promoting sustainable land use practices (Bhatta, 2010). For instance, analyzing the spatial relationships between population density and available resources can inform decisions about infrastructure development and resource allocation. Spatial analysis enhances resource management by providing a robust framework for understanding and addressing complex environmental and socio-economic challenges. By leveraging spatial data, managers can make more informed decisions that promote sustainability and resilience in resource use.

Geo AI in Biodiversity Conservation

Geo AI, which combines geographic information systems (GIS), remote sensing, and artificial intelligence, is transforming biodiversity conservation by enabling more effective monitoring, analysis, and management of ecosystems and species. The integration of spatial data with advanced AI techniques allows conservationists to tackle complex challenges in biodiversity preservation, particularly in the face of climate change, habitat loss, and human encroachment.

One of the most significant applications of Geo AI in biodiversity conservation is species distribution modeling. By analyzing historical occurrence data alongside environmental variables, machine learning algorithms can predict the potential habitats of species under current and future climate scenarios. This capability is crucial for identifying areas that may serve as refuges for vulnerable species, enabling targeted conservation efforts (Elith & Leathwick, 2009). For instance, Geo AI has been employed to predict the impacts of climate change on amphibian habitats, helping conservationists prioritize areas for protection and restoration (Milanović et al., 2020). Remote sensing technologies also play a vital role in biodiversity monitoring. High-resolution satellite imagery and aerial drones allow for the real-time assessment of habitat conditions and changes. Geo AI enhances this process by automating the analysis of large datasets, identifying patterns in land cover changes, and detecting signs of habitat degradation or fragmentation (Zhang et al., 2021). For example, AI algorithms can classify land cover types, assess vegetation health, and monitor changes in forest cover, providing critical information for managing protected areas and wildlife corridors. Moreover, Geo AI facilitates the integration of multiple data sources, including ecological, socio-economic, and policy-related information. This holistic approach allows conservationists to analyze the interactions between human activities and biodiversity. By employing spatial analysis, they can identify hotspots of biodiversity, assess threats, and evaluate the effectiveness of existing conservation policies (Kumar et al., 2018). For instance, Geo AI can help determine the relationship between agricultural expansion and species decline, guiding land-use planning and policy interventions.

Community engagement is another essential aspect of successful biodiversity conservation. Geo AI tools can empower local communities by providing them with access to spatial data and decision-making platforms. By using participatory GIS, community members can contribute local knowledge about species and ecosystems, enhancing data quality and fostering a sense of ownership in conservation initiatives (Manda et al., 2020). Engaging communities in conservation planning not only improves outcomes but also promotes sustainable practices that align with local needs and values. As the field of Geo AI continues to evolve, its potential applications in biodiversity conservation are expanding. Innovations in deep learning and big data analytics offer new opportunities to enhance predictive modeling, automate data processing, and improve decision-making. For example, convolutional neural networks can analyze complex imagery data to identify species and habitats with high accuracy, facilitating timely interventions in conservation efforts (Niemeyer et al., 2019). However, the use of Geo AI also raises ethical considerations, such as data privacy and the potential for biased algorithms. It is essential to ensure that data collection and analysis practices are transparent and inclusive, addressing concerns related to the equitable distribution of benefits among different stakeholders (Sullivan et al., 2021).

Community Engagement through Geo - AI Technologies

Community engagement through Geo AI technologies is increasingly recognized as a vital component of effective environmental management and conservation efforts. By integrating geographic information systems (GIS), remote sensing, and artificial intelligence, Geo AI facilitates participatory approaches that empower local communities to actively contribute to decision-making processes regarding their environments (Heipke, 2010). These technologies enable residents to visualize spatial data, such as land use changes, pollution sources, and habitat conditions, fostering a deeper understanding of local issues and encouraging informed dialogue among stakeholders (Sullivan et al., 2021).

One of the primary advantages of Geo AI is its ability to democratize access to information. Community members can utilize user-friendly platforms that incorporate Geo AI tools to map resources, identify environmental concerns, and track changes over time. For instance, mobile applications equipped with Geo AI functionalities allow citizens to report environmental hazards, monitor wildlife, or assess the health of local ecosystems in real-time (Graham et al., 2018). This data can then be integrated into broader conservation strategies, ensuring that local knowledge and priorities shape management efforts. Engaging communities in this manner not only builds trust between stakeholders but also fosters a sense of ownership and responsibility toward local resources (Roche et al., 2015). As communities become more involved in the decision-making process, they are more likely to adopt sustainable practices and advocate for policies that protect their environments. Geo AI technologies offer powerful tools for enhancing community engagement in environmental management.

Conclusion

In conclusion, Geo AI technologies significantly enhance community engagement in environmental management and conservation. By providing accessible tools for data visualization and analysis, these technologies empower local communities to actively participate in decision-making processes regarding their natural resources. The integration of geographic information systems, remote sensing, and artificial intelligence allows residents to contribute valuable local knowledge, identify pressing environmental issues, and collaborate on sustainable solutions. Participatory GIS initiatives further facilitate this engagement by fostering transparency and trust among stakeholders, ensuring that community voices are heard and prioritized in conservation strategies. As communities gain ownership over local resource management, they are more likely to adopt sustainable practices and advocate for policies that protect their environments. Ultimately, the application of Geo AI not only strengthens the effectiveness of conservation efforts but also fosters a sense of responsibility and stewardship among community members.

References

1. Bhatta, B. (2010). Analysis of urban growth and sprawl from remote sensing data. Springer. https://doi.org/10.1007/978-3-642-02688-3
2. Elith, J., & Leathwick, J. R. (2009). Species distribution models: A guide to data analysis and visualization. Journal of Biogeography, 36(2), 201-215. https://doi.org/10.1111/j.1365-2699.2008.02087.x
3. Fischer, J., et al. (2018). Biodiversity and the challenges of sustainability: A global perspective. Ecological Applications, 28(3), 470-482. https://doi.org/10.1002/eap.1680
4. Graham, S., et al. (2018). Citizen science and participatory approaches to environmental science. Environmental Science & Policy, 89, 205-211. https://doi.org/10.1016/j.envsci.2018.08.016
5. Heipke, C. (2010). Crowdsourcing geospatial data. ISPRS Journal of Photogrammetry and Remote Sensing, 65(6), 550-557. https://doi.org/10.1016/j.isprsjprs.2010.06.003
6. Klenk, N. L., et al. (2017). Climate change and conservation in a changing world. Environmental Research Letters, 12(7), 074019.

https://doi.org/10.1088/1748-9326/aa7e87

7. Köhl, M., et al. (2015). Forest inventory: The contribution of remote sensing. Forest Ecology and Management, 352, 62-75. https://doi.org/10.1016/j.foreco.2015.06.013
8. Manda, A. K., et al. (2020). Participatory GIS: Bridging the gap between science and community. Sustainability, 12(6), 2469. https://doi.org/10.3390/su12062469
9. McCollum, D. L., et al. (2018). Connecting the dots: Integrated modeling for climate change mitigation. Nature Sustainability, 1(8), 384-397. https://doi.org/10.1038/s41893-018-0024-5
10. Milanović, M., et al. (2020). Predicting climate change impacts on amphibian habitats. Diversity and Distributions, 26(10), 1185-1198. https://doi.org/10.1111/ddi.13115
11. Niemeyer, J., et al. (2019). Deep learning for environmental monitoring: A case study on land cover classification. Remote Sensing, 11(10), 1179. https://doi.org/10.3390/rs11101179
12. Olesen, J. E., & Børgesen, C. D. (2007). Impacts of climate change on agriculture: A global analysis. Agricultural Systems, 94(2), 220-229. https://doi.org/10.1016/j.agsy.2006.09.001
13. Pahlow, M., et al. (2019). Data-driven approaches to climate adaptation. Global Environmental Change, 54, 1-8. https://doi.org/10.1016/j.gloenvcha.2019.01.003
14. Roche, S., et al. (2015). Integrating local knowledge into environmental management: The role of participatory GIS. GeoJournal, 80(4), 549-563. https://doi.org/10.1007/s10708-015-9652-5
15. Sullivan, S., et al. (2021). Equity and justice in conservation. Conservation Biology, 35(1), 3-10. https://doi.org/10.1111/cobi.13644
16. Turner, W., et al. (2015). Free and open-access satellite data are key to biodiversity conservation. Frontiers in Ecology and the Environment, 13(7), 335-336. https://doi.org/10.1890/1540-9295-13.7.335
17. Vörösmarty, C. J., et al. (2010). Global threats to human water security and river biodiversity. Global Environmental Change, 19(2), 181-194. https://doi.org/10.1016/j.gloenvcha.2008.10.007
18. Zhang, L., et al. (2021). Advancements in remote sensing for biodiversity monitoring. Remote Sensing of Environment, 258, 112-123. https://doi.org/10.1016/j.rse.2021.112123

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Impact Of Yeldari Irrigation Project on Agricultural in Parbhani District.

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Abstract

This research is to understand the impact of irrigation project on agriculture development. Here we will study the impact of irrigation project study conducted based on "YELDARI IRRIGGATION PROJECT", district Parbhani by studying the data collected from various source of government statistics books and websites. We will also include the challenges and its possible solution in the irrigation project which impact the agro-production

Keywords: Agricultural Development, Irrigation, Project.

Introduction

Yeldari Dam, is an earthfill dam on Purna river near Yeldari in Jintur taluka of Parbhani district in the state of Maharashtra in India. It is the second largest dam in Marathwada region. Dam is renovated and developed as a big reservoir and also tourist attraction spot in Parbhani district Water is an important pre-requisite for agricultural development. The process of economic development involves the growth of national output. Each economy/country tries to attain the goal of economic development by making use of natural resources. There is no doubt that existence or absence of natural resources can facilitate or retard the process of economic development. An assured water supply spells prosperity, creates employment potential, increase income and enhance capital formation. Infect.the production of a crop requires soil, water, seeds, labor implements, proper planning and management. The famine enquiry commission of 1945 has rightly observed that among the measures that may be adopted to mcrease the area under cultivation and the yield per acre, the first place must be given to the works for the supply and conservation of water

Yeldari Dam, is an earthfill dam on Purna river near Yeldari in Jintur taluka of Parbhani District in the state of Maharashtra in India. It is the second largest dam in Marathwada region. Dam is renovated and developed as a big reservoir and also tourist attraction spot in Parbhani district, which providing water to agriculture and drinking as well as for fish culture to know about more details about this dam and its link of food chain

Purpose of dam is Irrigation and Hydroelectricity. The dam was built between 1958 and 1968 under the observation of Yashwantrao Chavan. It has a hydroelectric power station consisting of three units of 7.5 MW capacity each for 22.5 MW total capacity. It is the second-largest dam in Marathwada for Hydro power.

The present study aims at exploration of agriculture in our life. Agriculture is a large activity in India as well as Maharashtra. The term "Agriculture is originated from the word "Ager' Meaning there by a cultivation. In our country agriculture is the backbone of Indian economy. In India farming is a main business. Today in India 70% people are depending upon agriculture.

Before understanding the Impact of irrigation project, we need to understand agro-development and then possible impact on the production by irrigation projects. Increase In the production of crops is called as agro-development. To achieve agro development or get an increase one should use improved variety of seeds, good fertilizers and pesticides, etc. Irrigation projects are supposed to be life line for any district or any region or any state. Irrigation projects are meant to be increased development for any region.

We observed that due to lack of irrigation project it is very difficult to achieve agro-development and ultimately overall development of people. If water resources are sufficient than one can convert barren land into fertile land with the help of irrigation projects. Not only agro-production increased but it helps to make self-sufficient in food-stock as a nation. Irrigation projects also useful for electricity production as well as fisheries production.

Study Area

We conducted the research on "Impact of Yeldari irrigation projects on agriculture development in Parbhani and Hingoli District. Yeldari dam is located 15 km distances away from Jintur city in the Yeldari village (rural area) at the GPS 190 43' 12.4" North Latitude and 760 43 55" East Longitude. Its total area is 101.540 km2 (39.205 sq mi) The height of the dam above its lowest foundation is 51.2 m (168 ft) while the length is 4,232 m (13,885 ft). The live storage capacity is 0.81 km3 (0.19 cu mi). The Dam is Situated impound Purna river as a sub-basin of Godavari River. In the middle of Hingoli and Parbhani districts.

Objective of study

1. To understand increase in production by the project
2. To study the increase in production by increasing irrigation facilities.

Research methodology and data collection:

To study this research, data have been collected based on secondary data collection method from various District statistics papers and agriculture data from government websites. To analyze the data simple mathematical calculations are used.

Irrigation Project

Irrigation is a method by which water is distributed to soil naturally or artificially, which helps to increase in agriculture and plant production. Irrigation project implement as large, medium or small scale. In case of less than average rains or in case to distribute

sufficient and required water for irrigation various small canals are built, which directly help agriculture. Not only irrigation project helps to fertile lands but it also helps to convert non-fertile land into fertile land to boost the agriculture and its production. The main purposes of irrigation projects are to distribute sufficient water to agriculture-oriented area and the producer of many food grains and agriculture products. To increase the production of agriculture irrigation facilities are important to be provided time to time.

Yeldari Dam is an important place to irrigation projects in Jintur (Parbhani) and Sengaon (Hingoli) taluka which is not limited to agriculture irrigation, but extended to electricity production and fisheries production, which help to boost the economic advantages to make it self-dependent.

Statement of the Research Problem

Parbhani and Hingoli districts farmer entirely depend upon agriculture income have to face several problems. The soil held becoming poor day by day because of overuse chemical fertilizer and pesticide. Today's due to irrigation system certain change occurred in the region which could be further changed in better ways.

1. Bad economic conditions of farmers to collect resources for better utilization of water from Irrigations Project.
2. Natural outbreaks which can spoil the crops.

Solution

We tried to find out the possible solutions for the problems given in by referring the possible solutions as under,

1. Bad economic conditions of farmers: Government are running many schemes which can provide easy loans to farmers by which they can buy pipes and sprinklers which can better supply the waters to farm lands, they can also buy the electric pumps on subsidies rates "Kisan Credit cards" are also a good step to help farmers & to provide economic supports as a credit
2. Natural Outbreaks: To swift recover from natural outbreaks Government announce the insurance of crops which can at least help to recover the investments of farmers.

Additionally, to protect them from natural Outbreaks, Government is also making aware farmers to make their extra/additional income from fisheries production, poetry farms and other small-scale productions which motivate farmers in case of natural outbreaks

Importance and Need of the Study

Agriculture development is the result of many factors and among them irrigation is the most important. It improves agriculture to a significant measure and acts as a tool of development in agriculture pursuits.

Owing to the rapid growth of population and development of other sectors besides agriculture in most of the countries, water is becoming a scare resource and most costly to develop. Most of the water needed for agriculture is irrigation water, and it is a forgone conclusion that irrigation is vital for irrigation development. The district of Parbhani has been selected as a study area in which agriculture has been the major source of livelihood for its inhabitants. We tried to find out the possible solutions for the problems given bad economic conditions of farmers, Government are running many schemes which can provide easy loans to farmers by which they can buy pipes and sprinklers which can better supply the waters to farm lands, they can also buy the electric pumps on subsidies rates. "Kisan Credit cards" are also a good step to help farmers to provide economic supports as a credit.

For proper and healthy supply of water we need to maintain the rivers, dam and canals clean and free from the wastes like plastic, industry wastes, etc. To maintain cleanliness of water in rivers, dams and canals (1.e. all types of water resources) [10:33 am, 2/8/2024] Athu=piu: Government has launched Swacha Bharat Abhiyan with the help of every citizen at every level. Its impact and awareness are positive.

Cropping Pattern:

Cropping pattern means the proportion of area under different crop at a particular period. The change in cropping pattern in a particular span of time clearly indicates the changes that have taken place in the agricultural development. Agricultural loans play a vital role in this connection. Moreover, Area under different crops would determine the generation of income and employment [10:34 am, 2/8/2024] Athu=piu: The trends in the cropping pattern in Parbhani District with average for the year 2008-09 and 2018-19 is shown in the table 1 In the Parbhani District Jawar, wheat and maize are the major cereal crops in the year 2018-19. The area under food grain crops was 7867.67 hectors (Le. 69.24 percent). Among the food grain Jawar crop occupied highest area (ie.51.70 percent) followed by wheat crop (495 percent) in the year of 2018-19 Moreover among the pulses gram crop occupied highest area (1.2.3.75 percent) than other pulses.

The cropping pattern in the district showed that, the food grians crop are main Among the food grains crops Jawar, occupied lion's share in the cropping pattern. In case of non-food grain crops the position of total oil seed crops showed that of the total gross cropped area 3.54 percent area was brought under these crops in the year 2018- 19. Moreover, among oilseeds groundnut is the major crop having 0.70 percent. Among the cash crops the sugarcane has occupied largest area 15.47 area, whereas the cotton has occupied a very small area 0.10 percent of the gross cropped area in the district. Over a period, it was observed from table 1 that in the district the area under sugarcane increased by 165.73 percent during the period of 2008-09 to 2018-19.

Conclusion:

While studying the impact of Irrigation Projects on Agriculture development, Agricultural productivity is a function of various factors like physical, socioeconomic technical and organizational. There are always some advantages and disadvantages of any project, but as far as we understand from data Impact of Yeldari irrigation projects has more advantages as it provides sufficient water to farmers for irrigations which not only making them economically independent but contributing in the income of people as a nation as agriculture production increases due to this project

References

1. https://www.indiastatdistricts.com/maharashtra/parbhani/data/agriculture
2. https://coap.vnmkv.ac.in/AgriDepartment/Books
3. Choudhary Umesh Chndra (1990) - "Jeevan Ka Adhar Krishi and Krishi Ka Adhar Jal Sansadhan" (Vansundhara Prakashan U.P.)
4. Singh, Surendre (1994) Agriculture development in India (A regional analysis. Kushwaha Publication, Shilong)
5. Dantewala (1966)- Agriculture development Since Independence
6. Shinde S.D., Jadhav M. G. and Pawar C.T. (1978): Agricultural Productivity in Maharashtra.

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Reviving Solutions from The Past: Embracing Traditional Sustainability To Tackle Climate Change

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Abstract

As our planet faces shifts in rising temperatures, and environmental disruption, the reality of climate change demands urgent action and adaptation. Amid this crisis, sustainable practices from diverse cultures offer essential insights into effective resource management and sustainable living. Tribal communities, along with Indian civilizations, have long embraced beliefs that prioritize the conservation and preservation of nature. These practices reflect a deep respect for the environment and a commitment to mindful and sustainable consumption. Central to many indigenous communities' way of life is the belief that "kill only enough for food" and "take only what you need," principles that advocate for minimal impact on nature and emphasize the importance of living in balance with the Earth. These communities have survived and adapted through countless challenges, including famines, droughts, and natural calamities. Their ability to thrive despite these hardships demonstrates their resilience, their value of sustainable, ecologically attuned lifestyles. These traditions are not merely survival strategies; they offer profound lessons on how to maintain harmony with the environment and protect vital resources for future generations. The time-tested practices of tribal communities and rural populations offer invaluable insights into facing the climate challenges of today. This exploration emphasizes the importance of reviving and respecting traditional ecological knowledge, which is crucial for promoting resilience and ensuring long-term sustainability. Many indigenous and rural communities have inherently embraced lifestyles of low consumption, where sustainability and ecological awareness are at the core of daily life. Additionally, traditional agricultural methods like intercropping, and crop rotation not only enhance food security but also improve the resilience of ecosystems. Natural resource

conservation practices, such as the protection of sacred groves and effective preservation techniques, ensure the long-term health of the environment while fostering biodiversity. These methods offer powerful strategies for confronting the climate crisis and promoting a sustainable future.

Keywords: Traditional practices, Environment Sustainability, Indigenous Knowledge, Resource Conservation, Climate change

Introduction

The dangers of Climate Change are undeniable. Rising temperatures drive extreme weather events like hurricanes, wildfires, droughts, and floods, affecting ecosystems, food supplies, and communities globally. These changes threaten biodiversity, strain resources, and cause displacement. Our planet's natural systems are nearing their limits, and action to prevent severe impacts is urgent. With a growing global population, human pressure on the environment may worsen, risking further degradation and climate impact. A shift to renewable energy, sustainable land use, and responsible consumption is critical to curbing climate change.[1]

Amid these challenges, both technological advances and traditional practices offer solutions. New farming technologies address food security issues driven by population growth, yet timetested sustainable practices like agroforestry, water conservation, and organic soil management also hold valuable insights. Rooted in centuries of coexistence with nature, these methods support ecosystems and resources. [2] Reviving these practices alongside modern science can yield effective, sustainable climate strategies, blending ancient wisdom with contemporary adaptation. This chapter explores sustainable practices from various cultures, offering insights for addressing today's climate challenges. Traditions often tie nature, ecology, and resources to customs, instilling a respect for sustainability. Indigenous people's Traditional Ecological Knowledge underpins resilience, helping them adapt to environmental shifts through a deep understanding of the land- a resilience recognized by many Western academics as vital to survival in changing conditions.[3] This chapter examines traditional sustainable practices from diverse cultures across areas such as food security, agriculture, construction, and more, offering insights that can inspire us to use resources in a more sustainable manner. Some of the practices are follows: -

1. Minimizing Food Waste and Promoting Local Consumption

Around 70 percent of India's population is estimated to live in rural areas. Communities closely connected to nature typically lead a frugal lifestyle, focused on minimal consumption.[34]. Food Waste Food production, processing, marketing, consumption and disposal have important environmental implications because of energy and natural resource usage and associated Green House Gas emissions. [5] In India, locally grown fruits and vegetables from nearby rural areas are easily accessible in local markets, minimizing the need for transportation and packaging. Fresh food is often preferred over processed, packaged, and artificially preserved options. The country's diverse food practices, tailored to local climates and resource availability, help reduce reliance on packaged or imported food products. [6] Additionally, natural food preservation methods such as sun drying, salt in pickles, and grain storage with natural disinfectants like Neem (Azadirachta indica) are widely practiced. [6]

2. Agriculture

Modern agriculture drives crop genetic resource loss in the Third World by promoting genetically uniform high-yield varieties [7] there are certain practices followed by traditional civilizations all over the world, which follow climatic patterns and use natural resources in a sustainable manner.

i. Crop Rotation

Long-term studies show that increasing crop rotation from single to double cropping (cornsoybean) improves carbon sequestration by 20 g cm−2 year−1 in humid continental climate at Wooster of Ohio, USA [8]. Crop rotation is effective for carbon sequestration and reduces GHG emissions compared to continuous cropping... [10], [11] Rotating rice with corn or sorghum cuts emissions by 68-78%, improving yield and water efficiency while reducing erosion [12],[13].

ii. Diverisification

A key principle of the Lun Bawang community is maintaining a diversified resource base through home gardens (kabun) and forest produce. This diversification helps mitigate risks across different spatial and temporal scales, thereby enhancing food and resource security. For instance, their home gardens support various food sources, including poultry, livestock, and fish, while the forests provide access to wild animals, fish, vegetables, and fruits. This variety reduces the risks associated with food shortages, ensuring that if one resource is affected, other food sources remain available.Thus, reducing the monoculture and saving the various wild genetic diversity. [3]

iii. Integrated Agriculture and Animal husbandry

In paddy fields, fish help control plant hoppers and weeds, add nutrients, soften the soil, and improve oxygen flow through their movement. Households also raise ducks, which eat insects, supporting a healthy rice harvest. Unlike conventional rice farming, which requires chemical fertilizers, rice-duck farming reduces fertilizer use.[13] Integrated crop-animal farming thus supports agrobiodiversity, food diversity, and sustainable land management. [14]

iv. Use of Stress-Resistant Crops

Farmers in Bangladesh adjust rice varieties during high temperatures by replacing rainfed crops like Aman with irrigation-based varieties such as Boro and Aus. Drought-resistant crops include maize, pearl millet, foxtail millet, and finger millet. Additionally, salinity-tolerant crops like henna and faba bean help reduce powdery mildew when grown alongside wheat, maize, and chili peppers. [16]

v. Enriching Soil

A study published in Nature highlights the importance of the soil microbiome for fertility, with soil and rhizosphere microorganisms influencing plant composition, productivity, and sustainability [35]. Using microbes to boost agricultural productivity offers a non-transgenic approach and can be considered an extension of the plant genome, contributing to soil health and supporting low-input, sustainable farming. Panchgavya, is a mixture of five ingredients from cows that is used in traditional Hindu rituals and Ayurvedic medicine, improves soil fertility by increasing organic matter, nutrient levels, and promoting microbial growth. It enhances soil structure, regulates pH, and boosts plant health, leading to larger leaves, increased photosynthesis, and better root growth. Panchgavya also extends crop freshness, reduces pesticide use, and improves yield, restoring organic practices and enhancing shelf-life while cutting costs and boosting profits.[17]

vi. Intercropping / Home Gardens

Intercropping is practiced across many communities, involving the simultaneous cultivation of multiple crop species on the same field. In their integrated home gardens, known as "kabun" by the Lun Bawang, crops like taro, sweet potato, yam, papaya, banana, and other vegetables are grown. This system is productive as it minimizes climate-driven crop failure, with different crops adapted to varying climatic conditions. The intensive use of nitrogen fertilizers has disrupted the climate system and the global nitrogen cycle through N2O emissions. [18] Legume intercropping helps reduce the need for nitrogen fertilizers by enhancing nutrient availability (nitrogen and phosphorus), boosting crop growth, and improving nutrient use efficiency.[19] In India, intercropping is an ancient agricultural practice, particularly intercropping of sorghum and pigeon pea.[9].

vii. Agroforestry

Agroforestry systems, with their deep-rooted trees, are well-suited for drought conditions as they access a larger volume of soil for water and nutrients.[20] The integration of trees with crops is a practice dating back to the origins of farming and animal husbandry.[21] Forest preservation is significant in all communities under local customary law, where forests act as a buffer for paddy fields and provide alternative resources. These forests are maintained as conservation areas with penalties for violations, and activities like logging and cutting are prohibited, except for hunting. Agroforestry systems, resilient in drought conditions due to deep-rooting trees, combine trees and crop in traditional farming.[3]

3. Sacred Groves

India's sacred groves, such as Devrai (Maharashtra), Orans (Rajasthan), Sama (Bihar), Devban (Himachal Pradesh), and Kavu (Kerala), are ecologically sensitive zones protected for carbon sequestration, nutrient recycling, topsoil preservation, and biodiversity. These groves are revered and left undisturbed, often linked to local deities such as Aiyappa, the forest god, which helps ensure their preservation in Kerala and Karnataka.[4]

4. Construction

Traditional Indian construction techniques, such as using mud insulation, solar-passive orientation, and large courtyards, reduce energy needs and align with natural surroundings. Indigenous materials like bamboo, stone, and clay are environmentally beneficial by minimizing GHG emissions and transport energy [22]. Cooling features like Cooling features like "Chhajjas" reduce sun exposure while also enhancing the aesthetic appeal [23]. Earthbuilding methods like (CSEB) Compressed stabilized earth blocks and rammed earth in South India use local resources for low-energy structures. Rainwater harvesting has long been practiced, with methods adapted to local climates, such as Gujarat's step wells and Rajasthan's johads. [25]

5. Transportation

In Indian cities, non-motorized transport (NMT), including walking, bicycles, and pedal rickshaws, dominates short-distance travel, representing 40-50% of the transport mode share even in large cities. Dense mixed land-use patterns support NMT, especially for low-income households, promoting sustainable transport goals.[6]

6. Festivals

In Jharkhand, the Sarhul festival honors the Sal tree for its provision of water, shade, housing, and food.[26] The Santal tribe celebrates the Baha festival during February-March, respecting trees like Mohuwa, Peepal, and Mango as they enter reproductive phases. During this time, they avoid cutting trees or using flowers for decoration, preserving these resources [28].

7. Day-To-Day Customs

With globalization came plastic use, but now a plastic-free lifestyle is trending. Many ecofriendly methods have been inspired from Indian traditions. For example, areca sheath fibers [29] can create biodegradable materials like compostable platesral fibers can replace nylon in various products. Miswak sticks [30] have also proven more effective than regular toothbrushes for plaque and gingivitis reduction. Clay pot cool water [31] but also store perishable items at moderate temperatures. The traditional earthen cup enhances the flavor of tea and offers an eco-friendly, plastic-free alternative [32]. Hindu rituals like “Vaastu Pooja” housewarming ceremonies emphasize sustainability, linking home ownership with resource preservation responsibilities.

8. Values And Belief Systems

The Bishnoi community in India’s Thar Desert is dedicated to biodiversity conservation and eco-friendly practices. They value the Khejri tree (Prosopis cineraria) for its moistureretention, protecting it even at personal risk. [33] The communittee motto of the Lun Bawang, “Kill only enough for food” and “take only what you need,” by the underpins their sustainable practices, discouraging over-harvesting and promoting resource conservation. This philosophy also aligns with their mindset, where preparing for uncertainties ensures resource security.[2]

Conclusion

The Bishnoi saying, "Sir santhe rooke rahe to bhi sasto jaan," emphasizes that even giving up one’s life to protect a tree is a valuable sacrifice. [33]. Such values are the reason why these communittees were able to overcome and adapt to many stress factors including climate change which show their resilience. They teach us how to maintain harmony with the environment and protect vital resources for future generations. Sustainable and eco-friendly living has always been integral to ancient Indian practices. What is now becoming a necessity was already embraced by our ancestors. It is time we stop viewing them as 'outdated' and embrace them sustainable practices too.

References

1. Jetz, W., Wilcove, D. S., & Dobson, A. P. (2007). Projected impacts of climate and land-use change on global bird diversity. PLoS Biology, 5(6), 1211–1219.
2. Manjrekar, S. M. (2017). Sustainability practices ingrained in Indian culture. In 5th International Conference on Civil, Architecture, Environment and Waste Management (CAEWM-17).
3. Hosen, N., Nakamura, H., & Hamzah, A. (2020). Adaptation to climate change: Does traditional ecological knowledge hold the key? Sustainability,12(2), 676.
4. Kumar, B. M. (2008). Forestry in ancient India: Literary evidence of productive and protective aspects. Asian Agri-History,12(4).
5. FAO. (2013). Food wastage footprint: Impacts on natural resources. Food and Agriculture Organisation, Rome.
6. Ministry of Environment, Forest and Climate Change. (2015). Climate-friendly lifestyle practices in India. Government of India. Prepared by WWF-India.
7. Altieri, M. A., & Merrick, L. (1987). In situ conservation of crop genetic resources through traditional farming. Economic Botany, 41(1),86–96.
8. West, T. O., & Post, W. M. (2002). Soil organic carbon sequestration by tillage and crop rotation: A global analysis. Soil Science Society of America Journal, 66,1930–1946.
9. Willy, R. W. (1983). Intercropping studies with annual crops. In J. Nugent & M. O'Connor (Eds.), Better crops for food (p. 1983). London: Pitman.
10. Triberti, L., Nastri, A., & Baldoni, G. (2016). Long-term effects of crop rotation, manure, and fertilization on soil carbon and fertility. European Journal of Agronomy, 74,47–55.
11. Theisen, G., Silva, J. J. C., Silva, J. S., Andres, A., Anten, N. P. R., & Bastiaans, L. (2017). New cropping system for subtropical lowland sustainability. Field Crops Research, 212, 82–94.
12. Cha-un, N., Chidthaisong, A., Yagi, K., Sudo, S., & Towprayoon, S. (2017). Greenhouse gas emissions, soil carbon sequestration, and yields in rice crop rotation. Agriculture, Ecosystems & Environment, 237, 109–120.
13. Long, P., Huang, H., Liao, X., Fu, Z., Zheng, H., Chen, A., & Chen, C. (2013). Rice–duck cultivation reduces ecological costs. Journal of the Science of Food and Agriculture, 93(12), 2881–2891.
14. Shava, S., O'Donoghue, R., Krasny, M. E., & Zazu, C. (2009). Traditional food crops and resilience in Zimbabwe. International Journal of African Renaissance Studies, 4, 31–48.
15. Moniruzzaman, S. (2015). Crop choice for climate adaptation in Bangladesh. Ecological Economics, 118, 90–98.
16. Singh, R., & Singh, G. S. (2017). Traditional agriculture: Climate-smart sustainable food production.

Energy, Ecology and Environment,2, 296–316.
17. Bajaj, K. K., Chavhan, V., Raut, N. A., & Gurav, S. (2022). Panchgavya: A gift to humankind. Journal of Ayurveda and Integrative Medicine, 13, (2),100525.
18. Bouwman, A. F., Boumans, L. J. M., & Batjes, N. H. (2002). N2O and NO emissions from fertilized fields. Global Biogeochemical Cycles, 16(4),1080.
19. Latati, M., Aouiche, A., Tellah, S., Laribi, A., Benlahrech, S., Kaci, G., & Ounane, S. M. (2017). Intercropping maize and beans enhance soil carbon and nitrogen. European Journal of Soil Biology, 80, 9–18.
20. Verchot, L. V., Van Noordwijk, M., Kandji, S., Tomich, T., Ong, C., Albrecht, A., & Palm, C. (2007). Linking adaptation and mitigation in agroforestry. Mitigation and Adaptation Strategies for Global Change, 12(5), 901–918.
21. Oelbermann, M., Voroney, R. P., & Gordon, A. M. (2004). Carbon sequestration in agroforestry systems in Costa Rica and Canada. Agriculture, Ecosystems & Environment, 104 (3), 359–377.
22. Dadhich, I., Panwar, K., Malodia, A., Choudhary, A., & Dave, M. (2022). Sustainable architecture vs. heat waves in India. International Journal of Engineering Technology and Management Sciences, 5(6), 143–150.
23. Sharma, A., Garg, S., Shah, V., Agrawal, P., & Lohan, P. (2015). Design insights from Jaipur's walled city.
24. Spišáková, M., & Mačková, D. (2015). Traditional building materials in modern construction. Selected Scientific Papers – Journal of Civil Engineering, 10(2), 127–138.
25. Dev, M. (2017). Indian culture for environmental conservation. International Journal on Emerging Technologies, 8(1), 256–260.
26. UNEP & UNEP RISO Centre. (2013). NMT infrastructure in India: Investment, policy, and design.
27. Kunwer, S. (2020). Sarhul Festival in Jharkhand: Performing Adivasiyat. Anthropology, 8 (215),1–5.
28. Mondal, A., & Pandey, M. S. (2024). Indigenous festivals and climate sustainability in India. Rupkatha Journal on Interdisciplinary Studies in Humanities, 16(1).
29. Nayak, S., Barik, S., & Jena, P. K. (2021). Eco-friendly plates from areca leaf. In Biopolymers and Biocomposites from Agro-Waste for Packaging Applications (pp. 127–139). Woodhead Publishing.
30. Al-Otaibi, M., Al-Harthy, M., Söder, B., Gustafsson, A., & Angmar-Månsson, B. (2003). Chewing sticks vs. brushing on plaque removal. Oral Health and Preventive Dentistry, (4), 301–307.
31. Sarkar, N., Somwanshi, A., Dhand, D., & Trivedi, R. (2023). Thermal analysis of clay pots for water cooling. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 45(2), 4146–4159.
32. Kumar, S. (2024). Top tea companies and startups in India.

Optimization: Journal of Research in Management,16(1).

33. Dhankhar, S. (2021). Sustainable customs: Bishnois of Marwar and other indigenous groups. Notions, 13(1), 44–49.
34. Das, D., & Pathak, M. (2012). The growing rural-urban disparity in India: Some issues. International Journal of Advancements in Research & Technology, 1(5), 1-7.
35. Suman, J., Rakshit, A., Ogireddy, S. D., Singh, S., Gupta, C., & Chandrakala, J. (2022). Microbiome as a key player in sustainable agriculture and human health. Frontiers in Soil Science, 2, 821589

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Land Use / Land Cover Changes Detection and Impact of Human Intervention on Land Degradation

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Abstract

Ecosystem plays a very important role for human life. Human life is almost impossible to live without ecosystem. Many actions of humans have an effect on the ecosystem. Human have harmed the environment to make their life easier and more comfortable. Humans are using the land in different ways while living their life but now day by day the use of land is going against the environment and overuse is causing land degradation. Land use land cover pattern is changing rapidly today. This change is leading to human development on one side and land degradation on the other side. Land degradation is not only a loss to the environment but also a huge loss to human being.

Keywords: land degradation, land use, land cover, human activity.

Introduction

Land is a very important natural resource. Water, soil, ecosystem, mineral resources, human landscape etc. are all parts of land. Land is an important component that supports life on earth and all activities of human life are directly or indirectly depend on land. The earth is limited resource and only 20 percent of the earth's surface is available as land. But land use/ land cover is constantly increasing to meet the needs of the growing population, which changing the land use/ land cover scenario. Economic liberalization was adopted in India after 1990, as a result of which industrialization, urbanization, agriculture, basic infrastructure, transport facilities and mineral resources have developed rapidly in the country. All the above activities related to development are related land use. Due to increasing development, land use is increasing due to which land use has exceeded its availability level. It is worth noting that development activities are being carried out without land use management. Due to development in the absence of land use management, forest areas are being degraded, industry, human settlement and mining activities are expanding on forest lands. Human intervention is increasing in the areas rich in water resources and agriculture and residential activities are developing on wetland areas. As a result, ecological crisis has arisen related to environmental pollution, water pollution, heavy fall in ground water level, decline in green cover, heavy increase in emission of greenhouse gases etc. the intensity of ecological crisis is more visible in urban areas but its intensity is continuously increasing in rural areas also. Forest areas have suffered the most damage due to development in the absence of land use management, which has increased carbon emissions and biodiversity is facing serious threats. Pollution in forest areas has increased due to mining activities and natural habitats have been damaged. The process of desertification has become more rapid due to decreasing forest areas.

The entire ecosystem has been damaged due to the ecological crises thus created and the goal of sustainable development for the future has become extremely challenging. There is a need to make detailed plans regarding land use management in the country and the land be judicious and sustainable.

Objectives:

1. changes in land use and land cover pattern and resulting land degradation.
2. Studying how climate change affects land degradation, through changes in land use and land cover.
3. To study how excessive human intervention in the environment leads to land degradation.

Data and Methodology:

The study of the presented topic has been done entirely on the basis of secondary data. It is generally accepted that long-term variations in vegetation cover reflect land productivity. The frequency of vegetation observed over long periods is indeed a good indicator of ecological conditions or changing production conditions - soil fertility, water availability, and land use. It is therefore a measure of the response of ecosystems to the external impacts, whether they are induced by the human activity or natural variability, and provides information on land condition. The reduction or loss of productivity, biological and/or economic, is a common denominator of the various definitions of land degradation (Escadafal and Bégni, 2016). Land productivity is therefore an essential piece of information for degradation monitoring.[1]

There are some significant efforts to assess the extent the extent of land degradation across different case study sites and for different ecosystem types (ELD- initiative, 2013). One way of approaching this is by conducting a cost-benefit analysis of the current land management type and alternative options. The ELD initiative has developed such a methodology, based on the 6+1 steps action plan established by the United Nations Convention to Combat. It is intended to allow the estimation of the overall benefits of addressing land degradation and implementing ecosystem restoration.[2] Desertification UNCDD global Mechanism (ELD- initiative, 2013) As clearly stated by Thornes (2004), Otto and others (2007), and Symeonakis and others (2007), the study of LULCCs trajectories may provide a meaningful contribution to the land degradation assessment.[3] According to S. Bajocco and others (2012), there is no methodology of how to use Land Use/ Land Cover Changes analysis to assess changes in land degradation sensitivity. The present study contributes to this deserving need.

Land Use and Land Cover:

Land use differ from land cover. Simply put, land cover is what covers the surface of the earth and land use describes how the land isused. Examples of land cover classes include: water, snow, grassland, deciduous forest, and bare soil. Land use examples include: wildlife management area, agricultural land, urban, recreation area etc. Two land parcels may have similar land cover, but different land use. For instance, A golf course and an office building are both commercial land uses. The former would have a land cover of grass, while the latter would be considered built up.[4]

Land Use: According to the FAO concept, land use defines the human activities which are directly related to land, making use of its resources, or having an impact on them. In that context the emphasis is on the function or purpose for which the land is used, and particular reference is made to "the management of land to meet human needs." The term includes both rural and urban or industrial uses. Land use automatically involves the concepts of optimizing the land use potential, land evaluation for example, and of land use planning. A distinction should be made here between present land use (the way in which the land is used at present) and potential land use.[5]

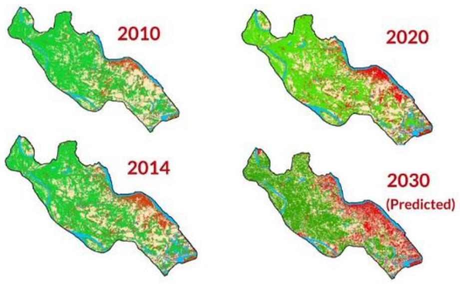
Land Cover: Land cover, a concern principally of the natural sciences, denotes the physical state of the land. It embraces, for example, the quantity and type of surface vegetation, water, and earth materials. Land-cover changes fall into two ideal types, conversion and modification. The former is a change from one class of land-cover to another: from grassland to cropland, for example. The latter is a change of condition within a land-cover category, such as the thinning of a forest or a change in its composition.[6]

Land Use and Land Cover Change:

Land cover is influenced by changing natural environmental conditions and human activities. Distinguishing changes in land cover due to natural variability as compared to human activities requires understanding how natural and human influences interact. Assessing the consequences of changes in land use and land cover begins with interdisciplinary knowledge of what changes are occurring, what processes are causing the changes, and what the impacts of changes in land use and land cover have been or may be.[7]

Land use and land cover change is the alteration of the land’s characteristics and how it’s used by humans. Climate can affect and be affected by changes in land cover (the physical features that cover the land, such as trees or pavement) and land use (human management and activities on land, such as mining or recreation). A forest, for instance, would likely include tree cover but could also include areas of recent tree removals currently covered by open grass areas. Land cover and use are inherently coupled: changes in land-use practices can change land cover, and land cover enables specific land uses.[8]

Changes in land use and land cover impact both environmental quality and the quality of life, two aspects that impact human wellbeing. Changes in habitat, water and air quality and the quality of life are some of the environmental, social and economic concerns associated with land use and land cover changes.[9]



Prediction of Land Use Land Cover Change Using QGIS and Arch GIS

(Source: Google Image)

Land Degradation by Human Activity:

Land degradation as "the substantial decrease in either or both of an area's biological productivity or usefulness to humans due to human activities." It is widely accepted truism that the greater the density of the human population, the greater are its impacts on the surrounding environment. However, human impact is the most frequent explanation for negative environmental change. [10] Climate change and landscape transformation are accelerating the rapid expansion of peri-urban areas globally, leading to rapid land degradation. Natural and socio-economic forces drive soil degradation and environmental degradation in peri-urban areas. Globally, the biophysical status of 5 670 million ha of land is declining, of which 1660 million ha (29 percent) is attributed to human-induced land degradation. The remaining 4 010 million ha is classified as deteriorated caused by natural processes or has an anthropogenic origin. About half of the deteriorated land has a low status, and is likely to be more sensitive to degradation processes than high-status areas. About 656 million ha, 12 percent of the overall global decline, is under moderate pressure, which may be enough to trigger human-induced land degradation. Most of these areas are probably affected by human-induced land degradation, which means about 41 percent of the global decline can be attributed to human-induced land degradation.[11]

The main causative factors of land degradation include: unsustainable land use practices, such as excessive use of chemical fertilizers and mono-cropping; deforestation and vegetation cover changes and loss; soil erosion due to poor soil management practices such as over cultivation of soils or overgrazing; pollution especially soil and water pollution, mainly caused by poor waste management practices; climate change which decreases the natural ability of land to recover and international economic activities.[12]

It is possible to prevent land degradation by taking some measure as follow: sustainable land management, reforestation and afforestation, soil conservation, contour farming, strip cropping, avoid over irrigation, apply the right amount of fertilizer, water management, land use planning, change grazing practices, environmental education and awareness, improved waste management system etc.

Result and Discussion:

If we look at the history of land use and land cover, it has been changing over the years. But in recent times it has been changing very rapidly. As the population grows and so do the human needs. And due to that reason, there is a change in land use and land cover. There are many disadvantages of land use and land cover change but among them land degradation is a huge human and environmental loss. Gradually it has become a matter of concern.

Conclusion:

Declining of the productive capacity of the land is a serious global problem and has adverse effects on society, economy, and environment. Land degradation is caused by changes in land use and land cover. Changes in land use and land cover do not occur automatically but are caused by environmental and human intervention. Environmental activities can lead to land degradation in many ways including flood, wind erosion, water erosion, climate, retrogression etc. however, human activities seem to cause more land degradation than natural activities. The activities like, deforestation, afforestation, urbanization, agriculture, road construction, dam building, irrigation, wetland modification, mining, power generation etc. it is important to have local and global policies and regulations to control the land degradation.

References:

1. Clovis Grinand1, Agnès Bégué2, Frédérique Montfort1, Louise Leroux3, Telina Randrianarivo4 (2019) An Analysis of Land Use Changes and Land Degradation in Mozambique. (Land use planning for enhanced resilience of landscape) P-22.
2. Katrine Grace Turner a, b,∗, Sharolyn Andersonc, Mauricio Gonzales-Chang d, Robert Costanza e, Sasha Courvillef, Tommy Dalgaarda, Estelle Dominati g,Ida Kubiszewski e, Sue Ogilvye, Luciana Porfirio h, Nazmun Ratna d, Harpinder Sandhui, Paul C. Suttonc, Jens-Christian Svenning b, Graham Mark Turner j, Yann-David Varennes d, Alexey Voinov k, Stephen Wratten (2016)A review of methods, data, and models to assess changes in the value of ecosystem services from land degradation and restoration. Ecological Modeling. P-197
3. S. Bajocco, A. De Angelis, L. Perini, A. Ferrara & L. Salvation (2012) The Impact of Land Use/Land Cover Changes on Land Degradation Dynamics: A Mediterranean Case Study. Environmental Management. P- 981.
4. Sudhakar S & Kameshwara Rao SVC. (2010) Land Use Land Cover Analysis. (Remote Sensing Application) P- 21
5. Willy H. Verheye (2009) Encyclopedia of Land Use, Land Cover and Soil Sciences Land Cover, Land Use and the Global Change VOL-1. P- 6.
6. Edited by WILLIAM B. MEYER And B. L. TURNER II (1994) Changes in Land Use and Land Cover: A Global Perspective. P- 5.
7. U.S. Department of the Interior U.S. Geological Survey (2013).

8. https://nca2018.globalchange.gov/chapter/5/
9. PS. Roy, R. S. Dwivedi, D. Visayan (2010) Remote Sensing Applications. P – 34
10. Douglas L. Johnson and Laurence A. Lewis (2007) Land Degradation Creation and Destruction Second Edition. P- 2, 25.
11. https://openknowledge-fao-org.translate.goog/server/api/core/bitstreams/bc8810ae-2a13-4cfe-b019-339158c7e608/content/src/html/chapter-1-2.html?_x_tr_sl=en&_x_tr_tl=mr&_x_tr_hl=mr&_x_tr_pto=tc
12. https://www-un--spider-org.translate.goog/links-and-resources/data-sources/daotm-land-degradation?_x_tr_sl=en&_x_tr_tl=mr&_x_tr_hl=mr&_x_tr_pto=tc

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Population Growth and Problems in India: A Geographical Study

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Introduction

Since ancient times, the world's population has been continuously increasing. Due to the increasing population, many social, economic, cultural, political and environmental problems are arising in the world. These problems vary depending on the place and time. The nature of the population of a country depends on the number of resources in the country. If the population is more than the availability of resources, that population is called excess population e.g. India, China, Pakistan and Bangladesh. Geographical study of population characteristics of a region is of important for understanding its dynamism as well as for planning at the local and regional level. In increase or decrease in the population may bring about a versatile change in the man-land ratio, distribution and composition of population. Population as resources become the Population distribution, density, sex ratio, literacy rate, literates, growth rate etc. depends on quantity and qualities of population. The study is mainly concerned with association between population characteristics and geographical factors. Population distribution, density is dependent upon the geographical condition of that particular area. The demographic characteristics, such as growth, density and sex structure, literacy and occupational structure play a very important role in the socio-economic development of any region. Population structure describes the socio-economic and demographic features of an area. Man is the single most important powerful geographical factor transforming the earth surface at an unparalleled speed (Husain, 1999). Thus, the spatio-temporal distribution of human population and its structure has become one of the important of the study in an area like population growth rate, density, literacy and sex ratio choose the demographic characteristics. Population structure is describing the various socio-economic and demographic features of an area. Thus, need have study in demographic characteristics are number of purposes, policy makers, planners and administrators.

The development of population during education and occupational guidance should consequently accord a very high precedence in the prospect planning and programmed of economic development. Population has both quantitative and qualitative scope. The characteristics like the size composition and distribution of population and skilled labour force, literacy level, the number of hours worked the output and earrings per head. Population is one of the important of a region. The qualitative and quantitative evaluation of human resources is thus vital to know the process of development in a region.

Population Growth in India:

The history of population growth in India shows fluctuations in different periods. India ranks second in the world in terms of population after China. The history of Indian population growth in the 20th century is generally divided into three periods. In it, the period of stable population, the period of increasing population and the period of rapidly increasing population are divided. The first stable population period is between 1901 and 1921. In 1901, the population of India was 23.6 crore, which reached 24.8 crore in the twenty years up to 1921. During this period, the birth rate was high along with the death rate. The death rate was high due to frequent droughts, epidemics and typhus. Due to this the natural increase (1.2 crore) in the total population of India decreased significantly. In the decade from 1901 to 1911, the population growth was 5.73 percentages, while in the decade from 1911 to 1921 it was - 0.31 percentages. But the period after 1921 became the decisive stage of the division of the Indian population, because after 1921, the population of India continued to increase. The thirty-year period from 1921 to 1951 is known as the period of population growth. In 1921, the population of India was 248 million, which increased to 360 million in 1951.

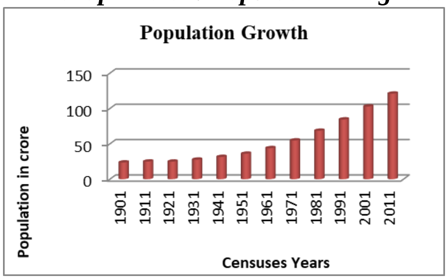
Table No 01: Indian population growth (1901-2011)

Censuses Years	Population in crore	Changes in Population
1901	23.6	--
1911	24.9	5.75
1921	24.8	-0.31
1931	27.6	11
1941	31.5	14.22
1951	36	13.31
1961	43.9	21.64
1971	54.8	24.80
1981	68.5	24.66
1991	84.5	23.87
2001	102.8	21.54
2011	121.02	17.64

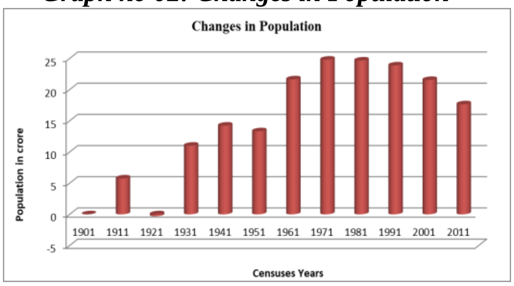
In the entire thirty years, the population increased by 112 million. During this period, the rate of population growth increased from -0.31 percentages (1921) to 13.31 percentages (1951). The death rate decreased due to the elimination of epidemic diseases, overcoming drought, improvement in medical facilities and improvement in transport and communication facilities. Along with economic development, progress in the agricultural sector led to an increase in food grain production, due to which the death rate, which was 47 per thousand in 1921, came down to 27 per thousand in 1951, but the birth rate, however, increased to about 40 per thousand, leading to an increase in the population.

The year 1951 is considered a decisive year in the history of India's population growth. Because of the significant changes have taken place in India's population in the period after 1951. The period from 1951 to 2001 is known as the period of rapid population growth in the history of Indian population. In 1951, India's population was 36 crores, which increased to 102.8 crore in 2001. In the entire fifty-year period, the population increased by 66.8 crore (more than double). During this period, the population growth rate averaged more than 2 percent every year. The process of development that reached every corner of the country, food supply, and increase in medical facilities and improved standard of living led to a significant reduction in the death rate.

Graph no 01: Population Progress



Graph no 02: Changes in Population

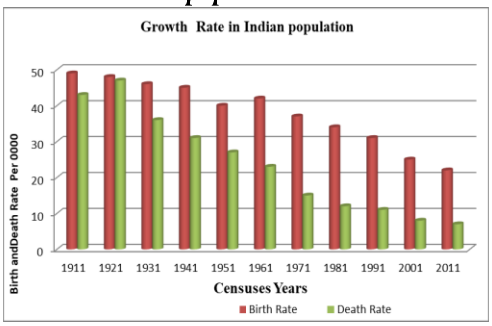


The death rate of 27 per thousand in 1951 came down to 8 in 2001. However, the birth rate of 40 per thousand in 1951 came down to only 25 in 2001. Due to the difference in birth rate and death rate, the population of India grew explosively during this period.

Table No 02: Natural Growth in Indian population (1911- 2021)

Censuses Years	Birth Rate (Per Thousand)	Death Rate (Per Thousand)	Natural Growth
1911	49	43	06
1921	48	47	01
1931	46	36	10
1941	45	31	14
1951	40	27	13
1961	42	23	19
1971	37	15	23
1981	34	12	22
1991	31	11	20
2001	25	08	17
2011	22	07	15

Graph no 03: Growth Rate in Indian population



Population Problem in India

After independence, continuous efforts were made in India for population control. But the desired success in population control was not achieved. As a result, the following problems have arisen due to the increase in population.

1. Unemployment:

India is an agricultural country. According to the statistics of 2011, 61.5 percent of the people in India depend on agriculture. However, due to the increase in the use of modern technology in agriculture, employment opportunities have decreased. Due to this, the problem of unemployment of the population associated with the agricultural sector arises. Despite the desire, qualification and readiness to work in the available wages, the young population of the country does not get a job / business. Due to unemployment, over-unemployment and seasonal unemployment in the country, the young class is attracted to foreign employment. Due to this, a large-scale brain drain problem arises.

2. Poverty:

Poverty is the condition of people who are unable to meet their basic needs. Along with the increasing population in India, the population below the poverty line is increasing. Per capita income is low due to low pace of industrialization, low productivity of agriculture, and increasing unemployment. As a result, poverty increases. In India, 29.9 percent are below the poverty line in 2011-12. The state with the highest population below the poverty line in India is Jharkhand, while the lowest is Goa.

3. Economic inequality:

In India, the problems of poverty and unemployment have arisen due to economic inequality. Out of the total national expenditure in India, 15 percent of the amount is spent by only 30 percent of the rich. Many efforts are made at the government level to eradicate poverty. But the gap between the rich and the poor has not reduced yet.

4. Increase in dependency ratio:

Along with the increasing population in India, the dependency ratio of the population has also become a major problem in India's economic development. Due to the increase in the birth rate, the burden of feeding the additional population falls on the working population, the products produced by the working people are spent on the non-working population, thus slowing down the pace of economic progress.

5. Increasing pace of urbanization:

Rural-urban migration occurs due to the decrease in employment opportunities in rural areas. Every year, a large number of young people migrate to urban areas in order to get employment. Due to this, the pace of urbanization has increased in India. For example, the pace of urbanization in India was 23.3 percent in 1981 and it was 31.6 percent in 2011.

6. Migration:

The highly educated and intelligent youth of India do not get employment, high salary range, scope for research and necessary facilities for research according to their qualifications. As a result, such people migrate to other countries. The benefit of the expenditure made to produce intelligent people in their own country is gained by other countries due to migration. Due to this, the technological progress and subsequent economic progress of the country are hampered. Also, in recent times, due to migration from rural areas to urban areas, rural areas are becoming deserted and problems are increasing due to population growth in urban areas.

7. Decrease in land holding area:

The population in India is continuously increasing but the land area is stable. As a result, there is a decrease in land holding area. In 2010-11, the land holding area per capita in India was 1.15 hectares, which came down to 1.08 hectares in 2015-16. The decrease in land holding area has an adverse effect on the growth of output.

8. Fragmentation of agricultural land:
In India, agricultural land owned by families is divided equally by inheritance. Due to the ever-increasing population, the land is fragmented and the size of the farms becomes smaller. There are limitations on the use of modern tools and techniques in these small-sized farms. A large amount of agricultural land is wasted in the embankments of the farms. As a result, production decreases.

9. Regional imbalance:
The process of development is uneven in different regions of India. This creates regional imbalance. Geographical, economic, social and cultural factors are responsible for regional imbalance. But in regions with economic prosperity, the population is concentrated and the backward areas are deserted. Regional imbalance has adverse effects on the economic, social and cultural situation of the country.

10. Declining standard of living:
The growth of population in India is leading to a decline in per capita income. As a result, the standard of living has deteriorated. Population growth leads to a shortage of food with sufficient and necessary calories, which leads to malnutrition and other health problems. To overcome this, expenditure has to be made on medical facilities.

11. Additional stress on infrastructure:
The increase in population has created additional stress on infrastructure such as transport and communication, education, health, water supply. The government has to make huge financial provisions to create infrastructure. As a result, the development process is stagnating as most of the funds are spent on infrastructure facilities.

12. Increasing pressure on resources:
The pressure of additional population on natural resources such as soil, water, minerals, plants and animals are increasing day by day. While the resources are on the verge of depletion, the use of chemical fertilizers for more production from resources like soil has created problems like soil pollution, water pollution. The decreasing number of elements like forest resources creates many problems.

13. Social unrest:
Increasing urbanization, poverty and unemployment in India have led to a large amount of social unrest. Due to unemployment, incidents like depression, addiction, theft, robbery, robbery and violence against women increase in criminal tendencies and create unrest.

14. Decrease in per capita income:
Due to the large population of India, the national product of the country is divided, due to which the per capita income is low and the standard of living deteriorates. The savings rate of the people decreases. This has an adverse effect on investment, production and employment generation and the unemployment rate increases. Compared to developed countries, India's per capita income is very low.

Along with the above problems, economic and social problems like slow industrial growth, decline in the working capacity of the population, traditionalism, pollution, backwardness in planning, population explosion, more imports than exports have arisen in India due to the excess population. Also, environmental problems like deforestation, energy crises, air pollution, water pollution and soil pollution have arisen before India.

Conclusion:

The increasing population of the country does not become the problem of the country, but the age structure of the population creates the problem of the population. Due to the increasing birth rate, the unproductive population is added to the population. Due to this, the dependency burden increases. It has an adverse effect on the economic development of the country.

Reference:

1. Azim Shaukath (2005): Literacy, Growth, Disparity in Karnataka, Economic and Political Weekly, Vol.40, No.16, pp. 1947-1949.
2. Bansode N. K. and Nanaware A.H. (2016): Impact of Literacy on Sex Ratio in Kolhapur District: A Geographical Analysis, Golden Research Thoughts, Vol. 5 No.11, pp. 1-7
3. Barah Bimal (2002): Sex Composition of Population in Assam: A Geographical Analysis, The Deccan Geographer, Vol. 40, No. 1 pp. 43-52.
4. Beijer G. (1969): Modern Pattern of International Migration Movements, Migration (Ed.) J.K. Jackson, Sociology Studies 2, Cambridge, pp. 11-59.
5. Bhagat R.B. (1999): Population Growth and Food Supply in India with Special Reference To Madhya Pradesh: The Present Trend and Future Prospects, Indian Journal of Regional Science, Regional Science Association, India, Vol. XXXI, No. 1 pp. 107-112.
6. Bhakare P. (2010): Spatio-Temporal Changes in Population Structure of Pune Division of Maharashtra, Shivaji University, Kolhapur, Unpublished Ph.D. Thesis.
7. Gadekar Deepak J (2018) Level of Human Resources Development in the Akole Tahsil District-Ahmednagra Maharashtra unpublished Ph.D Thesis Savitribai Phule Pune University
8. Gosal G.S. (1962). Regional aspects of population growth in India. Pacific view point, Vol.3, P/p.88-99
9. Husain, M. (1999). Human Geography, Rawat Publications, Jaipur, India, Pp 83.
10. M.E. Shejul (2020) Temporal Analysis of Human Resources Development (HRD) in Pathardi Tehsil of Ahmednagar District, Maharashtra State, India, International Journal of Scientific Research in Multidisciplinary Studies, 6(8) Pp 36-45
11. Nanaware A.H, Gophane B.N & More. J. (2012). Impact of Literacy on life expectancy in India. Maharashtra Bhugolshatra Sanshodhan Patrika, Pune Vol. XXIX No 01, Jan-June 2002 p/p 60-65.
12. Ravindra Hande and Arjun Musmade (2012) Spatio-Temporal Assessment of Selected Demographic Characteristics in Pune Administrative Division, Maharashtra Bhugolshastra

Sanshodhan Patrika, Vol. 38, No.2, pp 95-104

13. Shejul Meena Eknath (2020) Level of Human Resources Development - A Conceptual and Review Exposition, International Journal for Research in Applied Science & Engineering Technology, 8 (03), 687-691. doi.org/10.22214/ijraset.2020.3130
14. Shejul Meena Eknath et.al, (2020) A Geographical Study of Human Resources Development in Ahmednagar District, Maharashtra, India. EPRA International Journal of Multidisciplinary Research 6 (03) 86-93. https://doi.org/10.36713/epra4116
15. Vimal Kumar (2016) Spatio Temporal Analysis of Population Characteristics in Indian District, Journal of Advances and Scholarly Researches in Allied Education Vol. XI, Issue No. XXI Pp 1-5

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Flood Hazard Zones Mapping in Pune District Using GIS Technique

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Abstract

Floods pose significant challenges to urban areas, necessitating effective mitigation strategies. This study employs Geographic Information Systems (GIS) and Remote Sensing techniques to identify flood-prone areas within Pune District, India. The methodology integrates various datasets, including SRTM DEM, CHRS rainfall data, FAO/UNESCO Soil Map, and LULC data from Sentinel-2 imagery. Eight key parameters, namely Drainage density, Topographic Wetness Index (TWI), Rainfall, Soil type, Slope, Elevation, Land Use/Land Cover (LULC), and Distance from River, are analysed using the Analytical Hierarchy Process (AHP) to prioritise their roles in flood susceptibility. Results highlight the significance of rainfall and Built-up areas in flood occurrence, with the Eastern part of Pune District exhibiting higher vulnerability due to its low-lying nature and comparatively lower water percolation capacity. The presence of the Western Ghats contributes to elevated rainfall levels in the western region, exacerbating flood risks. Moreover, increased Built-up areas in the southwest diminish water infiltration, leading to heightened runoff and adverse effects on low-lying zones. This study underscores the importance of incorporating diverse geospatial datasets and advanced analytical techniques for comprehensive flood risk assessment. By identifying critical causative factors and vulnerable areas, policymakers and urban planners can develop targeted mitigation measures to enhance resilience against flooding in Pune District and similar regions worldwide.

Keywords: Flood, Pune, GIS, Remote Sensing, Mapping.

Introduction

Floods are inevitable natural or man-induced disasters worldwide, which must be monitored and analysed to reduce their impacts. As Indian precipitation mainly relies on monsoons, floods usually occur in India annually during the monsoon season from July to October (Pawar et al., 2016). A stream is stated to flood when the flow exceeds the capacity within the banks. In recent decades, flooding has increased profoundly, mainly due to the growth of population, diffusion of settlements over hazardous areas and changes in hydrological characteristics (Winsemius et al., 2013). Foremost urban flooding in the last decade affected Mumbai, New Orleans (near the Gulf of Mexico), Yangon (the largest city in Myanmar) and Dresden (capital of the eastern German state of Saxony) because of unplanned development, uncontrolled population growth, and not strictly inspected construction by authorities (IFRC, 2010). In addition, other aspects that play a role in flooding include rainfall intensity, snowmelt, deforestation, land use practices, sedimentation in riverbeds, and natural or human-made impediments. Floods destroy billions of dollars and kill thousands of people each year (Manfreda et al., 2011; Komolafe et al., 2015). Hence, predicting the extent of the flood and identifying flood susceptibility regions are essential in flood risk management. With GIS and remote sensing techniques, the visualisation of flood-prone areas and their mitigation become more accessible. This directly supports decision-making by facilitating real-time forecasting (to mitigate floods and control their impacts), risk management and LULC management. The chosen study area is the Pune district, which receives good rainfall. Due to western ghats, the western part of Pune receives more rainfall than the eastern part. The study mainly focuses on the zonation of flood susceptibility regions of the Pune district. Secondary data has been used for this study. The objectives of the present study are to identify the hydrological and morphometric parameters, i.e., rainfall distribution and river drainage density, the elevation and slope of the terrain, and the flood susceptibility zones using weighted overlay using different parameters.

Pune district is situated in the western part of the Maharashtra state of India (Fig.1). It covers an area of nearly 15642 km2, having 5.1% of the total geographical area in Maharashtra State. The exact geographical location lies between 17°54’N to 19°24’N latitude and 73°29’E to 75°10’E longitude. For administrative convenience, it is divided into 14 tehsils (Fig.1), namely Pune City, Haveli, Khed, Ambegaon, Junnar, Shirur, Daund, Indapur, Baramati, Purandhar, Bhor, Velhe, Mulsi and Maval (Vadgaon) (CGWB, 2009). The district encompasses seven major rivers: Kukdi, Ghod, Bhima, Bhama, Indrayani, Mula-mutha Kanha and Neera. The landscape of Pune district is distributed triangularly in western Maharashtra at the foothills of the Sahyadri mountains/Western ghats and is divided into three parts: “Ghatmatha”, “Maval”, and “Desh”.

The most commonly used Urban Flood Hazard assessment parameters are slope, elevation, drainage density, land use/land cover (LULC), distance from streams, soil, rainfall-runoff, and basin catchment. (Safaripour et al., 2012; Tehrany et al., 2014; Catherin R Sebastian, Sheeja R., Shashi M, 2016; Nitin N. Mundhe,2019; DaoudaNsangou, AmidouKpoumie, Zakari Mfonka,2021; Neha Bansal, Mahua Mukherjee, Ajay Gairola,2021; Sameer Ali, Abraham George,2022). Waterlogging is essential in urban flooding due to the uncontrolled development of built-up areas without proper planning (Nitin N. Mundhe,2019). Using GIS techniques, flooding and its zonation in any region can be studied quickly. (Das 2018, 2019; Nitin N. Mundhe,2019; Samanta et al. 2018; Dano et al. 2019; Swain et al. 2020).The most widely used technique includes flood hazard modelling (Samanta et al., 2018; Siahkamari et al., 2018) by using the weights-of-evidence (WoE) method (Rahmati et al. 2016a, b; Costache, 2019; Costache & Zaharia, 2017), by use of fuzzy logic(Vaishnavi et al., 2017), with Analytic Hierarchy Process (AHP) analysis(Stefanidis & Stathis, 2013; Rahmati et al., 2016; Gigović et al., 2017; Das 2018). Multi-criteria decision analysis (MCDA) is also considered to be the most crucial approach in flood hazard zonation (Abdelkarim et al., 2020). In this integrated MCDA and GIS techniques, AHP is considered the best and most widely accepted. (Catherin R Sebastian, Sheeja R.V, Shashi M, 2016; Nitin N. Mundhe,2019; Daouda Nsangou, Amidou Kpoumie, Zakari Mfonka,2021; Neha Bansal, Mahua Mukherjee, Ajay Gairola,2021; Sameer Ali, Abraham George,2022). This method can identify the flood susceptible regions, and its effectiveness is determined using the geographic position. There is a high need for more extensive studies in this flood hazard zone to mitigate the upcoming floods. (Swain et al. 2020; Samanta et al. 2018). This study mainly focuses on the flood-suspective zonation of regions, so a widely accepted AHP analysis was carried out with all essential thematic layers according to the chosen topography.

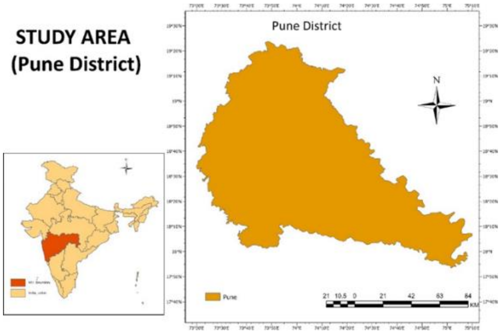


Fig.1 Study Area map

Methodology

Multi-criteria decision Analysis and Analytical Hierarchy Process (AHP) method. This is an approach in which multiple causative factors are considered for the final susceptibility prediction to reduce the time and cost. It helps reduce the complexity of the nature of the problem and makes it more manageable by understanding the relationships and combining each component to identify the solutions. The most popular and widely accepted method is Saaty's Analytical Hierarchy Process (AHP), which determines the relative importance of the criteria in a specified decision-making problem. (Mundhe, 2018). This study identifies the flood susceptibility zones in the Pune District using Saaty's AHP analysis. For this, eight parameters are used: drainage density, Rainfall Map, Slope Map, Elevation Map, Distance from River, TWI (Topographic wetness Index), Soil Map and LULC (2019). Based on the other expert research papers, these parameters were chosen to understand the main factors leading to the flood in the study region. An eight-point scale is considered for normalised weighting of the parameters.

Rank	Scale	Rank	Scale
1	Equally Important	6	Moderately to Strongly
2	Very Strong to extremely	7	Very Strongly important
3	Moderately important	8	Equally to moderately
4	Strongly to Very Strongly	9	Extremely Preferred
5	Strongly important		

Table 1. Saaty's nine-point scale for Analytical Hierarchy Process (AHP) Preference (Saaty, 1980)

Understanding built-up Area

Land Use Land Cover:

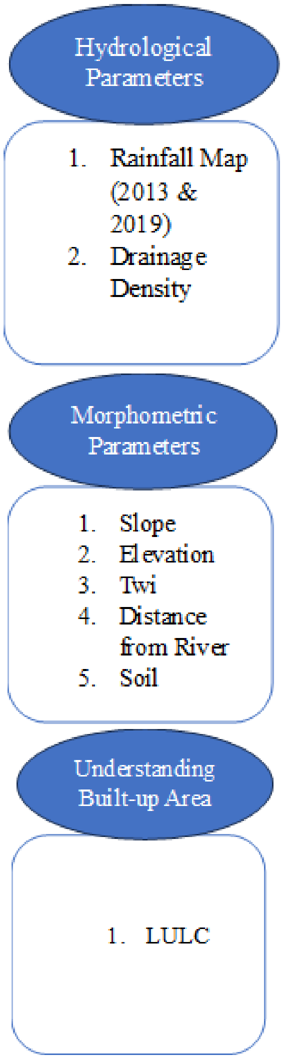
The LULC of the world produced by ESRI is used for this study. The data downloaded from ESRI is masked with the basin shapefile to get information about the particular study area (2019). After getting all the required thematic layers, the final map will be generated based on the weighted overlay process. The thematic layers generated will be reclassified based on their importance. For example, areas < 400m to the water body will be considered highly affected, 400-800m will be high, 800-1200m moderately affected, 1200-1600m less affected, and >2000m least affected. All layers and subclasses will be assigned by weightage based on their importance for getting the flood hazard zones using the AHP analysis method. The weights will be calculated using the pairwise comparison matrix based on the nine-scale Saaty's method.

1. Prepare the pairwise comparison matrix
2. Sum the values in each column
3. Divide each element of the matrix by its column total
4. Average the elements in each row

The final flood susceptible map will be prepared after the weighted overlay using the above AHP multi-criteria method, giving an idea of the Pune District's susceptible areas.

Thematic Map/Weightage Map Preparation

The primary analysis uses thematic layers based on the integrated GIS and AHP methods. The main conditioning factors that are included are as follows: -



Hydrological Parameter

Rainfall Map

In Pune district, the average rainfall varies from approx. 115 cm, which means our study area receives moderate to high precipitation. As most of the part lies in the Western Ghats region, as the monsoon arrives, the windward side receives more rainfall than the leeward side. The rainfall data from 2013 and 2019 are used in our study to compare the change in rain and its effect on the cause of the flood.

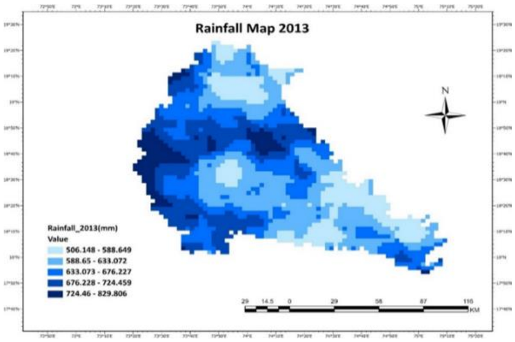


Figure 2. Rainfall Map of Pune district (2013)

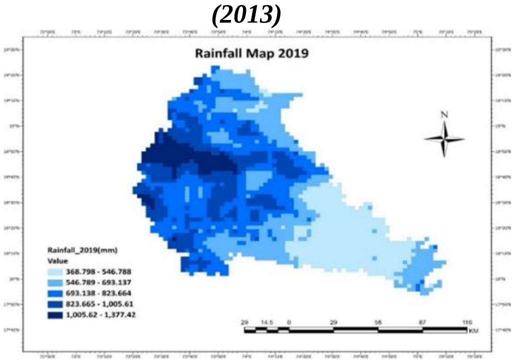


Figure 3. Rainfall Map of Pune district (2019)

The data used is from May to October. Figures 2 and 3 show that the rainfall of 2013 and 2019 ranges from 506.148 – 829.806 mm and 368.798 – 1,377.42 mm, respectively. It is very clear from the rainfall map that the rainfall received during 2019 was slightly higher than in other years. The rainfall trend in this basin is such that the western part of the area is getting more rainfall, and the intensity is getting lower as we come down part of the basin. All two rainfall maps are classified into five classes. The 2019 rainfall map is used for the susceptibility of flood zonation as the high rainfall within the last seven years gives the same region where the possibility of a flood can happen shortly. The reclassified Rainfall Map of 2019 is given in Fig. 3. Values 1,2,3,4,5 give information about the Very Less, Less, Moderate, High and Very High intensity of rainfall within the study area.

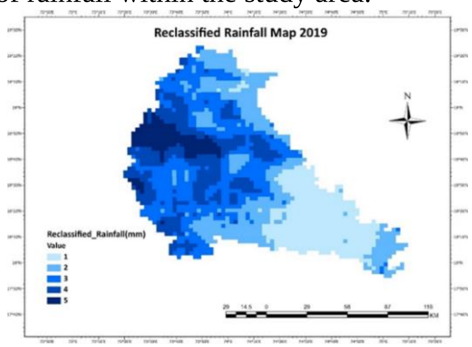


Figure 4. Reclassified Rainfall map (2019)

Drainage Density

Drainage density is a measure of stream spacing (Langbein, 1947). When there is an increase in drainage density, the floods occurring in that region will significantly increase. (Fred L. Ogden, Nawa Raj Pradhan, Charles W. Downer, Jon A. Zahner, 2011). For the same geology and slope angle, humid areas tend to have lower density due to the growth of thick vegetation that promotes infiltration. The arid region would have had a higher density, given the same geology. A higher drainage density indicates a relatively high density of streams. (Nitin N. Mundhe, 2019). The drainage density is inversely related to terrain permeability.

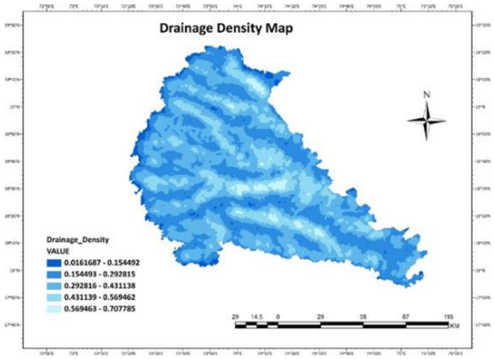


Figure 5. Drainage Density map

Drainage density is classified into five classes ranging from 0.01 – 0.70 sq. Km. The higher density is present in the stream regions with higher stream order. It is then reclassified into values 1,2,3,4,5, i.e. Very low, Low, Moderate, High and Very High drainage density. The Lesser regions are not visible as they are not present due to the streams everywhere. Higher density values will be given more weightage as they are more susceptible to flooding.

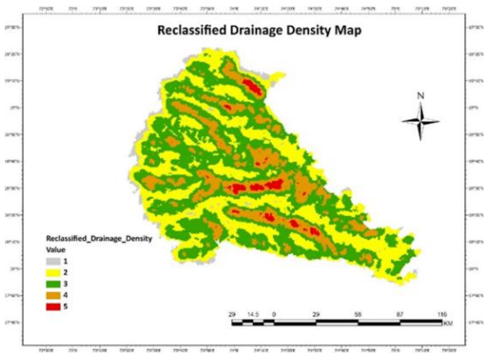


Figure 6. Reclassified Drainage Density map

Morphometric Parameters

Slope

Slopes with steepness usually drain the rainwater, falling faster and reducing its infiltration, resulting in a more considerable runoff. Less infiltration means high run-off, allowing more water to reach the lowlands. Hence, it plays a vital role in determining flood hazard zoning. The higher the slope, the less the possibility of flood formation, as there is increased surface runoff. Regarding lower regions with fewer slopes, the water run-off decreases, and flood possibilities increase if no infiltration happens.

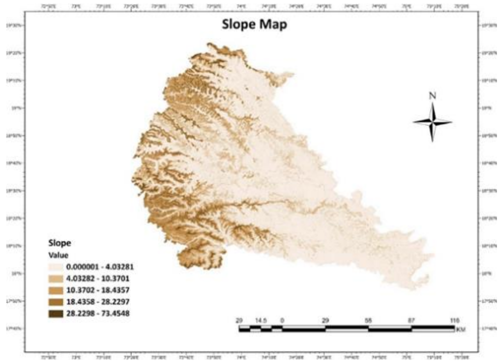


Figure 7. Slope map

Pune district slope is classified into five classes according to its slope ranging from 0.000001 to 73.4548 degrees. The western side has higher slope values as it is under the part of the Western Ghats.

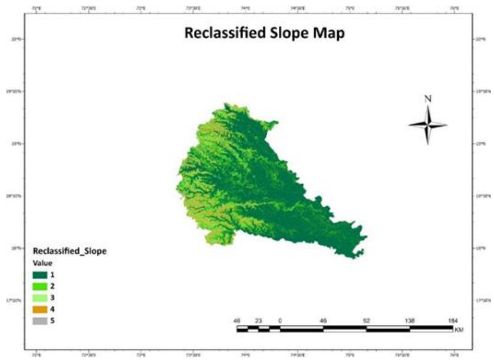


Figure 8. Reclassified Slope map

The Map is again reclassified into 1-5 values, i.e., very low, Low, Moderate, High, and Very High, based on the steepness for better understanding and ranking. Low regions will be given a higher rank here as they are more vulnerable to flooding.

Elevation

Water usually flows from the higher elevations to the lower elevations. So, it is necessary to understand the height of the terrain as most flood-hit areas are under the low-lying regions. The study area elevation ranges from 91 – 1476 m. The higher the elevation, the lower the degree of flooding, while the lower the degree of flooding, the higher the tendency of water to flow from high to low regions. In this study area, the eastern part has regions with low elevation. Hence, the chances of flooding in this area are much higher than in the western part. So, the higher weightage is given to the lower regions to find the flood susceptible regions.

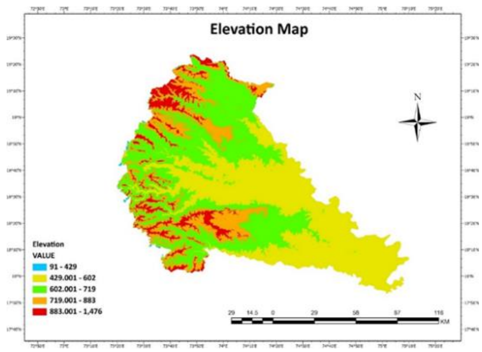


Figure 9. Elevation map

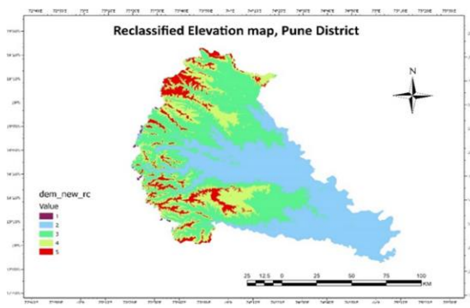


Figure 10. Reclassified Elevation map

Topographic Wetness Index (TWI)

As TWI gives us information about the wetness, it helps us understand regions with high water content. The TWI divided the study area into five classes with values ranging from 2.1941 to 28.3749. The lesser the value, the lesser the wetness index; the higher the value, the higher the presence of water. From the map, we can even get information on the present streams, as wetness will be high in that region of water content. The darker colour represents the higher value of TWI. Fig shows that the western and some northeastern parts show a higher wetness index due to the rivers over there. The reclassified map of the same is given in Fig.12. The values 1,2,3,4,5 represent Very low, Low, Moderate, High, and Very high wetness index in topography.

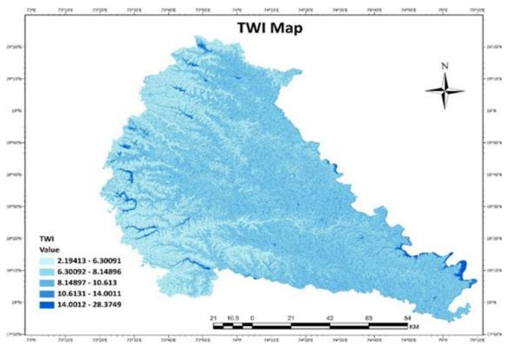


Figure 11. TWI map

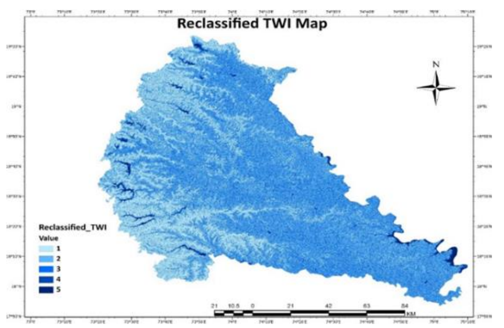


Figure 12. Reclassified TWI map

Distance From River

It is necessary to get the distance from the river to understand which areas nearby are at risk of flooding. The multiple buffer method is used to find this. The site is classified based on distances <500,501-1000,1001-1500,1501-2000,>2000 m. Usually, the areas near the river network are more prone to flooding. Hence, areas <500 will be ranked more as this region will be the first to be hit by water bodies during flooding. Others will be ranked so that as the distance increases, the ranking is decreased. A reclassified image of the same is given in Fig. The value 1,2,3,4,5 in the reclassified image represents the distance <500,501-1000,1001-1500,1501-2000,>2000 m.

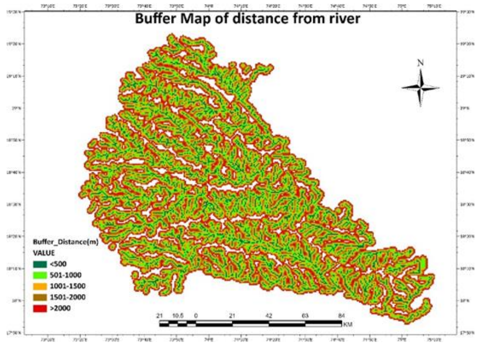


Figure 13. Distance from river map

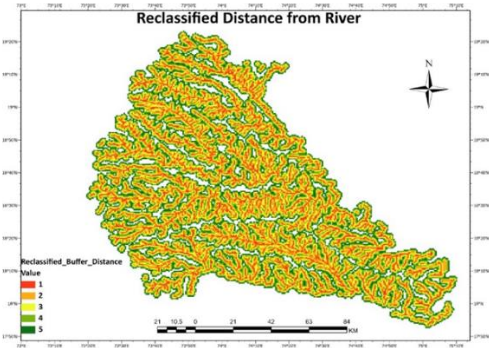


Figure 14. Reclassified Distance from River map

Soil

The soil data of the Pune district is collected from the soil map of the world, which the FAO has compiled from the information from the field projects. The name given is the FAO names in which 1, 2, and 3 stand for respectively coarse, medium, and delicate textures, and a, b, and c stands for respectively flat (0-8% slope), undulating (8-30% slope) and hilly (> 30% slope). The reclassified map gives values from 1 to 5 according to soil permeability and occurrence in hilly, middle, or low-lying lands.

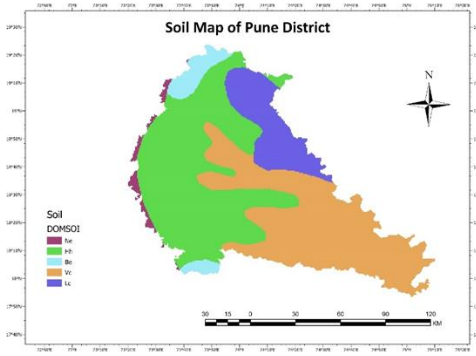


Figure 15. Soil map

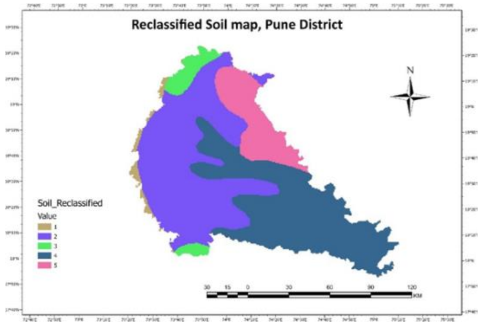


Figure 16. Reclassified Soil map

Understanding Built-up

LULC:

LULC Map of the Pune district is generated using the sentinel-2, 2019 satellite image. The map shows that most of the basin is under agricultural cover, as it receives good rainfall. Most of the highland is seen in the district's western part, while the Central part comprises the built-up regions. Others, like forests, water bodies, and Barren Land, are visible.

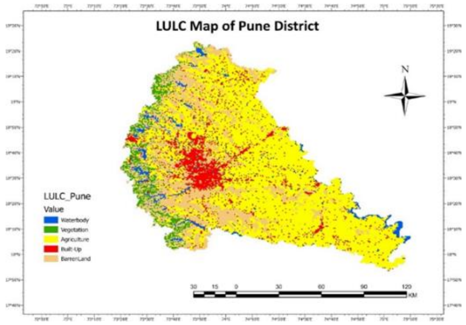


Figure 17. LULC map

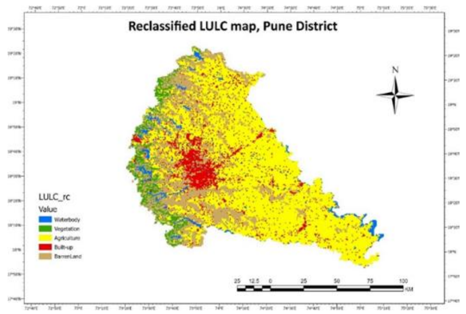


Figure 18. Reclassified LULC map

Sr. No	LULC Type	Area (Sq.Km.)
1	Vegetation	0.4489
2	Barren Land	2.0073
3	Built-up	0.4489
4	Waterbody	0.2875
5	Agriculture	2.1673

Table 2. LULC Area (Sq.Km.)

The majority of the area, 41%, is under Agriculture. Barren Land cover 38% of the total area, with 8% Built-up and 5% of water bodies. The vegetative area is mostly in the western part. Built-up is mainly seen in the South-western part.

Classes	Elevation	Slope	TWI	Drainage density	Distance from river	LULC	Rainfall	Soil
Elevation	1	3	0.33333	0.5	0.5	0.33333	0.2	3
Slope	0.33333	1	2	0.5	3	0.33333	0.33333	2
TWI	3	0.5	1	0.5	3	0.33333	0.33333	2
Drainage density	2	2	2	1	2	0.33333	0.33333	2
Distance from river	2	0.33333	0.33333	0.5	1	0.33333	0.2	2
LULC	3	3	3	3	3	1	0.33333	2
Rainfall	5	3	3	3	5	3	1	5
Soil	0.33333	0.5	0.5	0.5	0.5	0.5	0.2	1
Col Total	16.6667	13.3333	12.1667	9.5	18	6.16667	2.93333	19

Table 3. Pairwise comparison matrix and finding the column total

Classes	Elevation	slope	TWI	Drainage density	Distance from river	LULC	Rainfall	Soil	Row Total
Elevation	0.06	0.225	0.0274	0.052631579	0.027778	0.05405	0.06818	0.15789	0.6729372
slope	0.02	0.075	0.16438	0.052631579	0.166667	0.05405	0.11364	0.10526	0.7516354
TWI	0.18	0.0375	0.08219	0.052631579	0.166667	0.05405	0.11364	0.10526	0.7919436
Drainage density	0.12	0.15	0.16438	0.105263158	0.111111	0.05405	0.11364	0.10526	0.9237114
Distance from river	0.12	0.025	0.0274	0.052631579	0.055556	0.05405	0.06818	0.10526	0.5080834
LULC	0.18	0.225	0.24658	0.315789474	0.166667	0.16216	0.11364	0.10526	1.5150932
Rainfall	0.3	0.225	0.24658	0.315789474	0.277778	0.48649	0.34091	0.26316	2.4556961
Soil	0.02	0.0375	0.0411	0.052631579	0.027778	0.08108	0.06818	0.05263	0.3808997
Col Total	1	1	1	1	1	1	1	1	8

Table 4. Averaging the row Element

Results

Parameter	**Weight (%)**
Rainfall	31
LULC	19
Drainage Density	12
TWI	10
Slope	9
Elevation	8
Distance from River	6
Soil	5

Table 5. Parameters used and their weight classification

The present study focused on preparing flood regions in the Pune district using the AHP method of multi-criteria decision analysis (MCDA). For this, I have considered eight parameters: rainfall, elevation, slope, TWI, soil, LULC, drainage density, and distance from the river. Weights are assigned to all eight parameters using expert opinion based on the nine scales of Saaty's 8x8 AHP matrix. The consistency is calculated in the matrix using the consistency ratio (CR). For the comparisons between the matrix to be consistent, the CR should be less than 10%. The CR is found using the following equation: -

CR= CI/RI

Where,
CI is the consistency index defined using the following;
CI=(λmax-n)/(n-1)
where λmax is the maximum eigenvalues, n is the number of key variables, RI is the random inconsistency index (Saaty & Vargas, 1993), CR is the consistency ratio, and CI is the consistency index. The above calculation found that the CR is 0.10, less than 10.

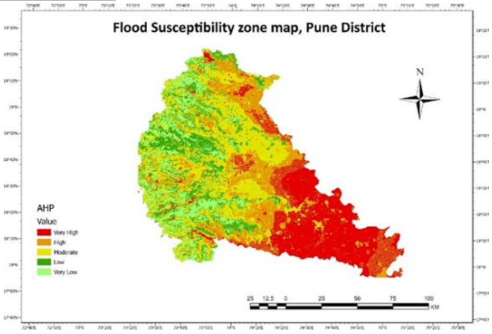


Figure 20. Flood Susceptibility Zones Map

After giving the weights using AHP, the final susceptible map is produced using the weighted overlay method. The map is divided into five classes according to their risks: -Very Low-risk zone, Low-risk zone, Moderate risk zone, High-risk zone and Very High-risk zone. The red in the Eastern part represents the very high-risk area where floods can happen. It is the low-lying regions where the majority of the agriculture and built-up is present; hence, the impact of the flood is very high. The high-risk areas are most distributed in the low-lying regions near the high-risk zone regions. When we come to the middle of the district, we can see a decrease in the severity of the risk zone as it is in the part of hilly regions. Similarly, there is a low risk when we go to the basin's eastern part. So, the risk trend is high in the east part, and as we go to the west, it is low. The primary significant factors that led to the boundary of high flood-risk regions in the eastern part include the high amount of rainfall and built-up, which also reduced the amount of water percolating into the ground, increasing the runoff of water resulting in the flood. Most of the study area lies under the moderate risk zones, ie.31 %. The very high and high-risk regions cover an area of 24% and 19%, respectively, in the Low-laying areas.

Conclusion

The current study focuses more on identifying flood-prone areas in the Pune district with the help of GIS and Remote sensing techniques. The main objective includes finding the causative factors of flood and more flood-prone areas and factors responsible for floods. Eight parameters were considered for analysis, including Drainage density, TWI, Rainfall, soil, slope, elevation, LULC and distance from the river. These parameters were the most effective and played an essential role in AHP. From the results, we learned about the flood-prone areas of the Pune district. In the west (Windward side), due to western ghats, there is more rainfall than in the east (Leeward side). The Eastern part of the Pune district is more prone to flood as it is a low-lying area. Built-up in the above regions (South-west) is more, so water percolation is less. Hence, runoff is more likely to cause harmful effects on low-lying areas. So, the study's findings are that rainfall and Built-up are the vital parameters in the Flood situation in the Pune district.

References

1. Bathrellos, George D., et al. "Urban flood hazard assessment in the Athens Metropolitan City, Greece basin." Environmental Earth Sciences 75 (2016): 1–14.
2. CGWB 2009. Ground Water Information of Pune District, Maharashtra. Central Region Nagpur, CGWB, Ministry of Water Resources: 1-2.
3. Costache R (2019). Flash-flood potential index mapping using weights of evidence, decision tree models and their novel hybrid

integration. Stoch Environ Res Risk Assess 33(7)

4. Das, Sumit. "Geographic information system and AHP-based flood hazard zonation of Vaitarna basin, Maharashtra, India." Arabian Journal of Geosciences 11.19 (2018): 576.
5. Gigović, Ljubomir, et al. "Application of GIS-interval rough AHP methodology for flood hazard mapping in urban areas." Water 9.6 (2017): 360.
6. IFRC, (2010). World Disaster Report 2010: Focus on Urban Risk, International Federation of Red Cross and Red Crescent Societies.
7. Komolafe, Akinola Adesuji, Suleiman Abdul-Azeez Adegboyega, and Francis Omowonuola Akinluyi. "A review of flood risk analysis in Nigeria." American journal of environmental sciences 11.3 (2015): 157.
8. Langbein, Walter Basil. Topographic characteristics of drainage basins. No. 968-C. USGPO, 1947.
9. Mundhe, N. "Multi-criteria decision making for vulnerability mapping of flood hazard: a case study of Pune City." Journal of Geographical Studies 2.1 (2019): 41–52.
10. Ogden, Fred L., et al. "Relative importance of impervious area, drainage density, width function, and subsurface storm drainage on flood runoff from an urbanised catchment." Water resources research 47.12 (2011).
11. Pawar Amol, D., Jyoti Sarup, and Sushil Kumar Mittal. "Application of GIS and RS for Flood Evacuation Planning: A Lonavala Case Study." International Journal of Ecology & Development 29 (2014): 71–78.
12. Rubinato, Matteo, et al. "Urban and river flooding: Comparison of flood risk management approaches in the UK and China and an assessment of future knowledge needs." Water science and engineering 12.4 (2019): 274–283.
13. Safaripour, Mahsa, et al. "Flood risk assessment using GIS (case study: Golestan province, Iran)." Pol. J. Environ. Stud 21.6 (2012): 1817-1824.
14. Samanta, Sailesh, Dilip Kumar Pal, and Babita Palsamanta. "Flood susceptibility analysis through remote sensing, GIS and frequency ratio model." Applied Water Science 8.2 (2018): 66.
15. Vaishnavi, B., et al. "An assessment framework for precipitation decision making using AHP." 2017 11th international conference on intelligent systems and control (ISCO). IEEE, 2017.
16. Winsemius, H. C., et al. "A framework for global river flood risk assessments." Hydrology and Earth System Sciences 17.5 (2013): 1871-1892.

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Morphometric Analysis of Bhogavati River basin

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Abstract

In the present study, Toposheet data used for deriving the morphometric parameters and DEM from ASTER DATA image (USGS) used for the landform characterization of a region, forming a part of the Western Deccan Traps, India. The emphasis of this investigation is placed on the comparison of the terrain derivatives from contour DEM to assess the utility of both in the landform studied of varying scales. Most DEM have the generalization of land surface. Built into them if this generalization is within the spatial range of the processes that are operating in the landscape of interest there is no problem. If the generalization is greater than the resolution of the landscape processes any result obtained from DEM to be treated with caution (pain2005). Accuracy of the landform attribute is dependent on the DEM or data resolution which is used for study of the landscape processes. But here question is "which type of resolution data will truly reflect the landscape processes in the interested area?" It is dependent on the type and scale of the landscape under the investigation and the DEM resolution of this area should be better than the land surfaces processes scale if researchers have to use the calculated attribute to predict the spatial pattern existing in the area Most appropriate data for studying any landscape can only be determined by geomorphic analysis of the landform shape and processes by determining a pixel resolution which is adequate to capture the scale of surface processes operating in an area.

Keywords: DEM, ASTER DATA, Morphometric Analysis, Hydrology, geomorphic characteristics

Introduction

The Morphometric analysis is important in any hydrological investigation like assessment of groundwater potential, groundwater management, pedology and environmental assessment. Hydrologists and geomorphologists have recognized that certain relations are most important between runoff characteristics, and geographic and geomorphic characteristics of drainage basin systems. Various important hydrologic phenomena can be correlated with the physiographic characteristics of drainage basins such as size, shape, slope of drainage area, drainage density, size and length of the contributories etc. (Rastogi et al. 1976). Likewise morphometric analysis of any landform unit throws light on the processes operating in any region. Thus, both the variables are important in the study of landscape.

A river basin is the area which contributes water to particular channel to set of cannels. In other words, it is an area that is drained by river and its tributaries. A drainage basin with all its elements and attributes can be considered as an open system where there is continuous exchange of matter and energy with the surroundings. Drainage basin evolves as a result of interactions among the flow of matter and energy and resistance of the topographic surface. Characteristics of the river basin are generally defined by the amount of matter and energy that act upon the basin variables. Some of these characteristics can be quantified by the amount of morphometric studies (Silwa,et. al.2006)

Geomorphologists often attempt at giving numerical expression to the shape of the earth and understanding the variety of landforms as well as quantifying various aspects related to the development of a particular landform. Employment of the geomorphometric measurement has encouraged the development of variety of approaches to the numerical landform description. Geomorphometry which is defined by Chorley, et.al.1957 as the science that treat the geometry of the landscape, attempts to describe quantitatively the form of the land surface, according to Strahler 1969 morphometry is the measurement of the shape or geometry of any natural form-be it plant, animal or relief features. But in geomorphology morphometry is defined as measurement and mathematical analysis of the configuration of the earth surface and of the shape and dimension of its landform.

Study Area

Study area lies in 76°4' 42''East to 18°5' 59'' North Latitude and 75°39'40'' East to 17°52' 9'' North Longitude of geographical location.

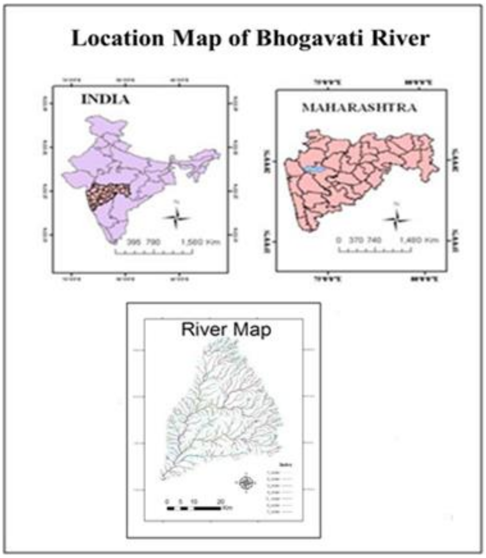

Fig. Location Map of Bhogavati River

Study area locating on the number of toposheet. Bhogavati originates near the Warwanti village. On the right bank of it receives the waters from Nilkanth & Ram Nala, and ultimately joins to the Sina at Bholare Village.

The banks of the Bhogavati are low and its bed sandy. After heavy rains, its flow is somewhat rapid, as is shown by the directness of its course. During summer, the river becomes practically dry.

Methodology:

- To carry out the objectives in this project work the following methodology has been adopted. Obtaining the topographical map (1:50000 scale) of the study area from Survey of India (SOI) and also downloading of ASTER (USGS) data.
- Digitization of the Toposheet with necessary layers of river Extraction of the interested area from ASTER data.
- Morphometric & basin parametric analysis by the ARC GIS 9.3 software.
- In the past few decades several researchers have carried out analysis of landscape by using data of varying resolution.

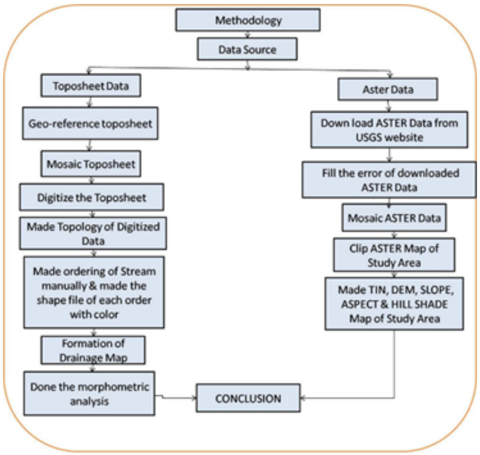

Fig. Flow chart of methodology

Digitization Of Layer:

Geographical data in the toposheet is given in the form of the signs and symbols with attribute. This information is made usable for the analysis of the GIS software for that purpose various layers were which are important for the study of the area under investigation. For the entire study area (Bhogavati Basin) rivers with all the orders of the study area were digitized with the help of software Arc GIS 9.3.

Topology Of the Data:

After the digitization analyst can't use that data without error correction. For the correction of the error topology is needed. Topology was done for the digitized layer in using the same software.

Ordering Of River:

For morphometric analysis of the river in the basin area it is necessary to give order for each and every tributary and main stream. Channel segments were ordered numerically from a stream's headwaters to a point somewhere down stream. Numerical ordering begins with the tributaries at the stream's headwaters being assigned the value 1. A stream segment that resulted from the joining of two 1st order segments was given an order of 2. Two 2nd order streams formed a 3rd order stream, and so on. In all the order went up to 7th orders are in the area depicted in the toposheet.

Stream Ordering:

Stream ordering is a method of assigning numeric order to links in stream network This order is method for identifying and classifying types of streams based upon their number of tributaries. Some characteristics of stream can be inferred by simply knowing their order. Arc GIS 9.3 provides the user with the stream order function, which has two methods that can be used to assign orders. These are the methods provided by Strahler in

1957 and Shreve in 1966. For the present study Strahler's (1957) method is used.

Vectorizing Stream Network:
By the stream ordering we get the raster streams which are not useful for further analysis. For that vectorization should be necessary. Using the conversion tool (raster to vector) of spatial analysis in the Arc tool box raster streams are converted into the vector. By using this method, it is possible to adjoin the linear feature such as river. But while using this method some nearest linear feature merge and form polygons. This error manually corrected.

Morphometrical Parameter Of The Basin Area:
In many studies, the characteristics of the basin morphometry have been used to predict or describe geomorphic processes such as prediction of the flood peaks, assessment of the sediment yield and estimation of erosion rate. The analysis of various stream parameters such as ordering of various stream, measurement of basin area and perimeter, length of drainage channels, drainage density, stream frequency, bifurcation ratio, texture ratio, basin relief etc are very useful indices which help us to understand the landforms operating at different scales (Verstappen,1983; Kumar et.al.2000).
Fluvial morphology includes the consideration linear aspect, aerial aspect and relief aspect of a fluvially originated drainage basin the topographical parameters include basin area, basin length, basin width, relative relief, absolute relief ect. And the basin parameters are including the drainage density, stream frequency and bifurcation ratio.

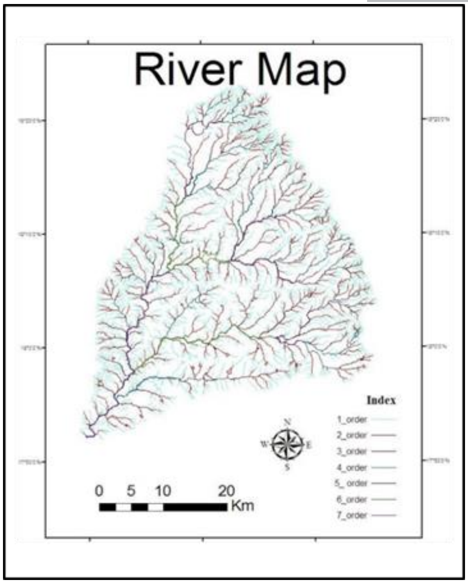

Fig. Drainage River map

Drainage Basin and network morphometry

Parameters	Toposheet data
Linear Aspect	
Stream order	7
Total Stream Length	2987.979559 Km.
Length of main stream	148.14km
Stream Length Ratio	2.25
Bifurcation Ratio	3.80
Aerial Aspect	
Drainage Density	1.86 km/km^2
Stream Frequency	1.7 km/ km^2
Channel Maintenance	0.54 km/ km^2
Relief Aspect	
Relative relief	284m
Slope	0.05^0
Elongation Ratio	0.81
Basin Circularity	0.0078

Linear Aspect:
Computation of the linear aspects such as stream order, stream number for

various orders, bifurcation ratio, stream lengths for various stream orders and length ratio are described below. All these parameters are shown in above table.

a) Stream Number (Nu):
It is obvious that the total number of streams gradually decreases as the stream order increases. Using Arc GIS, the number of streams of each order and the total numbers of streams were computed.

b) Stream Order:
The variation in order and size of the tributary basins are largely due to physiographic and structural conditions of the region. Application of this ordering procedure through GIS shows that the drainage network of the study area is in the toposheet data get the 7th order of the stream.

c) Stream Length (Lu):
Length of the stream is different for the different order of the stream as well as toposheet and Aster data also. Total stream length of for all the orders of the streams indicated by toposheet data is 2987.979559 Km. 148.14km is the length of the main stream in the toposheet data.

d) Length Ratio (RL):
The length ratio (RL) is defined as the ratio of mean stream length (Lu) of segment of order (u), to mean stream segment length (Lu-1) of the next lower order u-1. leangth ratio for the Bhogavati is 2.25. The RL has an important relationship with the surface flow discharge and erosional stage of the basin (Sreedevi et al. 2005).

e) Bifurcation Ratio (Rb):
The term 'bifurcation ratio' (Rb) was introduced by Horton (1932) to express the ratio of the number of streams of any given order to the number in the next lower order. According to Strahler (1964), the ratio of number of streams of a given order (Nu) to the number of segments of the higher order (Nu+1) is termed as the Rb. Bifurcation ratio calculated for the toposheet data is 3.80. Bifurcation ratio of the toposheet data is between 3 to 5 and it indicates geological and structural control in the basin of study area
(Sreedevi et al. 2005)

Aerial Aspect:

a) Drainage Density (Dd)
The relationship between various environmental variables and Dd has been analyzed and the main findings are reported below. Several studies indicate the influence of climate on drainage density. According to Gregory and Gardiner (1975) and Gregory (1976) showed that drainage density broadly increases with precipitation intensity index defined as the ratio between the maximum reported 24th rainfall and the average annual rainfall. Generally, it is a positive correlation between Dd and rainfall parameters (Montgomery and Dietrich, 1989; Tucker and Bras, 1998). Abrahams (1984) showed that several climatic factors simultaneously affect drainage density in a complex way.
Dd is generally inversely related to hydraulic conductivity of the underlying soil. For steep slopes, an inverse correlation has been modeled by Montgomery and Dietrich (1992). Generally, Dd increases with decreasing infiltration capacity of the underlying

rocks and/or decreasing transmissivity of the soil. Horton (1945) defined Dd as the total length of channels (Lu) in a catchment divided by the area (A) of the catchment. Drainage density is 1.86 km/km2 for the Bhogavati.

b) Stream Frequency (Fs)

The stream frequency (Fs) of a basin may be defined as the number of streams per unit area (Horton, 1945). Stream frequency shows the texture of the drainage network

1.7 km/ km2 stream frequency is indicated by the toposheet area.

Relief Aspects:

Evaluation of some of the relief aspects of the basin is discussed below

a) Relative Relief:

Relief is the maximum vertical distance between the lowest and the highest points of a basin. Basin relief is an important factor in understanding the denudational characteristics of the basin (Sreedevi et al. 2005). The relative relief is for the toposheet data is 284m

b) Slope:

Slope analysis is an important parameter in geomorphic studies. The slope elements, in turn are controlled by the climatomorphogenic processes in the area having the rock of varying resistance. An understanding of slope distribution is essential as a slope map provides data for planning, settlement, mechanization of agriculture, deforestation, planning of engineering structures, morph conservation practices etc. (Sreedevi et al. 2005). Slope map of the study area is obtained from toposheet data, Slope for the toposheet data is 0.05degrees.

The overall picture that emerges out of this analysis is that toposheet generated DEM is showing more detail in almost all the morphometric and drainage basin parameters, compared to SRTM. This is not a new finding at all. Several researchers have already established this fact. However, an exercise is conducted in the study which will enable us to quantitatively analyze this aspect. Hence in the following paragraphs, profile analysis has been attempted.

Result

River Bhogavati having 7th stream order. Total stream length of Bhogavati is 2987.97 Km. Length of main channel of Bhogavati 148.14km. Length Ratio of Bhogavati is 2.25. Bifurcation Ratio of Bhogavati River is 3.80. Drainage Density is 1.86 km/ km2. Constant of channel maintenance is 0.54 km/ km2. Stream Frequency is 1.7 km/ km2. Relative relief of relief of study region is 284m. Slope of the study region is up to 0.050 it is very gentle slope. Elongation Ratio of Bhogavati Basin is 0.81. Basin Circularity of Bhogavati Watershed is 0.0078.

References

1. Abrahams A.D. (1984) Channel Networks: A Geomorphological Perspective. Water Resources Research, pp161-168.
2. Abrahams A.D. (1984) Channel Networks: A Geomorphological Perspective. Water Resources Research, pp161-168.
3. Chorley, Malm, R. J., D.E.G. and Pogorzelski. H.A. (1957): A New Standard for Estimating Basin Shape, Am. J. Sci,pp 138-141.

4. Demirkesen, A.C., (2008). Digital terrain analysis using Landsat-7 ETM+ imagery and SRTM DEM: a case study of Nevsehir province (Cappadocia), Turkey. International Journal of Remote Sensing, 29 (14), pp 4173–4188.
5. Desmet, P.J.J., and Govers, G., (1996). Comparison of Routing Algorithms for Digital Elevation Models and their Implications for Predicting Ephemeral Gullies. International Journal of GIS, 10, pp 311-331.
6. Florinsky, I.V., (1998). Accuracy of local topographic variables derived from digital elevation models, International Journal of Geographical Information Science, 12(1), pp 47–61.

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