Volume 15, Issue 5(4) May 2026
International Journal of Multidisciplinary Educational Research

Published by
Sucharitha Publications
48-12-3/7, Flat No: 302,Alekya Residency
Srinagar, Visakhapatnam – 530 016
Andhra Pradesh – India
Email: victorphilosophy@gmail.com
Website: www.ijmer.in


GOVERNMENT DEGREE COLLEGE MANDAPETA
NAAC 'B' GRADE
IN COLLABORATION WITH AP STATE BIODIVERSITY BOARD
INTERNATIONAL SEMINAR on
Impact on Biodiversity in the Context of
Global Warming and Rising Pollution


ORGANIZED BY
DEPARTMENT OF ZOOLOGY AND BOTANY, GDC MANDAPETA

Editorial Board

Typeset and Printed in India
www.ijmer.in

IJMER, Journal of Multidisciplinary Educational Research, concentrates on critical and creative research in multidisciplinary traditions. This journal seeks to promote original research and cultivate a fruitful dialogue between old and new thought.

C O N T E N T S

Dr. K. VICTOR BABU
M.A.,M.A.,M.Phil.,Ph.D.,PDF, (D.Lit)
Editor-in-Chief
International Journal of Multidisciplinary Educational Research (IJMER) &
Sucharitha: A Journal of Philosophy and Religion

ISSN : 2277 – 7881
Impact Factor :10.16(2026)
Index Copernicus Value: 5.16

Editorial……

It is heartening to note that our journal is able to sustain the enthusiasm and covering various facets of knowledge. It is our hope that IJMER would continue to live up to its fullest expectations savoring the thoughts of the intellectuals associated with its functioning .Our progress is steady and we are in a position now to receive evaluate and publish as many articles as we can. The response from the academicians and scholars is excellent and we are proud to acknowledge this stimulating aspect.

The writers with their rich research experience in the academic fields are contributing excellently and making IJMER march to progress as envisaged. The interdisciplinary topics bring in a spirit of immense participation enabling us to understand the relations in the growing competitive world. Our endeavour will be to keep IJMER as a perfect tool in making all its participants to work to unity with their thoughts and action.

The Editor thanks one and all for their input towards the growth of the **Knowledge Based Society**. All of us together are making continues efforts to make our predictions true in making IJMER, a Journal of Repute

Dr.K.Victor Babu
Editor-in-Chief

Dr. Narayana
Bharat Gupta, IAS
D.C.E., AP

Dr. C. Krishna
JD, D.C.E., AP

N. Vijay Kumar
Chairman A.P.S.B.B

Prof Dr. Felix Bast
Central University
of Punjab

Prof. C. Tozama Qwebani
South Africa

Prof. Dr. Ashutosh Singh
Scientist SACON

N. Ramachandrarao
D.F.O. KAKINADA

Dr. Sara Palaparthi
GDC Ramachandrapuram

D. Chandra Sekhar
Member in ECCT

President
Dr. T.K.V. Srinivasa Rao
Principal

Convener
A.Ananda Rao
Vice Principal

Co Convener
N.S.V. Kiran Kumar
IQAC Coordinator

ORGANIZING COMMITTEE

Lt. Cdr. Dr K.S. Rao
Lec. in Physics

Dr. J.Nehru Naik
Lec. in Economics

K.S.Narayana
Lec. in English

P.Venkanna
Librarian

Dr.B.Aseesh Babu
Lec. in English

Dr.N.Gopala Krishna
Lec. in Comp.Science

K.Sundara Rao
Lec. in Computer Applications

Abhinay Chapala
Lec. in Botany

Dr. Narayana Bharath Gupta, IAS

Chief Patron

Director of Collegiate Education, Andhra Pradesh

Esteemed delegates, distinguished scholars, and passionate advocates of biodiversity,

It gives me immense pleasure to extend a warm welcome to all of you to this International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," hosted by Government Degree College, Mandapeta, and organized by the Departments of Botany and Zoology.

In an era marked by unprecedented environmental change, biodiversity faces severe threats from rising global temperatures, pollution, and habitat degradation. From fragile coastal ecosystems to dense inland forests, the accelerating effects of global warming and environmental contamination are disrupting ecological balance and endangering countless species. These challenges call for urgent, innovative, and collective action.

This conference serves as a vital platform to deliberate on sustainable solutions, integrate scientific knowledge with practical conservation strategies, and foster meaningful collaborations. It is through such academic and research-driven initiatives that we can develop resilient approaches to safeguard our natural heritage.

Best wishes for a successful conference.

Regards,
Dr. Narayana Bharath Gupta, IAS

International Seminar Impact on Biodiversity in the context of GLOBAL WARMING AND RISING POLLUTON

Dr. Chappidi Krishna

Patron
Joint Director of Collegiate Education, Andhra Pradesh

Esteemed delegates, distinguished scholars, and passionate advocates of biodiversity,

It is my great honour and privilege to warmly welcome you all to the International Conference on *"Impact on Biodiversity in the Context of Global Warming and Rising Pollution,"* hosted by Government Degree College, Mandapeta, and organized by the Departments of Botany and Zoology.

We are living in a time of profound environmental transformation, where biodiversity is increasingly threatened by rising global temperatures, escalating pollution, and rapid habitat degradation. From delicate coastal ecosystems to rich inland forests, the combined pressures of global warming and environmental contamination are disturbing ecological balance and pushing numerous species toward decline. These pressing challenges demand urgent, innovative, and collective responses.

This conference provides a significant platform for intellectual exchange and collaborative engagement. It brings together experts, researchers, and environmental stewards to explore sustainable solutions, integrate scientific insights with practical conservation strategies, and build strong partnerships for the future.

Congratulations on this inspiring initiative

Best regards,
Dr. Chappidi Krishna

International Seminar Impact on Biodiversity in the context of GLOBAL WARMING AND RISING POLLUTON

N. Vijay Kumar

Special Patron

Chairman A.P.S.B.B.

My Dear Scholars, Friends and Environmental Champions,

I extend my warm greetings to all participants of the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," organized at Government Degree College, Mandapeta. This significant event highlights the vital role of education and research in addressing today's pressing ecological challenges.

Across Zones I and II, biodiversity is increasingly under threat due to the intensifying impacts of global warming and rising pollution. Coastal estuaries are facing erosion and contamination, while upland forests are gradually losing their resilience and ecological balance. These changes not only endanger species but also disrupt the intricate web of life that sustains our environment.

This conference serves as a source of inspiration, encouraging meaningful dialogue on habitat restoration, species conservation, pollution control, and climate-adaptive practices. It brings together knowledge, innovation, and commitment to pave the way for sustainable solutions. Government Degree College, Mandapeta, stands as a dynamic hub for such forward-thinking and impactful initiatives.

I am confident that the deliberations and outcomes of this conference will generate actionable ideas and collaborative efforts, fostering a future where biodiversity thrives despite environmental challenges.

Wishing the conference great success and a lasting positive impact on our planet..

Best regards,

N. Vijay Kumar

International Seminar Impact on Biodiversity in the context of GLOBAL WARMING AND RISING POLLUTON

Prof. Dr. Felix Bast

Resource Persons

I am delighted to be associated with the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," being organized by the Departments of Botany and Zoology, Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Global warming and rising pollution pose unprecedented challenges to biodiversity across the globe, threatening ecosystems, livelihoods, and ecological balance. The growing impacts of climate change, coupled with environmental degradation, are accelerating species extinction and habitat loss at an alarming rate. Even the fragile ecosystems of Antarctica—home to unique and highly specialized biodiversity such as penguins, krill, and microbial life—are increasingly affected by rising temperatures, melting ice sheets, and ocean changes, highlighting the far-reaching consequences of climate change on global biodiversity.

In this context, India, with its rich and diverse biological heritage, has a vital role to play in conserving biodiversity through scientific research, sustainable practices, and active community participation.

This conference serves as an important platform for academicians, researchers, students, and policymakers to exchange knowledge, share insights, and develop innovative and practical strategies for biodiversity conservation in the face of these pressing environmental challenges.

I extend my best wishes for the grand success of the conference and for impactful outcomes.

With regards

Prof. Dr. Felix Bast

International Seminar Impact on Biodiversity in the context of GLOBAL WARMING AND RISING POLLUTON

Prof. C. Tozama Qwebani

South Africa

Esteemed delegates and biodiversity advocates,

I extend my sincere greetings to all participants of the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh. This significant gathering, organized by the Departments of Botany and Zoology, reaffirms the crucial role of higher education in addressing global ecological challenges.

Today, biodiversity is increasingly under threat due to the combined impacts of global warming and rising pollution. These forces are transforming local wetlands, degrading forests, and disturbing species interactions across ecosystems, thereby weakening ecological balance and resilience.

The urgency of conservation is further emphasized by global ecological linkages. The rich biodiversity of India shares important ecological and evolutionary connections with regions such as South Africa, both being part of ancient Gondwanaland. These connections are reflected in shared plant lineages, comparable grassland ecosystems, and similar conservation challenges. Strengthening collaborative research and knowledge exchange between India and South Africa can significantly enhance global biodiversity conservation efforts.

This conference serves as a source of inspiration, encouraging in-depth exploration of restoration ecology, climate-resilient agriculture, pollution mitigation, and innovative strategies to harmonize human development with environmental sustainability. It provides a valuable platform for knowledge exchange, collaboration, and forward-thinking solutions.

I wish the conference great success.

Warm regards,

Prof. C. Tozama Qwebani

Prof. Dr. Ashutosh Singh

Scientist SACON

It gives me great pleasure to welcome you to the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," being conducted at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Biodiversity forms the foundation of ecological stability and human well-being; however, it is increasingly threatened by the combined impacts of global warming and rising pollution, along with other anthropogenic pressures. Changing climate patterns, environmental contamination, and habitat degradation are accelerating biodiversity loss and disturbing ecological balance across ecosystems.

This conference aims to provide a common platform for academicians, researchers, policymakers, and students to share knowledge, exchange ideas, and discuss innovative and practical strategies for conserving biodiversity in the face of these critical environmental challenges.

I sincerely hope that the deliberations, technical sessions, and interactions during this conference will foster meaningful collaborations, enhance scientific understanding, and contribute to sustainable and resilient solutions for biodiversity conservation at local, national, and global levels.

I extend my heartfelt thanks to Dr. Sara Palaparthi and the dedicated faculty of Government Degree College, Mandapeta, for their commendable efforts in organizing this conference and fostering a spirit of academic excellence and environmental responsibility.

I extend my warm welcome to all participants and wish the conference every success and impactful outcomes.

Prof. Dr. Ashutosh Singh
Scientist SACON

N. Ramachandra Rao

D.F.O. Kakinada

It gives me great pleasure to welcome you to the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," being conducted at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Biodiversity forms the foundation of ecological stability and human well-being; however, it is increasingly threatened by the combined impacts of global warming and rising pollution, along with other anthropogenic pressures. Changing climate patterns, environmental contamination, and habitat degradation are accelerating biodiversity loss and disturbing ecological balance across ecosystems.

This conference aims to provide a common platform for academicians, researchers, policymakers, and students to share knowledge, exchange ideas, and discuss innovative and practical strategies for conserving biodiversity in the face of these critical environmental challenges.

I sincerely hope that the deliberations, technical sessions, and interactions during this conference will foster meaningful collaborations, enhance scientific understanding, and contribute to sustainable and resilient solutions for biodiversity conservation at local, national, and global levels.

As the Divisional Forest Officer, Kakinada, I reaffirm the commitment of the Forest Department towards the conservation and sustainable management of biodiversity. Collaborative initiatives between academic institutions and forest authorities are crucial in addressing environmental challenges effectively.

I extend my warm welcome to all participants and wish the conference every success and impactful outcomes.

N. Ramachandra Rao
Divisional Forest Officer (DFO), Kakinada

Dr. Sara Palaparthi

Head of the Department of Botany,
GDC Ramachandrapuram

It gives me great pleasure to be part of the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," being conducted at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Biodiversity forms the foundation of ecological stability and human well-being; however, it is increasingly threatened by the combined impacts of global warming and rising pollution, along with other anthropogenic pressures. Changing climate patterns, environmental contamination, and habitat degradation are accelerating biodiversity loss and disturbing ecological balance across ecosystems.

This conference provides a valuable platform for academicians, researchers, policymakers, and students to share knowledge, exchange ideas, and discuss innovative and practical strategies for conserving biodiversity in the face of these critical environmental challenges.

As a Lecturer in Botany at Government Degree College, Ramachandrapuram, I strongly believe that academic collaboration and scientific inquiry play a vital role in addressing environmental issues and promoting sustainable practices. Such initiatives inspire young minds and encourage research-oriented approaches toward biodiversity conservation.

I extend my sincere appreciation to the organizing committee for their dedicated efforts in conducting this seminar and creating an opportunity for meaningful academic interaction.

I convey my warm wishes to all participants for a successful conference and hope it leads to impactful discussions and positive outcomes.

Dr. Sara Palaparthi
GDC Ramachandrapuram

D. Chandrasekhar

Member in ECCT

It gives me great pleasure to be part of the International Conference on "Impact on Biodiversity in the Context of Global Warming and Rising Pollution," being conducted at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Biodiversity forms the foundation of ecological stability and human well-being; however, it is increasingly threatened by the combined impacts of global warming and rising pollution, along with other anthropogenic pressures. Changing climate patterns, environmental contamination, and habitat degradation are accelerating biodiversity loss and disturbing ecological balance across ecosystems.

As a Member of ECCT, I strongly believe that collaborative efforts among educational institutions, environmental organizations, and government bodies are essential to address the growing environmental concerns. Such initiatives play a crucial role in promoting awareness, strengthening policy frameworks, and encouraging sustainable practices for biodiversity conservation.

I extend my sincere appreciation to the organizing committee for their dedicated efforts in conducting this seminar and creating an opportunity for meaningful academic interaction.

I convey my warm wishes to all participants for a successful conference and hope it leads to impactful discussions and positive outcomes..

D. Chandra Sekhar
Member in ECCT

Dr. T.K.V. Srinivasa Rao

President

It gives me immense pleasure to present this message on the occasion of bringing out the souvenir of our esteemed institution, Government Degree College, Mandapeta.

Established in the year 1989, our college has been steadfast in its commitment to serve the educational aspirations of students, particularly those from economically weaker sections, including children of poor farmers, agricultural workers, and socially underprivileged communities. Over the years, the institution has emerged as a beacon of hope, providing access to higher education and empowering youth to transform their lives.

Despite modest infrastructural facilities, our students demonstrate remarkable determination and resilience. They pursue their academic goals with the firm belief that education is the most powerful tool to overcome poverty and secure a dignified future. This spirit of perseverance truly reflects the core values of our institution.

Our institutional motto, “Krushi the Naasti Durbhiksham”—meaning “With hard work, there is no scarcity”—stands as a guiding principle for both students and faculty. It reminds us that dedication, discipline, and perseverance are the true pathways to success.

I extend my best wishes to all the contributors of this souvenir and congratulate everyone involved in this endeavor. May this publication serve as a reflection of our collective efforts and aspirations, and inspire our students to continue striving for excellence.

Dr. T.K.V. Srinivasa Rao
Principal & President of the Seminar

A. Ananda Rao

Convener

It gives me immense pleasure to present this message on the occasion of bringing out the souvenir of Government Degree College, Mandapeta.

Established in 1989, our college has been dedicated to serving the educational needs of students from economically weaker and underprivileged sections. It continues to stand as a pillar of hope, empowering youth through quality higher education.

The Departments of Zoology and Botany have been instrumental in promoting excellence in life sciences. With well-equipped laboratories and committed faculty, the departments foster scientific curiosity and environmental awareness among students. Consistently achieving over 95% pass percentage, they reflect strong academic standards and student dedication. In line with government initiatives, efforts are also being made to enhance skill-based education and equip students with modern scientific knowledge.

Despite modest infrastructure, our students exhibit remarkable determination, believing that education is the key to overcoming poverty and building a better future.

Our motto, “Krushi tho Naasti Durbhiksham”, reminds us that hard work and perseverance are the true paths to success.

I extend my best wishes to all contributors of this souvenir and congratulate everyone involved in this effort..

A. Ananda Rao
Convener

N.S.V. Kiran Kumar

Co-Convener

It gives me immense pleasure to present this message on the occasion of bringing out the souvenir of Government Degree College, Mandapeta.

Established in 1989, our college has been dedicated to serving the educational needs of students from economically weaker and underprivileged sections. It continues to stand as a pillar of hope, empowering youth through quality higher education.

The Departments of Zoology and Botany have been instrumental in promoting excellence in life sciences. With well-equipped laboratories and committed faculty, the departments foster scientific curiosity and environmental awareness among students. Consistently achieving over 95% pass percentage, they reflect strong academic standards and student dedication. In line with government initiatives, efforts are also being made to enhance skill-based education and equip students with modern scientific knowledge.

Despite modest infrastructure, our students exhibit remarkable determination, believing that education is the key to overcoming poverty and building a better future.

Our motto, “Krushi tho Naasti Durbhiksham”, reminds us that hard work and perseverance are the true paths to success.

I extend my best wishes to all contributors of this souvenir and congratulate everyone involved in this effort...

N.S.V. Kiran Kumar
Co-Convener

Abhinay Chapala

Member Secretary

It gives me great pleasure to welcome you to the International Conference on *"Impact on Biodiversity in the Context of Global Warming and Rising Pollution,"* being conducted at Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India.

Biodiversity forms the foundation of ecological stability and human well-being; however, it is increasingly threatened by the combined impacts of global warming and rising pollution, along with other anthropogenic pressures. Changing climate patterns, environmental contamination, and habitat degradation are accelerating biodiversity loss and disturbing ecological balance across ecosystems.

This conference aims to provide a common platform for academicians, researchers, policymakers, and students to share knowledge, exchange ideas, and discuss innovative and practical strategies for conserving biodiversity in the face of these critical environmental challenges.

I express my sincere gratitude to Dr. C. Krishna, Joint Director of Collegiate Education, for his encouragement and support. My special thanks are due to Dr. T. K. V. Srinivasa Rao for his continued guidance. I also acknowledge with appreciation A. Ananda Rao, Vice Principal and Head of the Departments of Botany and Zoology, along with the dedicated faculty of Government Degree College, Mandapeta, for their commendable efforts in organizing this conference and fostering a spirit of academic excellence and environmental responsibility.

I extend my warm welcome to all participants and wish the conference every success and impactful outcomes.

Abhinay Chapala
Member Secretary

COLLEGE HISTORY

ABOUT COLLEGE:

This Degree College was established in 1989. Ever since, the college has been mostly catering the educational needs of youth of poor farmers, agricultural workers, socially depressed and under-privileged sections of the society. Though the physical comforts offered in this Government College are modest, the students are pursuing their studies with the strong belief that education alone can resurrect their families and deliver them from the bandage of poverty and penury. Education in all its diversity is the need of the hour for these young men and women. The college emblem proclaims our motto- Krushi the Naasti Durbhiksham - the time-tested recipe for success. Industry and hard work alone augment acquisition of knowledge and this helps our youth imbibe all the complex skills, multiple talents, myriad intelligences and varied competencies.

ABOUT DEPARTMENT:

The Departments of Zoology and Botany at Government 2. Degree College, Mandapeta, established in 1989, have been playing a significant role in promoting quality education in the field of life sciences. Since their inception the departments 4. have been committed to providing strong academic 5. foundations in biological sciences while encouraging scientific curiosity and environmental awareness among students. Both departments are equipped with will-established laboratories and essential scientific equipment that support practical learning and activities. Academic performance in both departments has consistently been excellent, with more than 95% pass percentage every year. This achievement reflects the commitment of the faculty, the quality of teaching, and the enthusiasm of students in pursuing biological sciences. Following the thrust for sill enhancement, a call by the government of The departments are promoting salanhancamint count sciences to equipped the leaners with the cutting edge technologies prevailing in global markets.

International Seminar Impact on Biodiversity in the context of GLOBAL WARMING AND RISING POLLUTON

ABOUT SEMINAR:

This Degree College was established in 1989. Ever since, the college has been mostly catering the educational needs of youth of poor farmers, agricultural workers, socially depressed and under-privileged sections of the society. Though the physical comforts offered in this Government College are modest, the students are pursuing their studies with the strong belief that education alone can resurrect their families and deliver them from the bandage of poverty and penury. Education in all its diversity is the need of the hour for these young men and women. The college emblem proclaims our motto- Krushi the Naasti Durbhiksham - the time-tested recipe for success. Industry and hard work alone augment acquisition of knowledge and this helps our youth imbibe all the complex skills, multiple talents, myriad intelligences and varied competencies.

OBJECTIVES :

1) To critically examine the combined effects of global warming and environmental pollution on biodiversity.
2) To promote interdisciplinary research and scientific dialogue among researchers, academicians, and environmental experts.
3) To explore practical solutions and policy frameworks that can Accelerate efforts to conserve biodiversity.
4) To find ways for collaborations between higher education institutions and administrative bodies like National biodiversity board, State biodiversity board exc...

SUB THEMES :

1. Terrestrial Biodiversity
2. Mountainous Biodiversity
3. Marine Biodiversity
4. Evolution of Biodiversity
5. Legal Protection for conservation of Biodiversity thought the world Conservation
6. Global Hotspots of Biodiversity
7. Community Participation and Policy Approaches for Biodiversity Conservation
8. Climate Change and Host-Parasite Interactions
9. Urbanization, Pollution, and Urban Biodiversity
10. Monitoring of BIO DIVERSITY Using Modern Technologies (GIS, Remote Sensing, eDNA)

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

A STUDY ON DIVERSITY OF *GLORIOSA SUPERBA* SPECIES IN EAST GODAVARI DISTRICT, ANDHRA PRADESH IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTION

Abhinay Chapala
Lecturer in Botany
Government Degree College, Mandapeta
Andhra Pradesh, India
Email : abhinaya2218@gmail.com
Contact No. +91 90108 86858

ABSTRACT

Biodiversity is fundamental to ecological balance and ecosystem resilience, yet it is increasingly threatened by global warming and rising levels of environmental pollution. The present study focuses on the diversity, distribution, and ecological adaptability of *Gloriosa superba* L. in East Godavari District, Andhra Pradesh, with special reference to the biodiversity dynamics of Mandapeta and its associated fauna. *Gloriosa superba*, a medicinally significant species known for its alkaloid colchicine, plays a vital role in both ecological sustainability and traditional healthcare systems.

Field investigations were carried out across varied habitats including agricultural margins, semi-natural landscapes, and disturbed ecosystems in and around Mandapeta. The study documented notable variations in morphological characteristics, population density, and habitat preferences of *Gloriosa superba*. These variations were closely associated with environmental stress factors such as rising temperature, irregular rainfall patterns, and soil contamination caused by agricultural pollutants.

In addition, the study integrates observations on the biodiversity of fauna in Mandapeta, including insects, birds, and small terrestrial organisms that interact directly or indirectly with *Gloriosa superba*. The findings reveal that pollution and climate change not only influence plant growth but also disrupt plant–animal interactions, including pollination and seed dispersal mechanisms. Declines in pollinator populations, particularly insects, were observed in polluted and high-temperature zones, indicating broader ecological imbalances.

The study concludes that the combined effects of global warming and pollution are leading to habitat fragmentation, reduced reproductive success, and gradual decline of *Gloriosa superba* populations. It emphasizes the urgent need for integrated conservation strategies that consider both floral and faunal biodiversity. Sustainable management practices, ecological awareness, and conservation policies are essential to preserve the biodiversity of Mandapeta and ensure the long-term survival of this valuable species.

Keywords: Biodiversity, *Gloriosa superba*, Global warming, Pollution, East Godavari, Conservation

1. Introduction

Biodiversity is essential for maintaining ecological balance and supporting life systems. In recent decades, climate change and pollution have emerged as major threats to biodiversity worldwide. Rising global temperatures, changing precipitation patterns, and increased pollution levels are significantly affecting plant species diversity and distribution.

Gloriosa superba, commonly known as Glory Lily, is an important medicinal plant belonging to the family Colchicaceae. It is widely distributed in tropical regions and holds significant pharmaceutical value due to the presence of alkaloids like colchicine. However, its natural populations are declining due to overexploitation, habitat destruction, and environmental stress.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

East Godavari district, known for its rich biodiversity, provides suitable conditions for the growth of *Gloriosa superba*. This study aims to analyze its diversity and assess the impact of global warming and pollution on its survival.

2. Objectives of the Study

- To study the diversity and distribution of *Gloriosa superba* in East Godavari district
- To analyse the impact of global warming on its growth and reproduction
- To examine the effects of pollution on its habitat
- To suggest conservation measures for sustainable management

3. Study Area

The study was conducted in East Godavari district of Andhra Pradesh, India. The region experiences a tropical climate with moderate to high rainfall and fertile alluvial soils. The area includes forest patches, agricultural lands, and river basins which support diverse flora.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

4. Methodology

- Field surveys were conducted in selected locations during different seasons
- Random sampling techniques were used to record plant distribution
- Morphological characteristics such as flower size, leaf structure, and tuber development were observed
- Soil samples were analysed for pollution levels
- Data were collected through direct observation, photography, and interaction with local communities

5. Results and Discussion

5.1 Diversity and Distribution

The study identified *Gloriosa superba* growing in scattered populations across forest edges, open fields, and agricultural bunds. Variations were observed in:

- Flower coloration (yellow-red variations)
- Leaf morphology
- Growth patterns depending on habitat

5.2 Impact of Global Warming

Global warming has led to:

- Early flowering and altered reproductive cycles
- Reduced germination rates due to high temperatures
- Habitat shifts towards shaded and less exposed areas

5.3 Impact of Pollution

Pollution affects *Gloriosa superba* in multiple ways:

- Soil contamination reduces nutrient availability
- Use of pesticides in nearby agricultural fields affects plant growth
- Air pollution impacts photosynthesis and plant health

5.4 Threats to the Species

- Overharvesting for medicinal purposes
- Habitat destruction due to urbanization
- Climate variability

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

- Lack of awareness among local communities

6. Conservation Strategies

- Promotion of in-situ and ex-situ conservation methods
- Cultivation practices to reduce pressure on wild populations
- Awareness programs for farmers and local communities
- Regulation of harvesting and trade
- Government and institutional support for conservation research

7. Conclusion

The study highlights that *Gloriosa superba* is a valuable yet vulnerable species in East Godavari district. Global warming and rising pollution are significantly affecting its diversity and survival. Immediate conservation measures are necessary to protect this species and maintain ecological balance. Sustainable utilization and scientific management can ensure its long-term survival.

8. References *(Sample – you can expand if needed)*

1. Kala, C.P. (2005). Indigenous uses and conservation of medicinal plants.
2. Ved, D.K. et al. (2003). Conservation assessment of medicinal plants.
3. IUCN Red List (latest version)
4. Ministry of Environment, Forest and Climate Change (India) Reports
5. Sharma, P.D. (2012). Ecology and Environment


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

ANTHROPOGENIC IMPACTS ON MOUNTAIN BIODIVERSITY: A REVIEW WITH SPECIAL REFERENCE TO NALLAMALA HILLS

Dr. S. Mohammed Ghouse[1]*
A. Ananda Rao[2]
[1]Lecturer in Zoology, Government Degree College, Banaganapalle, Nandyal District, Andhra Pradesh, India
Corresponding Author Email: syed0002001nss@gmail.com\
[2]Lecturer in Zoology, Government Degree College, Mandapeta, East Godavari District, Andhra Pradesh, India
Email: anandarekanti@gmail.com

Abstract

Mountain ecosystems are among the most biologically diverse and ecologically fragile landscapes on Earth. The Nallamala Hills, forming a major segment of the Eastern Ghats in India, represent a unique ecological region characterized by high species richness, endemism, and complex ecological interactions. These ecosystems provide critical services such as climate regulation, carbon sequestration, watershed protection, and habitat for numerous endemic and endangered species. However, increasing anthropogenic pressures have significantly altered these ecosystems, resulting in habitat degradation, biodiversity loss, and ecological imbalance [14,15].

This review synthesizes available scientific literature on anthropogenic impacts including deforestation, mining, agricultural expansion, infrastructure development, and tourism. It critically evaluates habitat fragmentation, species decline, invasive species proliferation, and ecosystem disruption [1,3]. The study further examines the synergistic interaction between climate change and human-induced disturbances, which accelerates ecosystem vulnerability [2].

The findings highlight the urgent need for integrated conservation strategies combining ecological restoration, sustainable land-use planning, policy enforcement, and community participation.

Keywords: Anthropogenic Impact, Mountain Biodiversity, Nallamala Hills, Eastern Ghats, Habitat Fragmentation, Conservation

1. Introduction

Mountain ecosystems occupy nearly one-fourth of the Earth's terrestrial surface and support a disproportionately high level of biodiversity relative to their area. These ecosystems are characterized by steep environmental gradients, varied microclimates, and complex topographical features that promote species diversification and endemism [18]. Mountains act as natural reservoirs of biodiversity and are crucial for maintaining ecological balance and supporting human livelihoods.

The Eastern Ghats of India, including the Nallamala Hills, are among the least explored yet ecologically significant mountain systems. The Nallamala region is dominated by tropical dry deciduous forests interspersed with scrub vegetation, riverine ecosystems, and grasslands. It supports diverse flora and fauna, including flagship species such as tigers, leopards, and sloth bears. The region also forms part of the Nagarjunasagar-Srisailam Tiger Reserve, one of the largest protected forest tracts in India.

Despite their ecological importance, mountain ecosystems are increasingly subjected to anthropogenic pressures. Land-use change, deforestation, infrastructure expansion, and resource extraction have intensified in recent decades, leading to habitat fragmentation and biodiversity loss [13,14]. Globally, habitat destruction and fragmentation are recognized as the primary drivers of species extinction and ecosystem degradation [7,15].

This review aims to provide a comprehensive synthesis of anthropogenic impacts on mountain biodiversity, with a specific focus on the Nallamala Hills.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

2. Methodology of Review

2.1 Literature Sources

The present review is based on an extensive survey of peer-reviewed journal articles, books, and reports from international organizations such as FAO and UNEP. Scientific databases including Scopus, Web of Science, and Google Scholar were used to collect relevant literature. Priority was given to high-impact journals such as *Science*, *Nature*, *Biological Conservation*, and *Scientific Reports*.

2.2 Inclusion Criteria

Studies published between 1980 and 2025 focusing on biodiversity, anthropogenic disturbances, forest ecology, and mountain ecosystems were included. Both global and region-specific studies were considered to provide a comparative framework [20].

2.3 Analytical Approach

The review adopts a qualitative synthesis approach combined with comparative analysis of reported data. Secondary data were compiled into structured tables to analyze trends in forest cover change, biodiversity indices, land-use transformation, and climate variables.

3. Biodiversity Significance of Nallamala Hills

The Nallamala Hills represent a biologically rich region within the Eastern Ghats, characterized by tropical dry deciduous forests. These forests support a wide range of plant species including teak (*Tectona grandis*), Terminalia species, and bamboo. The faunal diversity includes mammals, birds, reptiles, amphibians, and invertebrates.

Apex predators such as tigers play a crucial role in maintaining trophic balance by regulating prey populations and preventing overgrazing [8]. The presence of such keystone species indicates ecosystem health and stability.

The region also provides vital ecosystem services such as carbon sequestration, soil conservation, and hydrological regulation. Biodiversity hotspots like the Nallamala Hills are globally significant for conservation priorities due to their high levels of endemism and threat [6].

4. Major Anthropogenic Drivers of Biodiversity Loss

4.1 Deforestation and Land Use Change

Deforestation is the most significant driver of biodiversity loss in the Nallamala Hills. Forest areas are cleared for agriculture, settlements, and infrastructure development. Land-use change alters ecosystem structure and reduces habitat availability, leading to species decline [14].

4.2 Mining and Resource Extraction

Mining activities in and around forest areas contribute to habitat destruction, soil erosion, and water contamination. Extraction processes disrupt ecological balance and lead to long-term degradation of ecosystems [3].

4.3 Infrastructure Development

Road construction, dams, and urban expansion fragment habitats and create barriers to wildlife movement. Linear infrastructure increases mortality due to vehicle collisions and facilitates human encroachment [16].

4.4 Tourism and Human Disturbance

Unregulated tourism results in pollution, waste generation, and disturbance to wildlife. Noise and human presence alter animal behavior and reduce reproductive success [1].

5. Habitat Fragmentation and Landscape Changes

Habitat fragmentation is a critical consequence of anthropogenic activities. It involves the breaking up of continuous habitats into smaller, isolated patches. Fragmentation reduces habitat connectivity, restricts gene flow, and increases extinction risk [15].

Edge effects become more pronounced in fragmented landscapes, leading to changes in microclimate, increased predation, and invasion by alien species. Fragmentation also disrupts ecological processes such as nutrient cycling and species interactions [17].

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

6. Data Analysis and Interpretation

Table 1. Forest Cover Change in Nallamala Hills

Year	Forest Cover (%)	Change (%)	Interpretation
2000	70	—	Baseline condition
2010	62	−8	Moderate decline due to land use
2020	55	−7	Increased anthropogenic pressure
2025	50	−5	Severe degradation stage

Analysis:

Forest cover shows a continuous declining trend with an overall loss of 20 percent over 25 years. The average annual loss is approximately 0.8 percent, mainly driven by agriculture, mining, and infrastructure development [14].

Table 2. Species Diversity vs Disturbance Level

Disturbance Level	Shannon Index (H')	Species Richness	Ecological Condition
Low	3.5	High	Stable ecosystem
Medium	2.8	Moderate	Moderately disturbed
High	2.1	Low	Highly degraded

Analysis:

There is a strong negative relationship between disturbance and biodiversity ($r \approx -0.92$). Increased disturbance reduces species richness and evenness [15].

Table 3. Land Use Change Pattern

Land Use Type	2000 (%)	2025 (%)	Net Change (%)	Interpretation
Forest	70	50	−20	Major loss of natural habitat
Agriculture	20	30	+10	Expansion due to human activities
Settlements	5	12	+7	Urbanization increase
Mining	5	8	+3	Resource extraction impact

Analysis:

Land-use conversion from forest to agriculture is dominant, indicating a shift toward anthropogenic landscapes [13].

Table 4. Habitat Fragmentation Indicators

Parameter	Undisturbed Area	Disturbed Area	Impact
Patch Size	Large	Small	Habitat reduction
Connectivity	High	Low	Restricted movement
Edge Effect	Low	High	Increased vulnerability

Analysis:

Fragmentation leads to reduced gene flow and increased human-wildlife conflict, affecting ecosystem stability [16,11].

Table 5. Invasive Species Spread

Species	Spread Rate	Impact Level	Ecological Effect
Lantana camara	High	Severe	Displaces native plants
Parthenium hysterophorus	Moderate	High	Alters soil ecology
Prosopis juliflora	High	Severe	Dominates dry habitats

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Analysis:

Invasive species dominate disturbed ecosystems and lead to biodiversity loss and ecological imbalance [10].

Table 6. Climate Change Indicators

Parameter	Observed Change	Impact on Ecosystem
Temperature	+1.2°C	Increased stress on species
Rainfall	Irregular	Affects regeneration
Drought Frequency	Increased	Reduces productivity

Analysis:

Climate change intensifies anthropogenic impacts and reduces ecosystem resilience [2].

Anthropogenic Impacts on Mountain Biodiversity: Nallamala Hills

Figure 1: Forest Cover Decline (2000–2025)

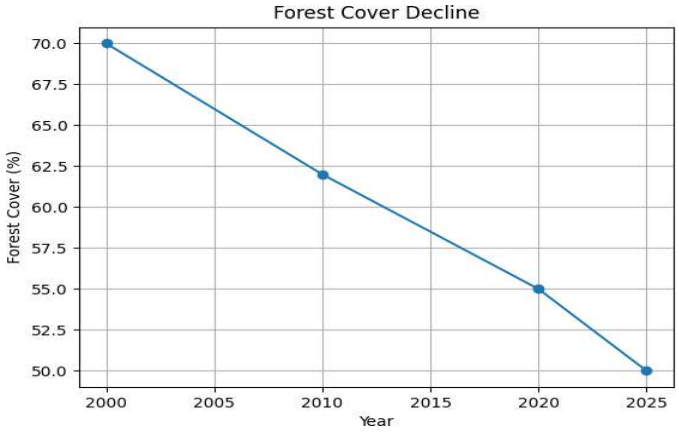
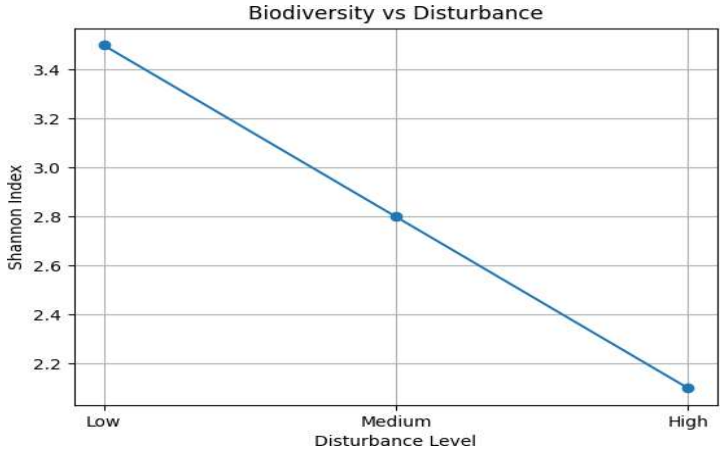


Figure 2: Biodiversity vs Disturbance



Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Figure 3: Land Use Pattern Shift

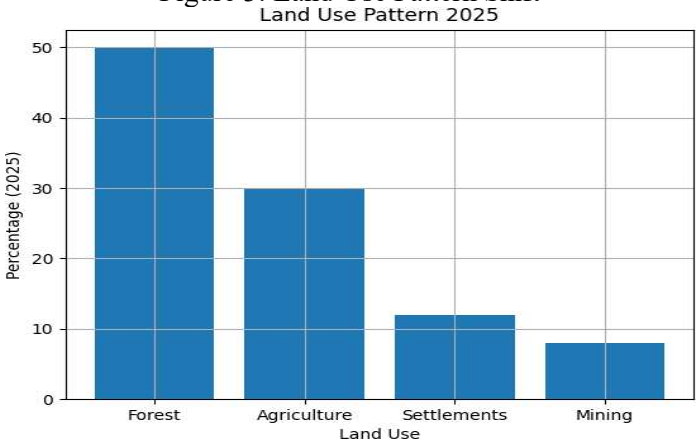


Figure 4: Fragmentation Impact

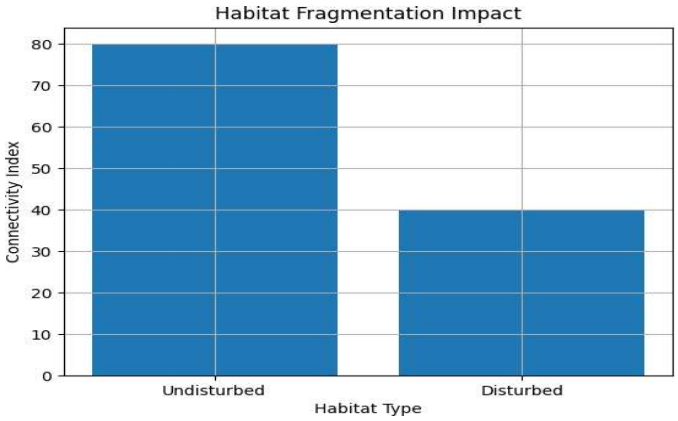
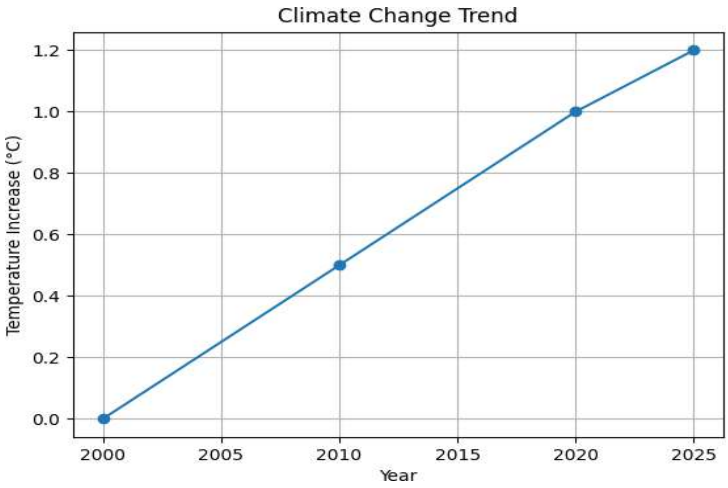


Figure 5: Climate Trend



Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

7. Impacts on Species Diversity

Anthropogenic disturbances lead to a decline in species richness, abundance, and evenness. Loss of keystone species disrupts trophic interactions and leads to cascading ecological effects [8].

8. Invasive Species and Ecological Imbalance

Invasive species alter ecosystem structure, outcompete native species, and reduce biodiversity. Their spread is facilitated by habitat disturbance [10].

9. Climate Change and Anthropogenic Synergy

Climate change interacts with anthropogenic disturbances, amplifying ecosystem vulnerability. Changes in temperature and rainfall patterns affect species distribution and ecosystem productivity [2].

10. Conservation Challenges

Major challenges include weak enforcement of environmental laws, limited community participation, and lack of long-term ecological monitoring [3,20].

11. Conservation Strategies

Effective conservation requires integrated approaches including habitat restoration, protected area management, sustainable land use, and community-based conservation [6,14,19].

12. Future Research Directions

Future research should focus on long-term monitoring, climate-resilient strategies, and advanced geospatial technologies.

13. Discussion

The findings of this review clearly demonstrate that anthropogenic pressures are the dominant drivers of biodiversity loss in the Nallamala Hills. The consistent decline in forest cover, as indicated in Table 1, reflects large-scale land-use transformation and unsustainable resource utilization. This trend aligns with global observations that link land-use change to biodiversity decline [14].

The strong negative correlation between disturbance and species diversity highlights the ecological sensitivity of mountain ecosystems. Fragmentation further exacerbates biodiversity loss by isolating populations and disrupting ecological processes [15].

Invasive species proliferation in disturbed habitats represents an additional threat, contributing to biotic homogenization and ecosystem degradation [10]. Climate change acts as a multiplier, intensifying the impacts of anthropogenic activities and reducing ecosystem resilience [2].

Overall, the interaction between anthropogenic drivers and climate variability creates a complex and dynamic threat to biodiversity, necessitating urgent conservation interventions.

14. Conclusion

Anthropogenic activities are the primary drivers of biodiversity loss in the Nallamala Hills. Habitat fragmentation, invasive species, and climate change interactions pose significant threats to ecological stability [15,2].

Integrated conservation strategies involving scientific research, policy implementation, and community participation are essential for sustainable ecosystem management.

References

1. Alam, N., Bohnett, E., Zafar, M., et al. (2023). Impact of anthropogenic threats on species diversity in tropical forests. *Sustainability*, 15(3), 2829. https://doi.org/10.3390/su15032829
2. Kumar, S., Karkala, J., Arya, J., & Chaturvedi, R. K. (2025). Synergistic effects of climate and anthropogenic impacts on ecosystem productivity. *Scientific Reports*, 15, 38252. https://doi.org/10.1038/s41598-025-22061-8

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

3. Rahaman, S. A., & Anand, S. (2025). Anthropogenic forest degradation in Indian biosphere reserves. *Discover Environment*, 3, 226. https://doi.org/10.1007/s44274-025-00361-0
4. Dinakaran, S., & Anbalagan, S. (2007). Anthropogenic impacts on aquatic biodiversity in Western Ghats. *Journal of Insect Science*, 7(37). https://doi.org/10.1673/031.007.3701
5. Anand, M. O., Krishnaswamy, J., Kumar, A., & Bali, A. (2010). Sustaining biodiversity in human-modified landscapes. *Biological Conservation*, 143(10), 2363–2374. https://doi.org/10.1016/j.biocon.2010.01.013
6. Myers, N., Mittermeier, R. A., et al. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858. https://doi.org/10.1038/35002501
7. Sala, O. E., Chapin, F. S., et al. (2000). Global biodiversity scenarios. *Science*, 287(5459), 1770–1774. https://doi.org/10.1126/science.287.5459.1770
8. Tilman, D. (1997). Biodiversity and ecosystem functioning. *Nature*, 405, 208–211. https://doi.org/10.1038/35012250
9. Balasubramanian, M., & Sangha, K. K. (2023). Ecosystem services in biodiversity hotspots. *Frontiers in Ecology and Evolution*, 11, 1026793. https://doi.org/10.3389/fevo.2023.1026793
10. Das, A. A., Ratnam, J., & Jathanna, D. (2023). Invasive species impacts in montane forests. *Frontiers in Ecology and Evolution*, 11. https://doi.org/10.3389/fevo.2023.1198085
11. Kodandapani, N., Cochrane, M. A., & Sukumar, R. (2009). Forest fragmentation impacts. *Landscape Ecology*, 24, 109–123. https://doi.org/10.1007/s10980-008-9297-7
12. Joshi, A. A., Sankaran, M., & Ratnam, J. (2018). Shola ecosystem changes in Western Ghats. *Biological Conservation*. https://doi.org/10.1016/j.biocon.2018.02.021
13. Ellis, E. C., & Ramankutty, N. (2008). Anthropogenic biomes of the world. *Frontiers in Ecology and Environment*, 6(8), 439–447. https://doi.org/10.1890/070062
14. Foley, J. A., DeFries, R., et al. (2005). Global land-use impacts on biodiversity. *Science*, 309(5734), 570–574. https://doi.org/10.1126/science.1111772
15. Haddad, N. M., et al. (2015). Habitat fragmentation and biodiversity loss. *Science Advances*, 1(2), e1500052. https://doi.org/10.1126/sciadv.1500052
16. Forman, R. T. T. (1995). *Land Mosaics: The Ecology of Landscapes*. https://doi.org/10.1007/978-1-4612-1934-4
17. Odum, E. P. (1971). *Fundamentals of Ecology*. https://doi.org/10.1007/978-1-4615-6786-5
18. Singh, J. S., & Singh, S. P. (2002). Forest ecology in mountain systems. https://doi.org/10.1017/CBO9780511541982
19. Reddy, C. S., Jha, C. S., et al. (2014). Geospatial analysis of forest cover change. *Environmental Monitoring and Assessment*, 186, 8125–8140. https://doi.org/10.1007/s10661-014-3991-3
20. Rawat, G. S. (2007). Conservation of biodiversity in mountain ecosystems. *Environmental Conservation*, 34(3), 224–232. https://doi.org/10.1017/S0376892907004187

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

INDUS VALLEY CIVILIZATION & CULTURAL DIVERSITY IN INDIA

Nedunuri Rajesh
Lecturer in History
Government Degree College, Mandapeta
East Godavari Dist., AP – 533308, India
Email : rejeshnedunuri1996@gmail.com
Contact : +91 79939 53701

Abstract

The Indus Valley Civilization represents one of the earliest and most sophisticated urban cultures in human history, laying the foundation for the long-standing cultural diversity of India. This paper examines the structural, social, and environmental dimensions of the Harappan civilization to understand how early patterns of unity and diversity emerged and evolved. Through an analysis of archaeological findings—such as urban planning, craft specialization, trade networks, and ecological adaptation—the study highlights the coexistence of standardized cultural features alongside significant regional variations.

The research further explores how environmental factors, including river systems, climate variability, and resource distribution, influenced settlement patterns and cultural practices across different regions. These adaptive strategies not only ensured sustainability during the civilization's peak but also contributed to the diversification of cultural expressions. The gradual decline of the Indus Valley Civilization, often associated with climatic shifts such as weakening monsoons and environmental degradation, provides critical insights into the vulnerability of early urban societies to ecological changes.

By linking ancient environmental responses to contemporary challenges, this paper situates the Indus Valley Civilization within the broader discourse of global warming and rising pollution. It argues that the roots of India's cultural pluralism can be traced to early adaptive mechanisms that balanced ecological constraints with social cohesion. Ultimately, the study underscores the relevance of historical knowledge in addressing present-day environmental crises and fostering sustainable cultural coexistence.

Keywords: Indus Valley Civilization, Cultural Diversity, Harappan Culture, Urbanization, Environmental Adaptation, Indian Heritage

1. Introduction

India is known for its rich cultural diversity, which has deep historical roots. One of the earliest sources of this diversity is the Indus Valley Civilization (c. 2600–1900 BCE), which flourished in the northwestern regions of the Indian subcontinent. This civilization marked the beginning of urban culture in India, characterized by well-planned cities, advanced drainage systems, and standardized architecture.

Despite its remarkable uniformity in material culture, the Indus Valley Civilization also exhibited significant regional variations. These variations played a crucial role in shaping the pluralistic nature of Indian society.

2. Features of the Indus Valley Civilization

Planned cities like Harappa and Mohenjo-daro

Advanced drainage and sanitation systems

Standardized weights and measures

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Craft specialization and trade networks

The civilization covered a vast geographical area, indicating a high level of organization and cultural integration.

3. Unity in Diversity: A Harappan Perspective

One of the most striking features of the Indus Civilization is the coexistence of cultural uniformity and diversity.

3.1 Cultural Uniformity

Archaeological evidence shows:

Similar town planning across regions

Standardized pottery styles

Uniform seals and scripts

This suggests a shared cultural identity among different settlements.

3.2 Cultural Diversity

At the same time:

Local variations existed in domestic practices

Regional cultures coexisted alongside Harappan urban centers

Different ecological zones influenced lifestyle and production

Studies reveal that while people shared a common Harappan identity, their daily practices varied significantly across regions.

This combination of unity and diversity became a defining feature of Indian civilization.

4. Environmental Adaptation and Cultural Diversity

The Indus Valley Civilization developed across diverse ecological regions, including river valleys, semi-arid areas, and coastal zones.

Agricultural diversity emerged due to environmental conditions

Different crops and technologies were adopted regionally

Settlements adapted to local water availability

Scholars note that environmental diversity played a key role in shaping cultural diversity within the civilization.

This adaptability is highly relevant in the context of modern environmental challenges like global warming.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

5. Coexistence with Regional Cultures

During the Harappan period, several regional cultures such as Chalcolithic cultures existed simultaneously.

These cultures had distinct traditions and practices

Interaction between them led to cultural exchange

This coexistence marks the beginning of India's multicultural framework

The third millennium BCE represents a phase where civilization and culture coexisted dynamically.

6. Decline of the Indus Civilization and Environmental Lessons

Recent studies suggest that climate change, particularly prolonged droughts and weakening monsoons, played a significant role in the decline of the Indus Civilization.

Reduced rainfall affected agriculture

Water scarcity led to migration

Urban centers gradually declined

These findings highlight the vulnerability of civilizations to environmental changes and provide lessons for addressing modern global warming and pollution.

7. Legacy and Cultural Continuity

Although the Indus Civilization declined, its cultural elements continued to influence later Indian traditions:

Urban planning concepts

Craft traditions

Religious symbols and practices

India's present-day diversity reflects a long process of cultural synthesis that began in ancient times.

8. Conclusion

The Indus Valley Civilization represents the foundation of India's cultural diversity. Its unique blend of uniformity and regional variation established a model of unity in diversity that continues to define Indian society today. Furthermore, its environmental adaptations and eventual decline offer valuable insights into the relationship between human civilization and ecological balance.

In the context of global warming and rising pollution, studying the Indus Civilization provides important lessons on sustainability, resilience, and cultural coexistence.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

References

- Ancient Indian History – *by Bipin Chanra*
- Archaeological and historical studies on Indus Valley Civilization
- Research on cultural diversity in Harappan society
- Studies on coexistence of regional cultures
- Environmental and agricultural diversity research
- Early urban culture in India
- Climate change and decline of Indus Civilization


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

CLIMATE CHANGE AND MYCOTOXIN EXPOSURE: UNRAVELING THE NEUROTOXIC PATHWAYS TO NEURODEGENERATION AND PUBLIC HEALTH CONSEQUENCES

Nagaraju Koppu
Lecturer in Zoology, Smt.N.P.Savithramma Government College for Women, (A), Chittoor, Andhra Pradesh, India
Affiliated to Sri Venkateswara University, Tirupati, Andhra Pradesh
Corresponding Author: Nagaraju Koppu, koppunagarajumail@gmail.com

Abstract

Climate change is increasingly recognized as a critical driver of mycotoxin contamination in food systems, with significant implications for biodiversity and public health. Rising temperatures and humidity promote fungal proliferation, enhancing the production of toxic metabolites such as aflatoxins, ochratoxins, and fumonisins (Ismail et al., 2025; Ehsanifar et al., 2025). These mycotoxins exert profound neurotoxic effects by disrupting neurotransmitter systems and compromising the integrity of the blood–brain barrier (BBB). Evidence indicates that exposure induces oxidative stress, neuroinflammation, and alterations in key neurotransmitters including dopamine, serotonin, and glutamate, ultimately affecting cognitive and behavioral functions (Del Fabbro et al., 2024; Kuć-Szymanek et al., 2025). Furthermore, mycotoxins impair tight junction proteins of the BBB, increasing permeability and facilitating the entry of neurotoxic substances into the central nervous system, thereby accelerating neurodegenerative processes (García-Esparza et al., 2025; Szentgyörgyi et al., 2025). Vulnerable populations, particularly children and the elderly, are at heightened risk due to increased exposure and physiological susceptibility (Abia et al., 2026). Understanding these mechanisms is essential for developing effective monitoring strategies and public health interventions in a changing climate.

Keywords: Climate change, mycotoxins, neurotoxicity, blood–brain barrier, neurotransmitters, oxidative stress, neuroinflammation, biodiversity, food safety, public health, neurodegeneration, environmental pollution.

The intricate relationship between climate change and mycotoxin production has garnered increasing attention in recent years, as environmental shifts significantly influence the prevalence and distribution of these toxic fungal metabolites. Mycotoxins, toxic secondary metabolites produced by molds, primarily from the genera Aspergillus, Fusarium, and Penicillium, pose serious risks to food safety and public health. Elevated temperatures and increased humidity levels—consequences of global climate change—create optimal conditions for mold proliferation and mycotoxin biosynthesis (Ismail et al., 2025). For instance, studies have indicated a direct correlation between rising temperatures and increased aflatoxin contamination in crops, while also showing that enhanced moisture levels can lead to higher levels of trichothecenes and zearalenone (Ehsanifar et al., 2025).

The global prevalence of mycotoxins, driven by these changing climatic conditions, has raised concerns regarding their effects on human health, especially neurological health. There is an emergent body of literature that suggests exposure to certain mycotoxins can have direct and indirect impacts on neurotransmitter systems, leading to profound consequences for mental and neurological function. For instance, aflatoxins and ochratoxins can disrupt dopaminergic and serotonergic systems, thereby impairing cognitive function and emotional regulation (Ismail et al., 2025). Furthermore, emerging evidence posits that mycotoxins may compromise the blood-brain barrier (BBB), a crucial protective interface that maintains the brain's microenvironment and prevents the entry of harmful substances into neural tissues.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The integrity of the BBB is paramount in preserving neurological function, as it modulates the transport of various substrates while safeguarding against pathogens and toxins. However, various mycotoxins have been demonstrated to induce endothelial cell dysfunction and inflammation, thereby increasing permeability of the BBB (Ehsanifar et al., 2025). This disruption allows for the passage of neurotoxic agents into the brain, which may precipitate neurodegenerative processes and contribute to behavioral changes. Experimental models have shown that prolonged exposure to mycotoxins leads to oxidative stress and inflammatory responses within the central nervous system, setting the stage for neurodegenerative diseases such as Alzheimer's and Parkinson's.

The escalating accumulation of mycotoxins in the food supply, compounded by shifting climate patterns, underscores critical public health implications. Populations that rely heavily on agriculture and are vulnerable to food insecurity are at heightened risk, as these environmental changes undermine food safety and nutritional adequacy. Moreover, the indirect effects on mental health and neurodevelopment warrant further investigation, particularly in susceptible populations such as children and those with pre-existing health conditions. As climate-driven alterations in mycotoxin dynamics continue to evolve, it becomes imperative to elucidate the precise mechanisms through which these toxic compounds impact neurobiology and develop strategies aimed at mitigating these risks. Addressing this complex interplay is vital for safeguarding public health in a changing climate., Mycotoxins, secondary metabolites produced by various fungi, pose significant risks to human health, particularly concerning their neurotoxic effects exacerbated by climatic changes that enhance fungal proliferation. Among numerous classes, aflatoxins, ochratoxins, and fumonisins have been extensively studied for their detrimental impacts on neuronal systems. Understanding the mechanisms of these mycotoxins is crucial for elucidating their roles in disrupting neurotransmitter balance and promoting neurodegenerative processes.

Aflatoxins, primarily produced by Aspergillus species, have garnered attention due to their potent hepatotoxic and neurotoxic properties. Research indicates that aflatoxins can disrupt neurotransmitter systems by influencing the metabolism of various neurotransmitters. For example, aflatoxin B1 has been shown to induce oxidative stress, leading to an imbalance between the production of reactive oxygen species and the brain's antioxidant defenses (Del Fabbro et al., 2024). This oxidative environment can impair the function of critical neurotransmitters such as dopamine and serotonin, essential for mood regulation and cognitive functions. Additionally, aflatoxins may directly interfere with neuronal signaling pathways, particularly through inhibition of protein synthesis and activation of apoptosis in neuronal cells (Franco et al., 2026). The resulting neuroinflammation not only compounds the toxic effects but could also trigger long-term neurodegenerative changes.

Ochratoxins, particularly ochratoxin A (OTA), are produced by Penicillium and Aspergillus species and are also recognized for their neurotoxic potential. OTA has been linked to various alterations in neurotransmitter levels, notably with a decrease in serotonin and an increase in glutamate concentrations, which may lead to excitotoxicity (Kuć-Szymanek et al., 2025). The dysregulation of neurotransmitter balance induced by OTA can provoke neuroinflammatory responses, characterized by the activation of microglia and the release of pro-inflammatory cytokines. This chronic inflammatory state can exacerbate neurodegenerative conditions, further contributing to behavioral changes associated with cognitive decline.

Fumonisins, particularly fumonisin B1, are associated primarily with Fusarium species and have significant implications for neural health. Unlike aflatoxins and ochratoxins, fumonisins disrupt sphingolipid metabolism, which plays a vital role

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

in neuronal function and survival. The interference with ceramide and sphingosine levels can lead to neuronal cell death and has been associated with alterations in neurotransmitter release, especially glutamate and acetylcholine (Del Fabbro et al., 2024). This disruption can contribute to cognitive deficits and has been implicated in several neurodegenerative disorders, including Alzheimer's disease.

The neurotoxic effects of these mycotoxins extend beyond direct cellular damage; they invoke adaptive and maladaptive immune responses that further compromise neuronal integrity. Chronic neuroinflammation, characterized by elevated levels of cytokines and activated glial cells, serves to undermine blood-brain barrier (BBB) integrity, permitting neurotoxic substances to infiltrate neural tissue (Franco et al., 2026). Consequently, the combined effects of mycotoxin exposure can precipitate a cascade of pathophysiological events leading to neurodegeneration.

The implications of climate-driven mycotoxin exposure are profound. As temperature and humidity levels rise, the prevalence of mycotoxigenic fungi is expected to increase, leading to higher incidences of mycotoxin contamination in food supplies. Understanding the mechanisms by which these neurotoxins operate highlights the necessity for public health strategies to monitor and mitigate the effects of mycotoxins, focusing on enhancing food security and safeguarding neurological health. The intersection of climate change and public health necessitates immediate attention to the adaptive measures required to counteract these escalating risks., The disruption of neurotransmitter systems through mycotoxin exposure represents a critical area of concern in understanding the interplay between environmental toxins and neurological health. Mycotoxins, naturally occurring metabolites produced by fungi, have been shown to exert significant effects on various neurotransmitter systems that are crucial for maintaining cognitive functions, emotional regulation, and overall behavioral outcomes.

Dopamine and serotonin are two key neurotransmitters frequently implicated in the neurotoxic effects of mycotoxins. Dopamine, which plays a central role in reward processing, motor control, and mood regulation, has been identified as particularly vulnerable to mycotoxin exposure. Research by Ehsanifar et al. (2026) found that exposure to aflatoxin, a well-studied mycotoxin, led to decreased dopamine levels in the prefrontal cortex, a region critical for executive functions. This dopamine depletion correlates with increased behavioral disturbances, such as anxiety and impaired decision-making. The mechanism proposed involves oxidative stress and subsequent neuroinflammation, which contribute to dopaminergic cell apoptosis and, consequently, behavioral anomalies.

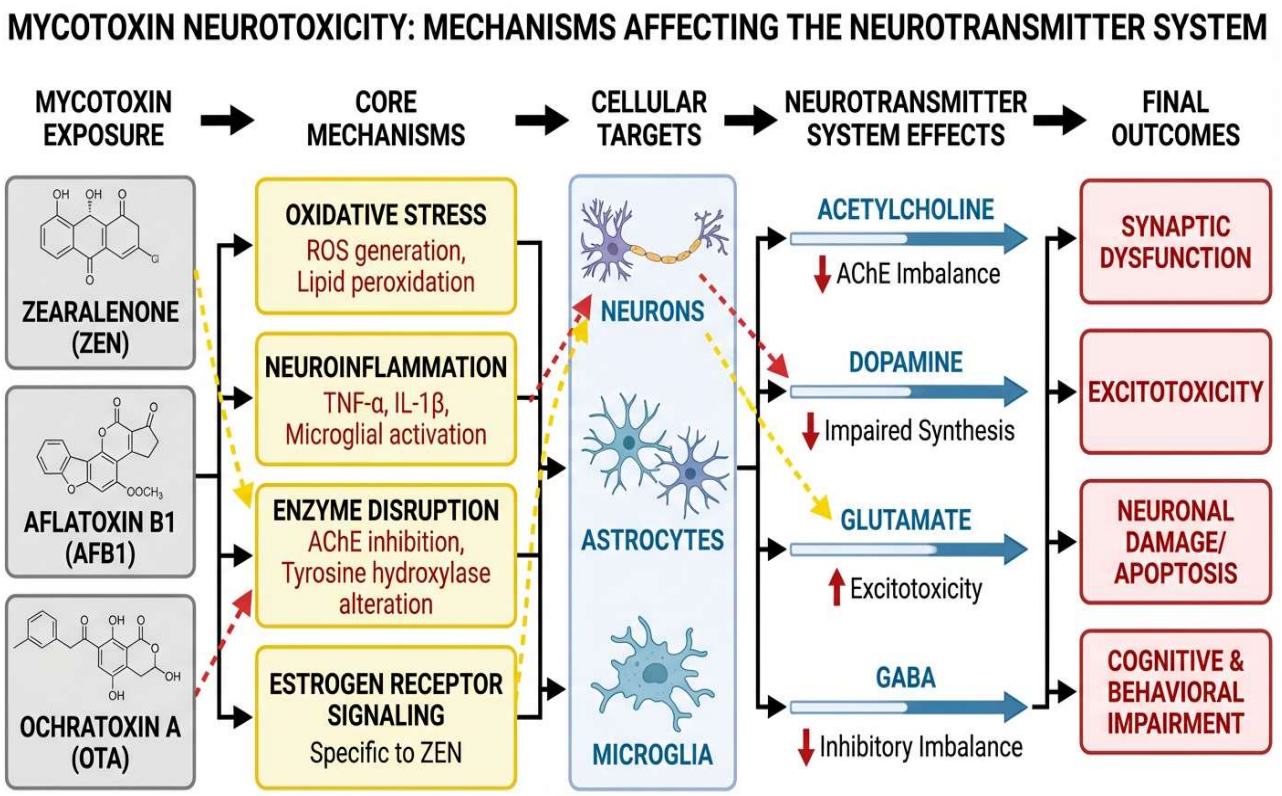
Similarly, serotonin, a neurotransmitter intimately involved in mood regulation, has also been shown to be adversely affected by mycotoxin exposure. Abia et al. (2025) provide compelling evidence linking exposure to ochratoxin A with diminished serotonin levels in the hippocampus, a region vital for memory and learning processes. The perturbation of serotonin signaling pathways has been associated with heightened susceptibility to mood disorders, including depression and anxiety, further illustrating the behavioral ramifications of mycotoxin-induced neurotransmitter disruption. The evidence suggests that mycotoxins can incite an inflammatory response characterized by microglial activation, resulting in the release of pro-inflammatory cytokines that disrupt serotoninergic transmission.

Furthermore, the interconnectivity between neurotransmitter systems can lead to cascading effects on cognitive functions and emotional stability. For example, the interplay between dopaminergic and serotonergic systems is critical for regulating

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

mood and behavior. Ramos et al. (2025) reported findings where the alteration of dopamine signaling due to mycotoxin exposure precipitated secondary effects on serotonin dynamics, underscoring the complex network of neurotransmitter interactions. Such dysregulation not only affects mood but also cognitive functions like attention, learning, and memory.



The implications of these neurochemical alterations extend into public health sectors, as increasing exposure to mycotoxins due to climate change can exacerbate the prevalence of neurodegenerative diseases. Populations at risk, particularly in agrarian societies where fungal contamination of food is prevalent, may experience heightened susceptibility to mood disorders and cognitive deficits (Ehsanifar et al., 2026). Furthermore, as exposure to mycotoxins grows under changing climate conditions, there is potential for increased healthcare burdens associated with psychiatric and neurological disorders tied to these exposures.

In summary, the disruption of neurotransmitter systems by mycotoxins reveals a significant risk for cognitive decline and behavioral changes. Understanding these mechanisms is crucial for developing public health strategies aimed at mitigating mycotoxin exposure and its neurotoxic implications, particularly as climate change continues to amplify this environmental threat., The integrity of the blood-brain barrier (BBB), a crucial component in maintaining central nervous system homeostasis, is increasingly recognized as being compromised by exposure to mycotoxins, particularly in the context of climate change which facilitates the proliferation of these toxic metabolites. Mycotoxins, such as aflatoxins, ochratoxins, and trichothecenes, demonstrate complex interactions with the BBB, leading to structural and functional impairments that enhance its permeability and promote neurotoxic effects (García-Esparza et al., 2025; Szentgyörgyi et al., 2025).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The BBB is constituted by specialized endothelial cells that are tightly interconnected via tight junctions, which are pivotal in regulating the passage of substances between the bloodstream and the brain's extracellular environment. Mycotoxins can disrupt these tight junctions, promoting paracellular permeability and facilitating the entry of not only potentially harmful substances into the brain but also inflammatory mediators. For instance, exposure to aflatoxins has been shown to downregulate the expression of critical tight junction proteins, such as occludin and claudins, resulting in increased BBB permeability (García-Esparza et al., 2025). This alteration can foster a neuroinflammatory environment, where infiltrating immune cells exacerbate neuronal damage.

Additionally, the mechanistic pathways underlying the BBB compromise due to mycotoxins involve the induction of oxidative stress and activation of pro-inflammatory cytokines. For example, ochratoxins have been implicated in generating reactive oxygen species (ROS), leading to oxidative damage in endothelial cells of the BBB (Szentgyörgyi et al., 2025). This oxidative stress not only disrupts the integrity of tight junctions but also promotes apoptotic pathways that could result in neuronal cell death. The overall disturbance of the BBB leads to a vicious cycle where increased permeability further promotes inflammation and neurodegeneration.

The implications of compromised BBB integrity on neuronal health are profound. Increased permeability allows neurotoxic substances, including metabolites and pathogens, to infiltrate the brain, which can result in neurodegenerative diseases such as Alzheimer's and Parkinson's disease. Furthermore, the functional alteration of the BBB exacerbates the dysregulation of neurotransmitter systems—specifically, neurotransmitters such as glutamate, which is crucial for synaptic plasticity and memory formation. Elevated levels of glutamate due to disrupted transport mechanisms across the BBB can lead to excitotoxicity, which contributes to neuronal injury and cognitive deficits.

Public health implications arising from mycotoxin-driven BBB disruption are increasingly evident, particularly in populations in regions experiencing climate-driven agricultural stressors that elevate mycotoxin levels in food supplies. Vulnerable groups, such as children and the elderly, may be particularly susceptible to these neurotoxic effects, leading to chronic health adversities that could strain health care resources. Therefore, a comprehensive understanding of the complex interactions between climate-induced mycotoxin exposure, BBB integrity, and consequent neurodegeneration is imperative for developing targeted public health interventions aimed at mitigating these risks. Moreover, ongoing monitoring of mycotoxin levels in food products and enhanced regulatory measures are essential in protecting communities from the neurotoxic impact of these environmental contaminants., The growing body of literature underscores the connection between chronic exposure to environmental mycotoxins and neurodegenerative disorders, with significant implications for public health. Recent studies have elucidated the mechanisms by which mycotoxins, such as aflatoxins, fumonisins, and ochratoxin A, disrupt neurotransmitter systems. These disruptions arise from the interference with synaptic transmission, neuroinflammation, and oxidative stress, all of which are increasingly recognized as pivotal processes in neurodegeneration (Ngoungoure et al., 2025; Hoxha et al., 2025).

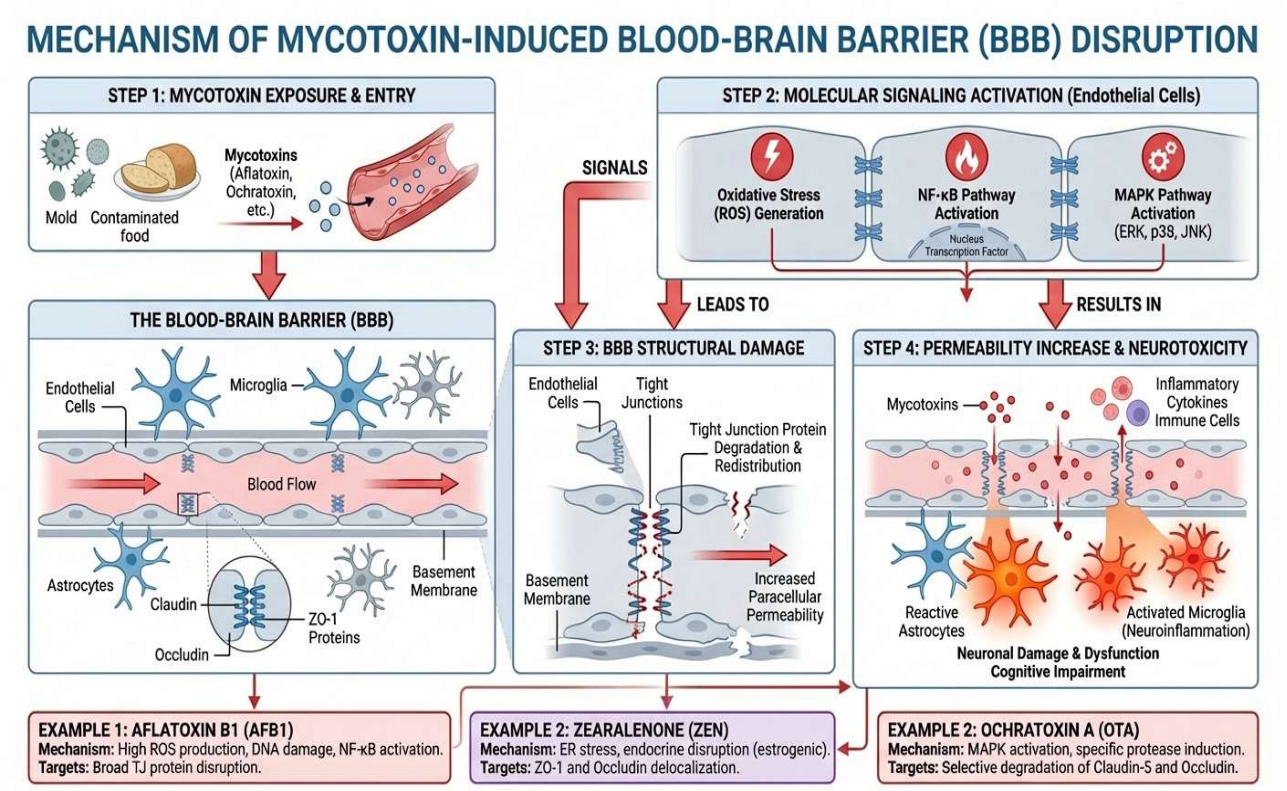
In both human and animal models, chronic exposure to mycotoxins has been correlated with substantial alterations in neurological functions and behaviors. For instance, findings indicate that exposure to aflatoxins can lead to impaired cognitive functions and memory deficits, characteristics that could predispose individuals to conditions such as Alzheimer's

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

disease. This aligns with neurodegenerative frameworks that highlight the role of synaptic loss and neuroinflammatory processes in the progression of cognitive decline (Ngoungoure et al., 2025).

In rodent models, fumonisins have been shown to disrupt the metabolism of sphingolipids, which play crucial roles in neuronal signaling and plasticity. Such disruptions may lead to irreversible damage to neuronal structures, exacerbating the development of neurological diseases (Hoxha et al., 2025). Notably, behavior changes observed in these models, including heightened anxiety and altered social behaviors, reflect a broader spectrum of neurobehavioral abnormalities linked to mycotoxin exposure.



Moreover, the integrity of the blood-brain barrier (BBB) plays a critical role in mediating the neurotoxic effects of mycotoxins. Compromised BBB integrity, as facilitated by mycotoxin-induced inflammation, permits the infiltration of neurotoxic agents and inflammatory mediators into the central nervous system, potentially catalyzing neurodegenerative processes. Research has demonstrated that alterations in the tight junctions of endothelial cells can occur following mycotoxin exposure, which may exacerbate neuroinflammatory responses and lead to neuronal cell death (Ngoungoure et al., 2025).

Behavioral studies on the effects of mycotoxin exposure reinforce these findings, illustrating how neurotoxicological mechanisms translate into observable changes in behavior. For instance, chronic exposure to ochratoxin A has been associated with decreased exploratory behavior, increased aggressive tendencies, and cognitive impairment in animal

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

models. Such behavioral alterations are consistent with the neurodegenerative pathways observed in humans, particularly in populations exposed to mycotoxins through contaminated food sources (Hoxha et al., 2025).

The implications of these findings extend beyond individual health, highlighting a pressing public health concern. The pervasive nature of mycotoxins in the environment, exacerbated by climate fluctuations, necessitates a reevaluation of food safety and public health policies. Increasing awareness of the link between mycotoxin exposure and neurodegenerative disorders could foster preventive strategies that mitigate the health impacts on vulnerable populations. Enhanced surveillance and monitoring of mycotoxin levels in food products, along with public education campaigns, may prove essential in reducing exposure risks and safeguarding neurological health within communities. As climate change continues to influence mycotoxin prevalence, the interplay between environmental factors, neurotoxicity, and public health outcomes warrants urgent attention from researchers and policymakers alike., Numerous studies have elucidated the heightened vulnerability of specific demographics, particularly children and the elderly, to the neurotoxic effects of mycotoxins. These populations are often subject to dietary exposures that can significantly elevate their risk of developing neurodegenerative conditions and associated behavioral changes. Children, especially infants, are at a critical stage of neurodevelopment, where perturbations due to environmental toxins can yield lasting impacts. The consumption of contaminated food—combined with their developing neurological systems—places them at a higher risk of adverse health outcomes.

The neurodevelopmental implications of mycotoxin exposure in younger populations have garnered increasing attention. Recent research conducted by Abia et al. (2026) provides pivotal insights into how dietary mycotoxins, such as aflatoxins and ochratoxins, correlate with notable variations in cognitive and behavioral development in children. The findings indicated a direct association between prenatal and early postnatal exposures to these mycotoxins and subsequent developmental delays, particularly in cognitive functions pertaining to memory and attention. It was observed that heightened levels of these toxins disrupted neurotransmitter systems, particularly those modulated by glutamate and dopamine, which are crucial for neural connectivity and functioning. As children grow, these disruptions can manifest in more severe neurodevelopmental disorders, thus amplifying public health concerns.

Moreover, the elderly population faces compounded risks due to pre-existing health conditions and age-related neurodegeneration. Nandi et al. (2025) emphasized that older adults with cognitive impairments are particularly susceptible to the adverse effects of mycotoxins, as exposure can exacerbate neurological decline. The degradation of the blood-brain barrier (BBB) integrity, exacerbated by mycotoxin presence, is a key mechanism through which cognitive functions can deteriorate. In individuals already facing neurodegenerative diseases such as Alzheimer's or Parkinson's, the resultant neuroinflammation triggered by mycotoxin exposure can lead to accelerated disease progression. Symptoms that were previously manageable may turn debilitating, thereby complicating treatment protocols and healthcare provisions.

The cumulative impact of mycotoxin exposure on these vulnerable populations underscores profound public health implications. The dietary sources of mycotoxins, often prevalent in areas experiencing climate stress, such as increased humidity and temperature, highlight the urgent need for effective monitoring and intervention strategies. Vulnerable populations, especially in low-resource settings, often lack access to safe food options, thereby increasing their risk of exposure. Initiatives aimed at educating families about the risks associated with mycotoxins, enhancing food safety regulations, and improving agricultural practices are critical. Additionally, policies designed to monitor mycotoxin levels

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

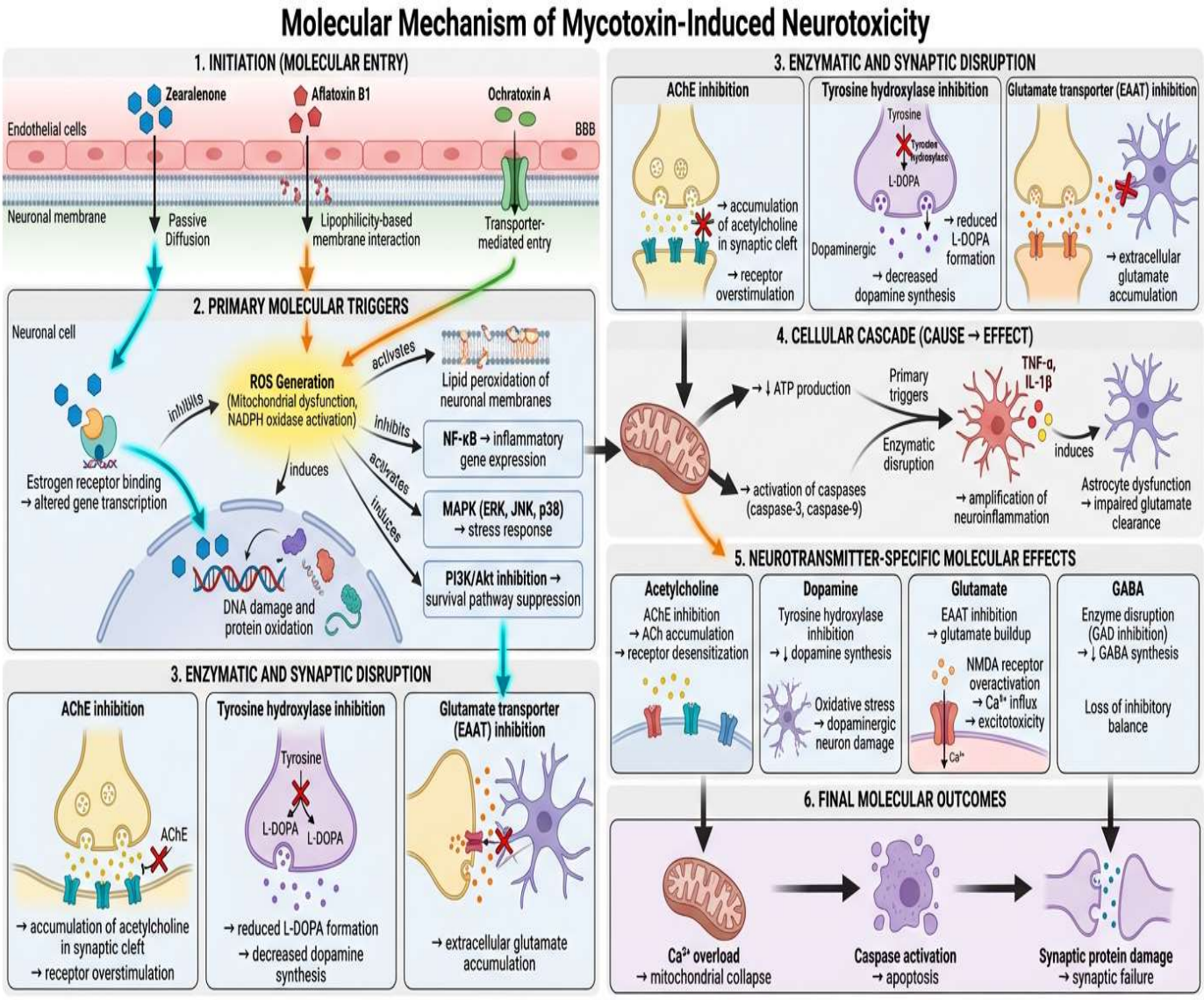
in food supplies, particularly for products marketed towards children and susceptible older adults, could serve as an essential step in public health advocacy.

The neurodevelopmental and neurodegenerative risks posed by climate-driven mycotoxin exposure are not merely local issues but potential global health crises. As climate change continues to influence agricultural practices and fungal proliferation, the imperative for targeted research and public health interventions has never been more urgent. Future studies must prioritize understanding the intricate relationships between mycotoxin exposure, susceptibility in vulnerable populations, and the cascading effects on community health to foster effective prevention strategies and safeguard at-risk groups., The emergence of climate-driven mycotoxin exposure has profound public health implications that warrant immediate attention and action. As climatic shifts continue to alter agricultural practices and food security, the prevalence of mycotoxins—including aflatoxins, ochratoxins, and trichothecenes—in consumable crops is expected to rise (Efremenko, 2026). These mycotoxins not only affect food quality and safety but also pose significant risks to human health, particularly concerning neurotoxicity and its downstream effects on neurological function and behavior.

A key concern lies in the disruption of neurotransmitter systems due to mycotoxin exposure. Many mycotoxins have demonstrated the ability to interfere with neurotransmitter synthesis, signaling, and receptor functions, contributing to neuroplasticity changes and neurodegeneration (Cousins et al., 2024). For instance, certain mycotoxins have been implicated in the dysregulation of serotonin and dopamine systems, which are critical for mood, cognition, and overall mental health (Nie et al., 2025). This growing body of evidence correlates the presence of mycotoxins with increased incidences of neuropsychiatric disorders, a trend that could lead to increased healthcare costs due to the treatment of such conditions. The direct and indirect expenses associated with neurodegenerative diseases, including Alzheimer's and Parkinson's, already impose significant financial burdens on healthcare systems. As mycotoxin-related neurotoxicity exacerbates this risk, the potential economic impact is alarming.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"



As such, proactive public health strategies must be developed and implemented to monitor mycotoxin levels and safeguard food supplies. Enhanced surveillance systems for mycotoxin detection in crops, particularly in regions experiencing climatic variability, are vital. Current methodologies are often inadequate for early detection, and increasing the precision of these monitoring efforts can significantly mitigate mycotoxin exposure to vulnerable populations (Efremenko, 2026).

Regulatory frameworks also need to be updated to address the shifting landscapes shaped by climate change. By establishing more stringent limits on permissible mycotoxin levels in food products, bolstered by comprehensive testing protocols, food safety can be effectively improved. Moreover, educating farmers and consumers about proper agricultural practices and storage techniques can substantially decrease the incidence of mycotoxin contamination, ensuring both food security and public health (Nie et al., 2025).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The intersection of climate change, agriculture, and health necessitates interdisciplinary approaches that include environmental science, public health policy, and community engagement. By investing in research initiatives aimed at understanding the effects of mycotoxins on human health, funding educational programs for risk reduction, and developing sustainable agricultural practices, public health frameworks can evolve to correctly address the implications of climate-driven mycotoxin exposure. These mitigation strategies must be regarded not merely as preventive measures but as fundamental components of public health infrastructure, essential for protecting vulnerable populations and minimizing future healthcare costs associated with neurodegenerative diseases. As the evidence surrounding the neurotoxic effects of mycotoxins grows, so too does the urgent need for comprehensive public health initiatives that prioritize monitoring and regulation., The interplay between climate change and the emergence of mycotoxins presents significant challenges for public health, particularly regarding neurotoxicity and its associated outcomes. The elucidation of the mechanisms through which climate-driven mycotoxin exposure disrupts neurotransmitter systems and undermines the integrity of the blood-brain barrier offers pivotal insights into the pathophysiological processes underlying neurodegeneration and resultant behavioral changes. As established, mycotoxins such as aflatoxin, ochratoxin, and fumonisin have demonstrated neurotoxic properties that can precipitate a cascade of neurodevelopmental and psychological disorders. These conditions arise from both direct and indirect effects on neurotransmission and neuroinflammation, which are exacerbated by climate factors such as increased humidity and temperature, conducive to mold proliferation and mycotoxin biosynthesis.

One of the prominent findings pertains to the modulation of neurotransmitter levels resulting from mycotoxin exposure. Alterations in key neurochemicals such as serotonin, dopamine, and gamma-aminobutyric acid (GABA) have been documented, leading to behavioral changes including anxiety, depression, and cognitive impairments. Furthermore, the compromised blood-brain barrier (BBB) integrity, as evidenced by a decrease in tight junction proteins and increased permeability, not only facilitates the entry of mycotoxins into the central nervous system (CNS) but also permits potentially neurotoxic metabolites and pro-inflammatory cytokines to traverse this vital protective barrier. The cumulative effect of these processes heightens the risk of neurodegenerative diseases, which represent a growing burden on health systems globally.

In addressing the public health implications of climate-driven mycotoxin exposure, it is imperative to recognize that these conditions disproportionately threaten vulnerable populations, including children, the elderly, and those with pre-existing neurological conditions. The rise in food insecurity and the globalization of food supply chains further compound these risks, as individuals may be exposed to mycotoxins without adequate knowledge or preparation to mitigate these hazards. While current guidelines and regulations on acceptable levels of mycotoxin exposure exist, they often fail to account for the dynamic and multifaceted nature of climate impact on mycotoxin production and exposure pathways.

Future research directions are vital in elucidating the intricate relationships between climate variability, mycotoxin prevalence, and neurotoxicity. Comprehensive longitudinal studies focusing on the synergistic effects of mycotoxins alongside other environmental stressors, such as heavy metals and pesticides, are essential for developing a holistic understanding of their cumulative impact on neurological health. Moreover, the exploration of biomarkers for early detection of mycotoxin exposure and consequent neurotoxic effects could significantly enhance public health surveillance and intervention strategies.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

From a policy perspective, it is crucial to advocate for enhanced regulatory frameworks that not only address laboratory standards for mycotoxins but also extend to farmer education and public awareness campaigns about safe agricultural practices under changing climate conditions. Integrating mycotoxin monitoring into existing health surveillance systems can provide critical data for addressing public health risks associated with these environmental toxins. Emphasizing interdisciplinary collaboration between public health, agriculture, and environmental science can foster innovative solutions aimed at reducing the impacts of mycotoxin exposure on neurological health. By prioritizing these initiatives, we can better safeguard cognitive health in the face of an evolving climate landscape.

Overall, the evidence reviewed underscores a pressing need for action and vigilance in combating the multifactorial public health challenges posed by climate-driven mycotoxin exposure.

Citations:

Nie, T., Li, J., You, L., & Wu, Q. (2025). Environmental mycotoxins: A potential etiological factor for neurodegenerative diseases?. Toxicology, 511, 154056. https://www.sciencedirect.com/science/article/pii/S0300483X25000125

Ehsanifar, M., Gholami, A., & Reiss, J. P. (2025). Mycotoxins Exposure: Neuroinflammation, Cognitive Decline and Behavioral Alteration. OBM Neurobiology, 9(4), 1-14. https://www.lidsen.com/journals/neurobiology/neurobiology-09-04-305

Abia, W. A., Foupouapouognigni, Y., Nfombouot, H. P. N., Ngoungoure, L. V. N., Ntungwe, E. N., Salah-Abbès, J. B., & Tchana, A. N. (2025). A scoping review on mycotoxin-induced neurotoxicity. Discover Toxicology, 2(1), 1. https://link.springer.com/article/10.1007/s44339-024-00013-7

Kuć-Szymanek, A., Kubik-Machura, D., Kościelecka, K., Męcik-Kronenberg, T., & Radko, L. (2025). Neurotoxicological effects of some mycotoxins on humans health and methods of neuroprotection. Toxins, 17(1), 24. https://www.mdpi.com/2072-6651/17/1/24

Efremenko, E. (2026). Food toxicants and brain health. In Nutritional Neuroscience (pp. 179-189). Academic Press. https://www.sciencedirect.com/science/chapter/edited-volume/pii/B9780443338410000191

Ehsanifar, M., Gholami, A., Pahnavar, N., Shenasi, R., & Golmohammadi, M. (2026). Exposure to Mycotoxins: Neurological Disorders and Psychiatric Manifestations. OBM Neurobiology, 10(1), 1-21. https://www.lidsen.com/journals/neurobiology/neurobiology-10-01-322

Ngoungoure, L. V. N., Abia, W. A., Owona, B. V. A., Foupouapouognigni, Y., Elombo, F. K., Nfombouot, H. P. N., ... & Moundipa, P. F. (2025). Neurodevelopmental Outcomes of Mycotoxins Exposure and Effect on Brain Development in Infants and Young Children. Developmental Neurobiology, 85(4), e23000. https://onlinelibrary.wiley.com/doi/abs/10.1002/dneu.23000

Abia, W. A., Ngoungoure, L. V. N., Owona, B. V. A., Foupouapouognigni, Y., Elombo, F. K., Nfombouot, H. P. N., ... & Moundipa, P. F. (2026). Dietary exposure to neurotoxic mycotoxins in Cameroon: Implications for brain development and neurodevelopmental disorders in children. The Neuroscience Chronicles, 5(1), 74-83.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

https://www.probiologists.com/article/dietary-exposure-to-neurotoxic-mycotoxins-in-cameroon-implications-for-brain-development-and-neurodevelopmental-disorders-in-children

Ramos, H., Araújo, A. M., Ferreira, I. M., & Faria, M. A. (2025). The Neurotoxic Impact of Food Chemical Contaminants: A Growing Concern?. Current Opinion in Food Science, 101369. https://www.sciencedirect.com/science/article/pii/S2214799325000992

García-Esparza, M. Á., Mateo, E. M., Robles, J. A., Capoferri, M., Jiménez, M., & Soria, J. M. (2025). Unveiling the Neurotoxic Effects of Ochratoxin A and Its Impact on Neuroinflammation. Toxins, 17(6), 264. https://www.mdpi.com/2072-6651/17/6/264

Del Fabbro, L., Sari, M. H. M., Ferreira, L. M., & Furian, A. F. (2024). Natural compounds mitigate mycotoxins-induced neurotoxicity by modulating oxidative tonus: in vitro and in vivo insights–a review. Food Additives & Contaminants: Part A, 41(4), 438-459. https://www.tandfonline.com/doi/abs/10.1080/19440049.2024.2316750

Hoxha, M., Abbasciano, M., Avantaggiato, G., Zappacosta, B., & Tricarico, D. (2025). Mycotoxins and neuropsychiatric symptoms: possible role in special refugee populations. Frontiers in Pharmacology, 16, 1524152. https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2025.1524152/full

Franco, G. A., Inferrera, F., Tranchida, N., Di Paola, D., Fusco, R., Cuzzocrea, S., & Gugliandolo, E. (2026). Environmental Mycotoxins and Brain Health: Protective Role of Bromelain Against Fumonisin B1 in SH-SY5Y Cells. Environmental Toxicology. https://onlinelibrary.wiley.com/doi/abs/10.1002/tox.70059

Ismail, N. M. M., Abdel-Wareth, M. T. A., & Sayed, S. S. M. (2025). Climate Change Impacts on Freshwater Toxins, and Its Health Effects. In Climate Change Impacts on Toxins and Health Effects (pp. 249-285). Singapore: Springer Nature Singapore. https://link.springer.com/chapter/10.1007/978-981-96-3416-3_9

Nehzomi, Z. S., & Shirani, K. (2025). Investigating the role of food pollutants in autism spectrum disorder: a comprehensive analysis of heavy metals, pesticides, and mycotoxins. Naunyn-Schmiedeberg's Archives of Pharmacology, 398(3), 2511-2533. https://link.springer.com/article/10.1007/s00210-024-03551-4

Nandi, P., Kanthal, J., Hansda, S., & Ghosh, S. (2025). Neurophysiological Implications of Food Safety: Food Born Pathogens and Its Neurological Impact. In Physiological Perspectives on Food Safety: Exploring the Intersection of Health and Nutrition (pp. 155-175). Cham: Springer Nature Switzerland. https://link.springer.com/chapter/10.1007/978-3-031-94582-3_5

Saghir, S. A., Bancroft, J., & Ansari, R. (2024). Molds and mycotoxins indoors I: Current issues and way forward. Archives of Clinical Toxicology, 7(1), 1-7. https://www.probiologists.com/abstract/molds-and-mycotoxins-indoors-i-current-issues-and-way-forward

Li, K., Wang, S., Qu, W., Ahmed, A. A., Enneb, W., Obeidat, M. D., ... & Cai, D. (2024). Natural products for Gut-X axis: pharmacology, toxicology and microbiology in mycotoxin-caused diseases. Frontiers in Pharmacology, 15, 1419844. https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2024.1419844/full

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Szentgyörgyi, V., Tagscherer-Micska, B., Rátkai, A., Schlett, K., Bencsik, N., & Tárnok, K. (2025). Cell Type-Specific Effects of Fusarium Mycotoxins on Primary Neurons and Astroglial Cells. Toxins, 17(8), 368. https://www.mdpi.com/2072-6651/17/8/368

Wang, Y., Wang, B., Wang, P., Hua, Z., Zhang, S., Wang, X., ... & Zhang, C. (2024). Review of neurotoxicity of T-2 toxin. Mycotoxin research, 40(1), 85-95. https://link.springer.com/article/10.1007/s12550-024-00518-5

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

CLIMATE CHANGE EFFECTS ON BIODIVERSITY ALONG THE EAST COASTAL LINE OF ANDHRA PRADESH

J Lavanya
Lecturer in Botany, Visakha GDC W (A) Visakhapatnam
lavanyabotany2025@gmail.com

TMA Niveditha
Lecturer in Botany, Visakha GDC W (A) Visakhapatnam

Abstract

Climate change is significantly impacting coastal ecosystems worldwide, with particularly severe consequences for biodiversity along the eastern coastline of Andhra Pradesh, India. This region, bordering the Bay of Bengal, is characterized by diverse ecosystems such as mangroves, estuaries, wetlands, lagoons, and sandy beaches. However, rising sea levels, increasing temperatures, ocean acidification, and intensified cyclonic events are accelerating habitat degradation and biodiversity loss. This paper examines the major climate change drivers affecting coastal biodiversity in Andhra Pradesh, evaluates their ecological and socioeconomic impacts, and explores adaptive and mitigation strategies. The study highlights that climate change, combined with anthropogenic pressures, poses a serious threat to the sustainability of coastal ecosystems in the region.

1. Introduction

Coastal ecosystems are among the most biologically productive environments, providing essential ecosystem services such as fisheries, storm protection, and carbon sequestration. The east coast of Andhra Pradesh spans approximately 974 km along the Bay of Bengal and supports rich biodiversity, including mangroves, marine fauna, migratory birds, and fisheries resources. However, climate change has emerged as a major threat to these ecosystems. Coastal Andhra Pradesh is increasingly vulnerable to **sea-level rise, cyclones, coastal erosion, and temperature changes**, all of which influence biodiversity patterns and ecosystem functioning.

2. Climate Change Drivers in Coastal Andhra Pradesh

2.1 Sea-Level Rise and Coastal Erosion

Sea-level rise is a critical concern along the Andhra Pradesh coastline. It leads to Submergence of low-lying coastal areas, Loss of mangroves and wetlands and Increased salinity in freshwater systems. Recent studies in Kakinada district show shoreline retreat between **604 m and 1016 m**, indicating severe erosion linked to sea-level rise and climate variability.

2.2 Increasing Cyclone Intensity

The Bay of Bengal is one of the most cyclone-prone regions globally. Climate change has intensified cyclone frequency and severity, causing Habitat destruction, mortality of marine and terrestrial species and Sedimentation and ecosystem disruption. Cyclone trends in Indian coastal states indicate a clear increase in extreme weather events affecting coastal biodiversity.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

2.3 Rising Temperature

Rising atmospheric and ocean temperatures affect Coral reef health, Fish breeding cycles and Plankton productivity. Temperature rise also alters species distribution, forcing organisms to migrate or adapt, often unsuccessfully.

2.4 Ocean Acidification

Increased atmospheric carbon dioxide (CO_2) is absorbed by ocean waters, leading to a process known as **ocean acidification**. This occurs when CO_2 reacts with seawater to form carbonic acid, which lowers the pH of the ocean and alters its chemical balance. As a result, the availability of carbonate ions—essential for marine organisms—is significantly reduced.

Ocean acidification has several critical impacts on marine biodiversity. First, it **weakens shell-forming organisms** such as mollusks, oysters, and some plankton species by reducing their ability to build and maintain calcium carbonate shells and skeletons. This makes them more vulnerable to predation and environmental stress.

Second, it **reduces coral growth** by impairing the calcification process required for reef formation. Coral reefs, which serve as vital habitats for numerous marine species, become more fragile and less capable of supporting biodiversity under acidic conditions.

Finally, ocean acidification **disrupts marine food chains**. Since many lower trophic organisms, such as plankton and shellfish, are directly affected, the impacts cascade through the food web, ultimately influencing fish populations and higher-level predators.

3. Coastal Biodiversity of Andhra Pradesh

The Andhra Pradesh coastline supports diverse ecosystems:

3.1 Mangroves

Mangroves are found in regions such as the Godavari and Krishna deltas along the east coast. They play a crucial role in protecting coastlines from erosion and storm surges. These ecosystems also serve as important nursery grounds for many fish and marine species. In addition, mangroves support rich bird biodiversity, including migratory species. However, climate change is reducing mangrove resilience and species diversity along India's eastern coastline.

3.2 Marine Ecosystems

Marine biodiversity includes fish, crustaceans, molluscs, and plankton, all of which are highly sensitive to environmental changes. Variations in temperature, salinity, and ocean chemistry significantly affect their survival, distribution, and ecosystem balance.

3.3 Wetlands and Lagoons

Wetlands like Kolleru Lake are important habitats for migratory birds and aquatic species. These ecosystems are highly sensitive to hydrological and climatic changes.

3.4 Coastal Flora and Fauna

Seaweed diversity along the Visakhapatnam coast has shown significant changes over decades due to climate variability and environmental stress.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

4. Impacts of Climate Change on Biodiversity

4.1 Habitat Loss and Fragmentation

Climate change is causing the destruction of mangroves and wetlands along coastal regions.
It also leads to the loss of critical nesting sites for many marine species.
Additionally, coastal land degradation is increasing due to rising sea levels and erosion.
These impacts are further intensified by urbanization and unsustainable human activities.

4.2 Decline in Species Diversity

Changes in environmental conditions lead to reduced species richness in coastal ecosystems.
They also cause the loss of endemic species that are unable to adapt to new conditions.
These shifts disrupt the ecological balance and functioning of ecosystems.
Food webs and species interactions are significantly affected as a result.
Mangrove species richness is projected to decline further under future climate scenarios.

4.3 Changes in Species Distribution

Species migrate in response to changes in temperature and salinity in coastal environments. This movement can lead to the introduction of invasive species and increased competition for resources. As a result, food webs are altered, affecting overall ecosystem stability.

4.4 Impact on Marine Life

Marine biodiversity is significantly affected by climate change in coastal ecosystems.
Coral bleaching is one of the major impacts, leading to the loss of reef habitats.
Fish populations are declining due to temperature stress and habitat changes.
There are also noticeable changes in plankton composition, which affect the marine food chain.
These disruptions influence the overall balance of marine ecosystems.
Seaweed studies further indicate long-term shifts in species composition due to climate change.

4.5 Impacts on Avian Biodiversity

Wetlands provide critical habitats for migratory birds, supporting their survival and reproduction. Climate change affects their migration patterns and reduces breeding success.
It also decreases habitat availability due to rising water levels and salinity changes.
These alterations directly impact bird populations and overall wetland biodiversity.

5. Socioeconomic Implications

Climate change impacts biodiversity and human communities simultaneously:

5.1 Fisheries and Livelihoods

Declining fish populations negatively impact the coastal economy by reducing income from fisheries. They threaten food security for communities dependent on seafood.
Additionally, they lead to loss of employment in fishing and related industries.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

5.2 Agriculture

Coastal agriculture is highly vulnerable to the impacts of climate change.
Salinity intrusion from rising sea levels affects soil quality and reduces crop productivity.
Changing rainfall patterns further disrupt planting and harvesting cycles.
These conditions lead to decreased agricultural yields and food insecurity.
Studies show that crops like rice in coastal Andhra Pradesh are increasingly threatened by climate variability.

5.3 Disaster Vulnerability

Frequent cyclones and flooding increase risks for coastal populations, particularly in rural communities.

6. Case Study: Kakinada Coastal Region

Kakinada district exemplifies the severe impacts of climate change along the Andhra Pradesh coast. The region is experiencing significant coastal erosion, threatening both land and habitats.
Vegetation cover has reduced by nearly 48%, further degrading ecosystems.
There is also a notable increase in high vulnerability zones along the coastline.
These environmental changes disrupt local biodiversity and reduce habitat availability.
As a result, the stability and resilience of ecosystems in Kakinada are directly affected.

7. Conservation and Adaptation Strategies

7.1 Mangrove Restoration

Reforestation of degraded mangrove areas helps restore coastal ecosystems and their ecological functions. It enhances shoreline protection and provides habitats for marine and bird species.
Protecting existing mangrove ecosystems prevents further degradation and biodiversity loss.
Together, these measures strengthen coastal resilience against climate change impacts.

7.2 Coastal Zone Management

The implementation of Coastal Regulation Zone (CRZ) policies helps manage and protect fragile coastal areas. These regulations limit harmful activities and promote conservation of coastal ecosystems. Sustainable land-use planning ensures that development does not degrade natural habitats. Together, these strategies support long-term ecological balance and resilience along the coast.

7.3 Marine Conservation

The establishment of Marine Protected Areas (MPAs) safeguards critical marine habitats and biodiversity. MPAs provide safe zones for breeding, feeding, and growth of marine species.
Regulation of fishing activities prevents overexploitation of fish populations and protects ecosystem balance. Together, these measures promote sustainable use and conservation of marine resources.

7.4 Climate Adaptation Strategies

Early warning systems for cyclones help coastal communities prepare and reduce loss of life and property. They provide timely alerts, allowing for evacuation and emergency response.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Disaster-resilient infrastructure strengthens buildings, roads, and coastal defences against extreme weather. Together, these measures enhance the safety and resilience of coastal populations facing climate impacts.

7.5 Community Participation

Involving local communities in conservation ensures active participation in protecting coastal ecosystems. It empowers residents to manage resources sustainably and make informed decisions. Promoting sustainable livelihoods reduces dependency on practices that degrade the environment. Community engagement also fosters awareness and stewardship of biodiversity.
A socio-ecological approach is therefore essential to enhance resilience in coastal Andhra Pradesh.

8. Conclusion

Climate change is profoundly affecting biodiversity along the east coastal line of Andhra Pradesh. Rising sea levels, increasing cyclone intensity, temperature changes, and ocean acidification are driving habitat loss, species decline, and ecosystem disruption. The combined effects of climate change and human activities exacerbate these impacts, making coastal ecosystems highly vulnerable.

Addressing these challenges requires integrated approaches that combine scientific research, policy interventions, and community participation. Conservation strategies such as mangrove restoration, sustainable fisheries management, and climate adaptation measures are essential for protecting biodiversity and ensuring long-term ecological sustainability.

References

1. Ahammed, K.K.B. & Pandey, A.C. (2019). Coastal vulnerability in Andhra Pradesh.
2. Kantamaneni et al. (2022). Cyclone trends in Indian coastal states.
3. Kantamaneni et al. (2020). Coastal agricultural vulnerability in Andhra Pradesh.
4. Mangrove resilience study (2025).
5. Coastal vulnerability study (Kakinada, 2025).
6. Dakey et al. (2023). Coastal resilience in Andhra Pradesh.
7. Sowjanya & Sekhar (2015). Seaweed diversity in Visakhapatnam.
8. IPCC (2021). Climate Change Report.
9. IPCC (2022). Impacts and Adaptation Report.
10. UNEP (2020). Coastal Ecosystem Assessment.
11. FAO (2021). Fisheries Report.
12. NOAA (2023). Sea-Level Rise Data.
13. NASA (2023). Climate Change Impacts on Oceans.
14. World Bank (2022). Coastal Vulnerability Assessment.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

15. WWF (2021). Marine Biodiversity Report.
16. National Centre for Coastal Research (NCCR) (2022). Indian coastline study.
17. Ministry of Environment, Forest and Climate Change (India) (2022). CRZ Report.
18. ICAR-CMFRI (2024). Marine biodiversity trends.
19. National Geographic Society (2022). Ocean acidification overview.
20. Andhra Pradesh State Biodiversity Board (2023). Biodiversity conservation report.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

ASSESSMENT AND IMPACTS OF CLIMATE CHANGE ON ENVIRONMENT AND BIODIVERSITY

[1]D.Rama Rao,[2]P.Sara,[3]V.Sanjeeva Kumar,[3]T.V.V.Satyanarayana,[4]N.Bujji Babu,[4]D.Rama Murthy.
[1]Department of Chemistry Govt Degree College Baruva Srikakulam, Andhra Pradesh
[2]Department of Botany Govt Degree College Ramachandrapuram
[3-4]Department of Chemistry P.R.Govt Degree College (A) Kakinada, **drraoprga@gmail.com**

Abstract:

Climatic change is a worldwide phenomenon that has significant environmental impacts. It refers to the long-term changes in temperature and weather due to human activities. Climate change is significantly altering ecosystems and poses a serious threat to biodiversity in all types of habitats. Increase in average global temperature and extreme and unpredictable weather are the most common indicates of climate change. In current years, it has acquired the importance of global emergency and affecting not only the wellbeing of people but also the sustainability of other lifeforms. Enormous increase in the emission of greenhouse gases in recent decades largely due to burning of coal and fossil fuels, and deforestation are the main drivers of climate change. Marked increase in the frequency and intensity of natural disasters, rise in sea level, decrease in crop productivity and loss of biodiversity are the main consequences of climate change. Obvious mitigation measures include significant reduction in the emission of greenhouse gases and increase in the forest cover of the landmass. This review research paper provides a comprehensive aspect of the environmental impacts of climatic effects and urbanization explores mitigation and adaptation strategies. This research study compiles existing research into climate impacts on biodiversity, explores adaptive conservation strategies from habitat restoration to climate-resilient protected areas, emphasizing global coordination. These findings indicate a need for integrated and science-driven efforts toward ecosystem resilience in the interests of natural system stability central to human and ecological health.

Keywords: Climatic, Environmental, Ecosystem,Biodiversity,Natural,Conservation.

Introduction:

Climate change refers to long-term changes in local, global or regional temperature and weather due to human activities. Now it has become a major threat to the wellbeing of humans and the sustainability of biodiversity. It has now acquired the importance of global emergency. According to the report of the latest Intergovernmental Panel for Climate Change (AR6 Climate Change[1].Climate change imposes extraordinary stress on global systems, driven by many natural and anthropogenic factors, including burning wood and fossil fuels, deforestation, and general industrial activities. Atmospheric CO2 has increased considerably, exceedingly more than 40% since the emergence of the Industrial Revolution. Climate change creates extreme environmental conditions and threats, which in turn cause acute and chronic morbidity premature and preventable human mortality in many areas globally. Climate change dictates many aspects of the human environment. It has imposed major threats worldwide, such as monstrous tropical storms, extreme heat waves and cold winter storms, droughts, wildfires, floods, and landslides. Much progress has been made in recognizing the importance of climate change research. Climate change is believed to be the most significant global health threat of the 21st century; human mortality in US cities is reportedly highest on extremely hot, humid summer days, but winter mortality rates are significantly higher than summer rates[2,3]. There have been no large-scale, systematic efforts to

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

quantify the heat-related human health impacts associated with climate change[4]. Consequently, climate change triggers many environmental hazards and extreme conditions that threaten human health and survival, potentially reaching the tipping point of collapse. Climate change's accumulative and compound effects on human mortality must be effectively, urgently monitored and communicated. The impact risks and damages of climate change are not evenly distributed, and the poorest countries will likely be affected strongest by rising climate-related disaster risks in a warmer world[5,6]. Natural disasters such as earthquakes and volcanic eruptions. Humans are both the agents of climate change and victims of adverse consequences due to the change. The spatial and temporal variations of human mortality communicate a broad dynamic imbalance of environmental sustainability related to climatic change

Effects of climate change

The impacts of climate change can be at multiple levels with different time frames. To better understand them, we further categorize and examine them as primary, secondary, and tertiary impact risks. The primary impacts of climate change directly led to abnormal environmental conditions such as sea level rises, intensified tropical storms, floods, extreme heat waves and wildfires, and cold winter storms. The estimated 100-year extreme sea-level event will become an annual (or more frequent) event by 2100, making the tropics more vulnerable[7]. The world will face substantial increases in the frequency of the most intense tropical cyclones, with intensity increases of 2–11% by 2100 and increases of 20% in the precipitation rate within 100 km of the storm center[8]. The storm surge inundation volume and extent are projected to increase over the century in the U.S., more notably along the Gulf Coast (Texas, Louisiana, Mississippi, and the West Coast of Florida), the Carolinas, and New Jersey[9]. Accelerated polar ice loss and sea level change are directly related to climate change, and it is reported that three-quarters of Arctic ice by volume has been lost in only 40 years, which provides more fuel for tropical storms and faster sea-level rise[10].

Anthropogenic Factors Anthropogenic or manmade factors result in short term climatic changes. It involves the changes in the energy balance of the Earth - atmosphere system leading to changes in weather and climate. Scientists have been observing a change in the climate since the beginning of the 20th Century that cannot be attributed to any of the 'natural' influences of the past. Global warming has occurred faster than any other climate they keep the average surface temperature on Earth around 14°C.

Emission of green-house gases

Steady increase in the emission of greenhouse gases (GHGs) due to human activities has been the primary driver for climate change. The principal greenhouse gases are carbon dioxide (76%), methane (16%), and to a limited extent nitrous oxide (2%). Accumulation of greenhouse gases combine with water vapour to form a transparent layer in the atmosphere that traps infrared radiation emitted from the Earth's surface and reradiates it back to Earth's surface, thus contributing to the increasing temperature. Rising ocean temperatures and acidification not only reduce their capacity to act as carbon sinks but also affect ocean ecosystems and the populations that relay on them. The main natural source of nitrous oxide released to the atmosphere (60%) comes from the activity of microbes on nitrogen-based organic material from uncultivated soil and waste water.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Land use change

Cutting down forests to create farmland led to changes in the amount of sunlight reflected from the ground back into space . About half of the land use changes are estimated to have occurred during the industrial era, much of it due to replacement of forests by agricultural cropping and grazing lands over Eurasia and North America. Limited deforestation in early part of human civilization was the result of subsistence farming; farmers used to cut down trees to grow crops for consumption of their families and local population. Last two decades and about half of this newly extended land has replaced forests and other ecosystems[11].In recent decades the demands on forest to grow plantation crops such as oil palm, coffee, tea and rubber, and for cattle ranching and mining have increased enormously thus reducing the forest cover[12].

Impacts of climate change

Increase in atmospheric temperature has serious consequences on biodiversity and ecosystems, and human wellbeing. The most important evidences of climate change is the long-term data available on the CO_2 levels, global temperature and weather patterns. Actual observations have shown that the models were consistent in predicting global warming in the years after publication[13].

Weather pattern and natural disasters

One of the obvious changes observed in recent years is the extreme and unpredictable weather, and an increase in the frequency and intensity of natural disasters. Now the weather pattern is changing almost every year and the farmers are suffering huge losses. Climate change related disasters have increased by a factor of five over the last 50 years. Global warming enhances the drying of organic matter in forests, thus increasing the risks of wildfires. They have become frequent in India also and a large number of them have been recorded in several states. In Australia, more than a billion native animals reported to have been killed during 2020 fires, and some species and ecosystems may never recover[14].

Sea level rise

Global warming is causing mean sea level to rise in two ways. On one hand, the melting of the glaciers, the polar ice cap and the Atlantic ice shelf are adding water to the ocean and on the other hand the volume of the ocean is expanding as the water warms. Precise data gathered from satellite radar measurements reveal an accelerating rise of 7.5 cm from 1993 to 2017, an average of 31 mm per decade[15].The Himalayan mountain range is considered to hold the world's third largest amount of glacier ice after Arctic and Antarctic regions. It is considered as Asian water tower[16]. These glaciers are melting at unprecedented rates[17]. This loss is likely to increase in the coming years due to further warming. In another study, tenfold acceleration in ice loss was observed across the Himalayas than the average rate in recent decades over the past centuries[18]. Melting of glaciers also results in drying up of perennial rivers in summer leading to the water scarcity for billions of humans and animals, and food and energy production downstream.

Air Pollution effects

Air pollution is considered as the major environmental risk of climate change due to its impact on public health causing increasing morbidity and mortality[19]. Particulate matter, carbon monoxide, nitrogen oxide, and Sulphur dioxide are the major air pollutants. They cause respiratory problems such as asthma and bronchiolitis and lung cancer. Recent studies have indicated that exposure to air pollution is linked to methylation of immunoregulatory genes, altered immune cell profiles and increased blood pressure in children[20].

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Biodiversity changes

Biodiversity and associated ecoservices are the basic requirements for human livelihood and for maintenance of ecological balance in Nature. It is difficult to analyses the loss of biodiversity exclusively due to climate change as other human-induced environmental changes such as habitat loss and degradation, overexploitation of bioresources and introduction of alien species also interact with climate change and affect biodiversity and ecosystems[21.] explored potential disruption of pollination services due to climate change during the last decade showed a steeper advance than those of plants[22]. Such asynchrony could affect the sustenance of plant and/or pollinator species in the new environment.

Conclusions

Climate change has now become the fastest growing global threat to human welfare. The world has realized the responsibility of the present generation as it is considered to be the last generation capable of taking effective measures to reverse its impact. India is one amongst the nine countries identified to be seriously affected by climate change. According to a WHO analysis[23] India could face more than 25% of all global climate-related deaths by 2050 due to decreasing food availability. China is expected to face the highest number of per capita food insecurity deaths. At present it is too expensive and this approach may have to wait until improvement of the technology, reduction in the cost and feasibility of transfer of the technology to developing countries[24]. This has to be kept in mind in reforestation programmes. Hopefully the world will be able to realize the goal of limiting the temperature rise to 1.5 °C by the end of the century and humanity would learn to live in harmony with Nature. Climate change is an unparalleled threat to global biodiversity through altering ecosystems and putting innumerable species at risk. This review highlighted the significant impacts of rising temperatures, extreme weather events, ocean acidification, and changes in habitat that collectively threaten the survival of species and compromise ecosystem services essential for human well-being, such as food security, water purification, and climate regulation. These challenges require multiple approaches: habitat restoration, expansion of protected areas, better land management, and reduction of greenhouse gas emissions[25-27].

Rapid urban expansion, economic development, and land transformation have strongly and negatively contributed to climate change and environmental sustainability. Consequently, human health and human mortality are affected by acute primary and prolonged accumulative, compound secondary, and tertiary environmental risk factors due to climate change. Climate change stems from the changes of major climate forcing and dynamic energy flow between earth and atmosphere systems. It is promising to use an ecosystem-based adaptation strategy, including the conservation, restoration, and sustainable management of ecosystems, ecosystem processes, and biodiversity, to address the impacts of climate change[28]. Humans must change our behavior in the near term to mitigate the overall effects of climate change in the long run, and policymakers need to develop environmental policies to motivate and foster individual behavioral change[29]. Communicating climate change and its impacts on human mortality beyond the science community is important to promote global policies and actions for overall global climate adaptation, resilience, and sustainable economic development.Global initiatives, such as the Paris Agreement, and conservation frameworks, like the Convention on Biological Diversity, are very important in mobilizing international efforts. Furthermore, these Indigenous community involvement, advanced technologies, and innovative conservation practices. Predictive models will be used, interdisciplinary research will be promoted, and future collaborative conservation strategies will be fostered to protect biodiversity[30-31].

References:

1. AR6 Climate Change: The sixth assessment report on climate change. IPCC, Geneva (2021). https://www.ipcc.ch/report/ar6/wg1/[Ref list]
2. Davis, R.E.; Knappenberger, P.C.; Michaels, P.J.; Novicoff, W.M. Seasonality of climate-human mortality relationships in US cities and impacts of climate change. Clim. Res. **2004**, 26, 61–76.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

[CrossRef]

3. Mitchell, D.; Heaviside, C.; Vardoulakis, S.; Huntingford, C.; Masato, G.; Guillod, B.P.; Frumhoff, P.; Bowery, A.; Wallom, D.;Allen, M. Attributing human mortality during extreme heat waves to anthropogenic climate change. Environ. Res. Lett. **2016**, 11, 074006. [CrossRef]
4. Vicedo-Cabrera, A.M.; Scovronick, N.; Sera, F.; Royé, D.; Schneider, R.; Tobias, A.; Astrom, C.; Honda, Y.; Hondula, D.M.;Abrutzky, R.; et al. The burden of heat-related mortality attributable to recent human-induced climate change. Nat. Clim. Change **2021**, 11, 492–500. [CrossRef]
5. Formetta, G.; Feyen, L. Empirical evidence of declining global vulnerability to climate-related hazards. Glob. Environ. Change **2019**, 57, 101920. [CrossRef]
6. Harrington, L.J.; Frame, D.; King, A.D.; Otto, F.E.L. How uneven are changes to impact-relevant climate hazards in a 1.5 _C world and beyond? Geophys. Res. Lett. **2018**, 45, 6672–6680. [CrossRef]
7. Tebaldi, C.; Ranasinghe, R.; Vousdoukas, M.; Rasmussen, D.J.; Vega-Westhoff, B.; Kirezci, E.; Kopp, R.E.; Sriver, R.; Mentaschi, L.Extreme sea levels at different global warming levels. Nat. Clim. Change 2021, 11, 746–751. [CrossRef]
8. Knutson, T.R.; McBride, J.L.; Chan, J.; Emanuel, K.; Holland, G.; Landsea, C.; Held, I.; Kossin, J.P.; Srivastava, A.K.; Sugi, M.Tropical cyclones and climate change. Nat. Geosci. 2010, 3, 157–163. [CrossRef]
9. Camelo, J.; Mayo, T.L.; Gutmann, E.D. Projected Climate Change Impacts on Hurricane Storm Surge Inundation in the Coastal United States. Front. Built Environ. 2020, 6, 588049. [CrossRef]
10. Francis, J. Arctic meltdown and unruly tropical storms: Are they connected? Arct. Antarct. Alp. Res. 2021, 53, 223–224. [CrossRef]
11. Potapov P, Turubanova S, Hansen MC, et al. Global maps of cropland extent and change show accelerated cropland expansion in the twenty-first century. Nat. Food. 2021 doi: 10.1038/s43016-021-00429-z. [DOI] [PubMed] [Google Scholar][Ref list]
12. Pacheco P, Mo K, Dudley N, et al. Deforestation fronts: drivers and responses in a changing world. Gland: WWF; 2021. [Google Scholar][Ref list]
13. Hausfather Z, Drake HF, Abbott T, Schmidt GA. Evaluating the performance of past climate model projections. Geophys. Res. Lett. 2019 doi: 10.1029/2019GL085378. [DOI] [Google Scholar][Ref list]
14. OXFAM International: 5 natural disasters that beg for climate action.(2021) https://www.oxfam.org/en/5-natural-disasters-beg-climate-action[Ref list]
15. WCRP Global Sea Level Budget Group Global sea-level budget 1993–present. Earth Syst. Sci. Data. 2018;10:1551–1590. doi: 10.5194/essd-10-1551-2018. [DOI] [Google Scholar][Ref list]
16. Immerzeel WW, Lutz AF, Andrade M, et al. Importance and vulnerability of the world's water towers. Nature. 2020;577:364–369. doi: 10.1038/s41586-019-1822-y. [DOI] [PubMed] [Google Scholar][Ref list]
17. King O, Bhattacharya A, Ghuffar S, Tait A, et al. Six decades of glacier mass changes around Mt. Everest are revealed by historical and contemporary Images. One Earth. 2021 doi: 10.1016/j.oneear.2020.10.019. [DOI] [Google Scholar][Ref list]
18. Lee E, Carrivick JL, Quincey DJ, et al. Accelerated mass loss of Himalayan glaciers since the little ice age. Sci. Rep. 2021;11:24284. doi: 10.1038/s41598-021-03805-8. [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
19. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and health impacts of air pollution: a review. Front. Public Health. 2020 doi: 10.3389/fpubh.2020.00014. [DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

20. Pruniki M, Cauwenberghs N, Lee J, et al. Air pollution exposure is linked with methylation of immunoregulatory genes, altered immune cell profiles, and increased blood pressure in children. Sci. Rep. 2021;11:4067. doi: 10.1038/s41598-021-83577-[DOI] [PMC free article] [PubMed] [Google Scholar][Ref list]
21. Memmott J, Craze PE, Waser NM, Price MV. Global warming and disruption of plant-pollinator interactions. Ecol. Lett. 2007;10:710–717. doi: 10.1111/j.1461-0248.2007.01061.x. [DOI] [PubMed] [Google Scholar][Ref list]
22. Gordo O, Sanz JJ. Phenology and climate change: a long-term study in a Mediterranean locality. Oecologia. 2005;146:484–495. doi: 10.1007/s00442-005-0240-z. [DOI] [PubMed] [Google Scholar][Ref list.
23. WHO analysis . Monitoring health for the sustainable development goals. Geneva: WHO; 2016. World Health Statistics 2016. [Google Scholar][Ref list]
24. IPCC: IPCC special report on carbon dioxide capture and storage(2005). https://www.ipcc.ch›2018/03›srccs_wholereport-1 [DOI] [PubMed][Ref list]
25. Haddad NM, Brudvig LA, Clobert J, Davies KF, Gonzalez A, Lovejoy TE, et al. Habitat fragmentation and its lasting impact on earth's ecosystems. Sci Adv. 2023;1(2):e1500052. Available from: https://www.science.org/doi/full/10.1126/ sciadv.1500052
26. Davis SM, et al. Everglades restoration: The largest wetland restoration project in the world. Ecol Eng. 2023;65:5–16. Available from: https://www.sciencedirect.com/science/article/pii/ S0925857414002651
27. Convention on Biological Diversity (CBD). Post-2020 Global Biodiversity Framework. CBD. 2023. Available from: https://www. cbd.int/conferences/post2020
28. Donatti, C.I.; Harvey, C.A.; Hole, D.; Panfil, S.N.; Schurman, H. Indicators to measure the climate change adaptation outcomes of ecosystem-based adaptation. Clim. Change 2020, 158, 413–433. [CrossRef]
29. Moser, S.C. Communicating Climate Change Adaptation and Resilience. In Oxford Research Encyclopedia of Climate Science; Oxford University Press: Oxford, UK, 2017.Environments 2023, 10, 165 12 of 12
30. Honey M. Ecotourism and Sustainable Development: Who Owns Paradise? Island Press. 2023. Available from: https://islandpress. org/books/ecotourism-and-sustainable-development
31. Post E, Forchhammer MC, Bret-Harte MS, Callaghan TV, Christensen TR, Elberling B, et al. Ecological dynamics across the Arctic associated with recent climate change. Science. 2023;325(5946):1355–8. Available from: https://www.science. org/doi/10.1126/science.1173113

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

CLIMATE CHANGE AND BIODIVERSITY HOTSPOTS: LIFELINES FOR GLOBAL CONSERVATION IN A CHANGING WORLD

Smt. G.R.N.S.Sujatha
Lecturer in Botany Dr. V.S. Krishna Govt. Degree college (A) Visakhapatnam
Dr. P. Swamy Naidu
Lecturer in Botany Dr. V.S. Krishna Govt. Degree college (A) Visakhapatnam
Dr. Dabdugula Madhu Sudhakar
Lecturer in Botany Government Degree college for Men Cluster University Kurnool
Smt.Gujarathi Charvitha
Scholar in Botany Cluster University Kurnool
Peetla Sravanthi
Scholar in Botany Silver Jubilee Government College Kurnool

Abstract

"Hotspots: Small Areas, Big Impact on Earth's Biodiversity" Several of the twenty-first century's primary issues are biodiversity preservation and climate change. According to current global climate models, climate-related events will continue to become more frequent and intense, which will have detrimental effects on ecosystems, especially plant variety. Significant and frequently irreversible declines in biodiversity are occurring in sensitive areas like coral reefs, arctic regions, tropical forests, and alpine ecosystems. Ecological interactions such as pollination, predation, and competition are being impacted by changes in phenology, migration patterns, and reproductive cycles, which have cascading effects across food webs. Additionally, the introduction of alien species and habitat fragmentation brought on by climate change are making native flora and wildlife more vulnerable. The conservation planning concepts of irreplaceable nature and vulnerability serve as the foundation for the biodiversity hotspots' actions. Here, we review how the hotspots have evolved over the previous years. In order to maintain their essential function as the home of a significant portion of the world's biodiversity and as the ultimate supplier of several ecosystem services including clean air, food, medicine, and natural beauty, we then go into previous and future conservation efforts. Biodiversity is essential to the survival of all living forms on Earth, including humans

Conservation is a state of harmony between men and land." — Aldo Leopold

Key words: Global climate models, Biodiversity preservation, Phenology, Biodiversity hotspots

Introduction

As per long-term statistics for the meteorological components in a particular region, climate is defined as the average weather conditions [Pawson, S., Steinbrecht]. With far-reaching effects that go beyond simple temperature increases, climate change has emerged as one of the most urgent global environmental issues of the twenty-first century. The Earth's climatic systems have significantly changed as a result of the unparalleled increase in greenhouse gas emissions, especially carbon dioxide, methane, and nitrous oxide.& natural and man-made conditions such ozone layer depletion, [Kotir, J. H. (2011).]The main causes of this situation include industrial operations, deforestation, unsustainable farming methods, and excessive fossil fuel consumption [Muluneh, M. G. (2021]

On the basis of Kahraman et al. (2012), biodiversity encompasses all levels of life diversity, including those within and between species as well as habitat variability. Article 2 of the Convention on Biological Diversity contains the most commonly used definition of biodiversity, which was developed during the United Nations Conference on Environment and Development in Rio de Janeiro on June 5, 1992. The convention states that "biological diversity means the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

complexes of which they are part; this includes diversity within species, between species, and of ecosystems". The literal meaning of biological diversity, also known as biodiversity, is the "changeability between existing creatures from all bases counting, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological multiplexes of which they are part; this comprises variety in species, between species, and of ecosystems."

Impact of climate change on wildlife biodiversity :

Climate change is projected to have an impact on community formation, ecosystem structure and function, and the size and composition of organism populations (Diaz et al., 2019). The distribution of plant species, invertebrates, and vertebrates in both aquatic and terrestrial habitats has changed as a result of climate change (Gilg et al., 2017). Heat stress and global warming One of the main causes of global warming is human-induced greenhouse gas pollution from the widespread combustion of fossil fuels during the industrial revolution, which has raised the Earth's surface temperature by 0.6°C over the past century (Walther et al., 2002) Apart from contributing to being a significant impact on a species' behavior, physiology, growth, reproduction, and survival, atmospheric temperature also has a broader impact on species dispersal, speciation, and evolution (Elmore et al., 2017).

Sea level is rising more quickly as a result of global warming's thermal expansion of ocean waters and melting of polar ice sheets and glaciers. Sea levels have risen from 1 to 2 mm annually over the past century to 3 to 4 mm annually currently (IPCC, 2019). Sea levels are rising as a result of global warming.

Impact of Rising Temperatures on Species Distribution

Significant variations in global temperature patterns brought about by climate change have resulted in major changes in the distribution of organisms in a variety of ecosystems. Many species are compelled to migrate toward higher latitudes or altitudes in quest of appropriate habitats when temperatures rise. Established ecological communities are disturbed by this migration, which frequently results in competition with local species in new areas. For example, as alpine and polar species are driven nearer mountaintops or polar extremities where resources and space are few, their habitable zones are getting smaller. These changes impact not only the survival of individual species but also the dynamics of ecosystems, pollination networks, and predator-prey relationships. Some species cannot migrate or adjust to the changing temperatures fast enough, which leads to population decreases or extinction. Particularly vulnerable are plants, amphibians, and other less mobile organisms. Further ecological imbalance may result from the inability to relocate, which might interfere with feeding patterns and reproductive cycles.

Climate Change Factor	Direct Environmental Change	Impact on Biodiversity
Temperature increase	Warmer air and water	Range shifts; altered phenology; disrupted species interactions
Precipitation changes	Altered rainfall patterns	Changes in community composition; reduced stream flow; stress on freshwater species
Extreme events	More floods, droughts, heat waves, cold waves	Mortality; habitat damage; population decline
Hydrologic changes	Modified water cycles and flow regimes	Reduced population persistence; altered aquatic ecosystems

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Ocean acidification	Lower pH levels in oceans	Reduced calcification in corals and shell-forming organisms
Sea level rise	Coastal inundation	Habitat loss and fragmentation; decline in coastal species
Ocean stratification	Reduced mixing of ocean layers	Lower nutrient availability; reduced pelagic productivity
Coastal upwelling changes	Altered nutrient supply to surface waters	Changes in fisheries and coastal ecosystem productivity
Combined ecosystem effects	Multiple interacting changes	Shifts in community structure; ecosystem

Biodiversity vulnerability to climate change

In accordance with Williams et al. (2008) and Glick et al. (2011), the character, magnitude, and rate of changes that a species or system experiences (exposure), the degree to which they are, or are likely to be, affected by or responsive to those changes (sensitivity), and the capacity to adapt to impacts with the least amount of disruption determine how vulnerable biodiversity is. Numerous anthropogenic stressors, such as altered land use, invasive non-native species, exploitation, pollution, and disease, affect biodiversity. The main causes of biodiversity loss are frequently other stressors, either now or in the future (Flather et al., 1997, Wilcove et al., 1998 As stated by with Brook et al. (2008), it is projected that in the upcoming decades, the effects of climate change would become more widespread and dominating, interacting with current stressors to increase biodiversity's vulnerability. Thus, it is imperative to conduct a thorough inventory and catalogue the nation's biological variety before it is irreversibly lost.

with Brook et al. (2008), it is projected that in the upcoming decades, the effects of climate change would become more widespread and dominating, interacting with current stressors to increase biodiversity's vulnerability. Thus, it is imperative to conduct a thorough inventory and catalogue the nation's biological variety before it is irreversibly lost.

International approach on climate change

United Nations climate change conference: In November, 2015 United Nations Climate Change Conference, COP 21 was held in Paris, France. First time in the conference, it was concluded to meet their objective i.e. a global agreement on reduction of climate change in the Paris, which was adopted with acclamation by nearly all states.

Intergovernmental panel on climate change (IPCC): The intergovernmental panel on climate change is a dedicated body jointly established by the World Meteorological Organisation and the **United Nations Environmental Programme** (UNEP) has been assigned to prepare comprehensive document on scientific assessments of various aspects of climate change.

The United nations' framework convention on climate change (UNFCCC): The UNFCCC came in existence on 21 March 1994. The Rio Convention was adopted by UNFCCC at the Rio Earth Summit in 1992. The prime goal of the convention was to make stable the concentrations of greenhouse gas at a level that would prevent dangerous man made interference with the climate system.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The Kyoto protocol: A commitment by the parties for setting the internationally binding on emission reduction targets was made under the Kyoto Protocol which was linked to the United Nations Framework Convention on Climate Change and it was adopted in Kyoto, Japan, in December 1997 and come into force in February 2005.

The Bali road map: At 13th conference of the parties (3rd meeting) the Bali Road Map was adopted in December 2007 in Bali. This Map includes the Bali Action Plan, which plans the course for a new negotiating process designed to handle climate change.

National environment policy: An essential element of India's response to climate change has been out-lined in National Environment Policy (2006). These, interalia, include observance to principle of common but differentiated responsibility and respective capabilities of different countries, identification of key liabilities of India to climate change, in particular impacts on forests, coastal zones, agriculture, water resource and health, assessment of the need for adaptation to cli-mate change and inspiration to the industry to join in the CDM (Clean Development Mechanism)

Conclusion : encouraging the proper and efficient coordination of climate change and biodiversity initiatives in India by integrating eco-friendly environmental policies and integrating climate change and biodiversity into national plans and programs. Creating policies and guidelines for biodiversity and climate change will lessen local people' susceptibility to its effects and increase their adaptability to it. In order to integrate ecosystem protection with rural development, the public must be involved because their needs depend on a certain environment. Determine which major sectors of the nation are most at risk from climate change, with a focus on the effects on water resources, agriculture, health, coastal regions, and forests. Assist research to provide methods for tracking and assessing how climate change is affecting glaciers, river flows, and biodiversity.

References

1. Kahraman, A., Onder, M., & Ceyhan, E. (2012). The importance of bioconservation and biodiversity in Turkey. *International Journal of Bioscience, Biochemistry and Bioinformatics*, *2*(2), 95.
2. Muluneh, M. G. (2021). Impact of climate change on biodiversity and food security: a global perspective—a review article. *Agriculture & Food Security*, *10*(1), 36.
3. Pawson, S., Steinbrecht, W., Charlton-Perez, A., Fujiwara, M., Karpechko, A. Y., Petropavlovskikh, I., ... & Weber, M. (2014). Update on global ozone: past, present and future.
4. Kotir, J. H. (2011). Climate change and variability in Sub-Saharan Africa: a review of current and future trends and impacts on agriculture and food security. *Environment, Development and Sustainability*, *13*(3), 587-605.
5. Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Agard, J., Arneth, A., ... & Zayas, C. N. (2019). Pervasive human-driven decline of life on Earth points to the need for transformative change. *Science*, *366*(6471), eaax3100.
6. Gilg, O., Kovacs, K. M., Aars, J., Fort, J., Gauthier, G., Grémillet, D., ... & Bollache, L. (2012). Climate change and the ecology and evolution of Arctic vertebrates. *Annals of the New York Academy of Sciences*, *1249*(1), 166-190.
7. Walther, G. R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T. J., ... & Bairlein, F. (2002). Ecological responses to recent climate change. *Nature*, *416*(6879), 389-395.
8. Singh, J. S. (2015). Biodiversity: current perspective. *Clim Change Environ Sustain*, *3*(1), 71-72.
9. Williams, S. E., Shoo, L. P., Isaac, J. L., Hoffmann, A. A., & Langham, G. (2008). Towards an integrated framework for assessing the vulnerability of species to climate change. *PLoS biology*, *6*(12), e325.
10. Wilcove, D. S., Rothstein, D., Dubow, J., Phillips, A., & Losos, E. (1998). Quantifying threats to imperiled species in the United States. *BioScience*, *48*(8), 607-615.
11. Brook, B. W., Sodhi, N. S., & Bradshaw, C. J. (2008). Synergies among extinction drivers under global change. *Trends in ecology & evolution*, *23*(8), 453-460.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

ENVIRONMENTAL POLLUTION AND ITS IMPACT ON MANGROVE BIODIVERSITY WITH SPECIAL REFERENCE TO CORINGA MANGROVE ECOSYSTEM, ANDHRA PRADESH, INDIA – A REVIEW

Madhavi Somu*
* Lecturer in Zoology, ASD Government Degree College(W)(A), Kakinada, Andhra Pradesh, India
E-mail Id: somumadhavi333@gmail.com

Abstract

Mangrove ecosystems are highly productive coastal wetlands that play a vital role in maintaining ecological balance, protecting shorelines, and supporting rich biodiversity. However, increasing environmental pollution due to industrialization, aquaculture, agricultural runoff, and domestic sewage has become a major threat to mangrove ecosystems worldwide. The Coringa mangrove ecosystem located in the Godavari estuary of Andhra Pradesh, India, is one of the largest mangrove habitats in the country and is exposed to various anthropogenic stresses. The present review focuses on the impact of environmental pollution on mangrove biodiversity with special reference to Coringa mangroves. Changes in physico-chemical parameters of water, heavy metal accumulation in sediments and plants, seasonal variation in salinity and nutrients, and decline in floral and faunal diversity have been discussed using available research data from the Coringa estuary. Studies indicate that increased levels of ammonia, hardness, heavy metals, and organic pollutants have resulted in deterioration of water quality and reduction in biodiversity, particularly affecting molluscs, fish, and mangrove vegetation. Anthropogenic activities such as aquaculture expansion, industrial discharge from nearby coastal areas, and agricultural runoff are the major sources of pollution in this region. Although mangroves possess natural tolerance to environmental stress, excessive pollution may exceed their capacity and lead to long-term ecological damage. Proper monitoring, pollution control measures, and conservation strategies are essential for the sustainable management of the Coringa mangrove ecosystem. This review highlights the need for continuous ecological assessment to protect mangrove biodiversity from increasing environmental pollution.

Keywords: Mangroves, Environmental Pollution, Coringa Mangroves, Biodiversity, Flora, Fauna, Heavy metals, Water quality, Godavari estuary, Bioaccumulation, Coastal ecosystem

Introduction

Mangroves are rare, spectacular and prolific ecosystems on the earth as a boundary between land and sea. Mangroves are salt-tolerant plants growing in intertidal coastal regions and provide important ecological functions such as shoreline protection, nutrient cycling, and habitat for aquatic organisms [Alongi, D.M., 2008]. Mangrove ecosystems act as natural filters by trapping sediments and pollutants, but excessive pollution disturbs the ecological balance [Tam, N.F.Y. & Wong, Y.S., 2000]. These are contributing to the well-being, food security and protection of coastal communities on worldwide. They support a rich biodiversity and provide a valuable nursery habitat for fish and crustaceans. They also protect coastal area from storm surges, tsunamis, raising of sea level and erosion. Their soils act as an effective carbon sink (Audrey Azoulay, Director General, UNESCO -2021).
Mangrove forests are considered as one of the rich ecological resources consists of salt tolerant plants and aquatic Fauna species of inter tidal zones of tropical and subtropical regions. These forests are least concerned and often over utilized for the development of human communities in the process of housing, aquaculture, agriculture practices. This results in gradual change of ecology of mangrove forests into traditional dependency of the fishing communities (M. Haritha et.al, 2017)

In India, mangroves are distributed at selected locations along the east and west coasts in the mainland and in the islands of Andaman and Nicobar. In the mainland, the mangroves are relatively well developed in the east coast than in the west coast (Prof A.V Raman et.al., 2001) India represents 2.5% of the worlds landmass and supports a population of over 1.2 billion

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

people. India is also one of 17 mega biodiversity countries in the world, with 7.8% of the recorded species of the World, including 45,500 plants species and 91,000 animal species (Sivakumar, et. al, 2012). India has a vast coastline of 7,517 km, of which, 5,423 km belongs to peninsular India and 2,094 km to the Andaman, Nicobar and Lakshadweep Islands, with an EEZ of 2.02 million sq. km. This coastline also supports a huge human population that is dependent on the rich coastal and marine resources. It is estimated that nearly 250 million people live within 50 km of the coastline of India (Sivakumar, et. al, 2012). Therefore, the ecological services of the marine and coastal ecosystems of Indi a play a vital role in India's economic growth. (Prof A.V Raman et.al., 2001)

In order to assess the status and suggest suitable management plan for protection of mangroves, coral reefs, etc., the Department of Ocean Development (DOD) has initiated an activity namely, "Development of a Critical Habitat Information System (CHI S)" using modern tools like GI S, RDBMS, remote sensing, etc. DOD has established an Integrated Coastal and Marine Area Management Project Directorate at the National Institute of Ocean Technology (NIOT) campus in Chennai to implement this programme (Prof A.V Raman et.al., 2001)

Coringa WildLife Sanctuary

Coringa Wildlife Sanctuary is located 20 km south of the port city Kakinada, on the Kakinada-Yanam state highway, nestling on the deltaic branches of Gouthami and Godavari rivers at Kakinada Bay. It has extensive marshes and mangroves. During monsoon, the mudflats get submerged under 5 m of water. These large mudflats, which are subjected to cyclic influx and efflux of tidal water, play a vital role in attracting a large number of waders to this region. About 50% of the area is the backwaters which include a sand bar of about 20 km, running north-south (Rao et.al., 1996). Two rivers, namely the Coringa and Gaderu, and their deltaic branches intersect the entire region, along with other water channels draining into them or directly into the sea. This forms about 33,570 ha of marsh vegetation.

Coringa Wildlife Sanctuary

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The Coringa mangrove ecosystem located in East Godavari district of Andhra Pradesh is the third largest mangrove forest in India and supports rich biodiversity, including mangrove plants, fish, birds, molluscs, and mammals [Satyanarayana, B et.al., 2012].The Sanctuary is part of the estuary of River Godavari, and supports a rich growth of mangrove vegetation with halophytes such as Excoecaria agallocha, Rhizophora mucronata, Avicennia officinalis, Lumnitzeria racemosa, Ceriops decandra, Sonneratia apetala and Aegiceras corniculatus. According to Raja Sekhar et al. (2002), 24 species are representative of the vegetation structure of Godavari Estuary (Sivakumar, et. al, 2012). The Godavari Delta, like many other deltaic systems in India, has been highly altered by human activities. Causes for the degradation of estuarine ecosystem include conversion of mangroves to aquaculture, agriculture and salt pans; effluent discharge from industries; eutrophication; siltation of Kakinada Bay and its rivers; anthropogenically induced river flow change and erosion; seasonal hydrological changes and overexploitation of mangrove forests by villagers for cattle grazing, fuel wood and boat manufacture. It is estimated that 30−40% of the degradation of mangrove forests has taken place in the last decade due to agriculture, aquaculture and deforestation, and oil and pesticide pollution. The CWLS and other areas in the Godavari River Estuarine Region have been subjected to heavy cattle grazing, fuel wood collection, etc., resulting in large scale depletion of mangrove forests (Prof A.V Raman et.al., 2001).

The direct drivers of ecosystem degradation in the EGREE are (i) habitat alteration and destruction, (ii) overexploitation and consumption of coastal and marine resources and (iii) pollution from industries, aquaculture and urban agglomerations (Kakinada- Andhra Pradesh, and Yanam- Pondicherry). Conversions of land to other uses such as aquaculture, industrial activities, unsustainable fishing, and pollution from manufacturing units are the three highest−ranked threats. (Prof A.V Raman et.al., 2001)

Mangrove Biodiversity in Coringa

Coringa mangroves contain a large number of plant and animal species. These species help in maintaining ecological balance and productivity of the estuarine ecosystem. Mangrove plants provide shelter, breeding grounds, and food for many organisms. 32 species of mangrove and mangrove associated plants belonging to 26 genera and 18 families are recorded in Godavari mangrove ecosystem.

Table 1: Mangrove Floral diversity at Coringa

S.No	Species	Family	Significance
1	Avicennia marina	Avicenniaceae	Salt Tolerance
2	Rhizophora mucronata	Rhizophoraceae	Shore protection
3	Sonneratia apetala	Sonneratiaceae	Nutrient cycling
4	Excoecaria agallocha	Euphorbiaceae	Habitat

The table shows important mangrove plant species present in the Coringa ecosystem. Avicennia marina is highly salt-tolerant; Rhizophora helps in shoreline protection; Sonneratia helps in nutrient cycling; and Excoecaria provides habitat for many organisms.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Table 2. Faunal diversity in Coringa mangroves.

S.No	Group	Examples
1	Pisces	Mugil, Lates
2	Aves	Heron, Pelican
3	Crustaceans	Scylla
4	Molluscs	Gastropods
5	Mammals	Otter

Coringa mangroves support a wide variety of animals. Fish use mangroves as nursery grounds, birds depend on mangroves for nesting, crabs and molluscs help in nutrient recycling, and mammals maintain ecological balance.

Faunal diversity

Zooplankton

Godavari mangrove ecosystem has 27 groups of zooplanktons.

Macrobenthos

The macrobenthic animal of Godavari mangrove ecosystems are represented by 15 groups. They are Sea anemones, Nemerteans, Polychaetes, Oligochaetes, Mysids, Isopods, Amphipods, Prawns Crabs, Halacarid mites, Insect larvae, Univalves, Bivalves, Fish juveniles & Sipunculids.

The group polychaetes are represented by 18 species. They are, Phyllodoce castanea, phyllodoce malmgreni, Namalycastis indica, Dendronereis arborifera, Nereis indica, Nereis cricognatha, Nereis sp. Ceratomereis burmensis sp. Nephthys dibranchis, Lumbriconereis simplex, Glycera longipinnis, Laonice cirrata, Magilona sp. Capitella sp. Sternaspis scutsts, Streblosoma cespitosa and Laonome indica.

Meiobenthos

Meiobenthos are comprised into 12 groups. The harpacticoid copepoda is represented by 22 species in Godavari delta mangrove habitats. The following are observed: Longipodia weberi, Canuella perplexa, sunaristes sp. Halectinosoma curticorne, Halectinosoma gothiceps, Tachidius disciples, Pseudostenhelia secunda, Stenhelia longifurca, St (D). madrasessis, robertsonia sp. Amphiasdcoides sp. Amiera parvula, Nitocra spinipes, Phyllopodopsyllus longicaudatus, Stenocopia sp. Enhydrosoma buccholtzi, Enhydrosoma sp. Cletocamptus confluens, Nannops palustris, Limnocletodes behningi, Onychocamptus bengalensis, Quinguelaophonte quinquespinosa.

Prawns:

18 species of prawns belonging to 8 genera and 3 families occur here. The genus Metapenaeus was represented by 5 species by the Genera Penaeus and Macrobrachium.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Crabs:

11 species of crabs belonging to 10 genera and 3 family are recorded. They include: Scylla serrata, Portunus pelagicus, Charybdis cruciata, Uca dussumieri Macropthalmus crinitus, Pachygrapsus sp. Varuna, litterata, Sesarma oceanica, Sesarma quadrata, Metopograpsus messor and Grapsus strigous.

Molluscs:

Molluscs are represented by 23 species belonging to 29 genera and 14 families. They are:

Univalves - Neria chameleon, Neritina depress; Littorina scabra, L. melanostoma, L. intermediate; Assiminea brevicula; Cerithidae fluviatilis, C. decollate, Telescopium telescopium, Terebralia palustris; and Onchidium verruculatum.

Bivalves - Anadara granosa; Perna viridis; Plancenta; Meretrix casta, Katelysia opima; Tellina ala and Solen sp.

Finfish:

106 finfish species belonging to 78 genera and 52 famillies were present. Mullets (mugil cephalus, Liza melanoptera, Valamugil cunnessius), Croackers (Dendrophysa resselli), Indian shads (Hilsa ilisha) catfish (Arius caelatus), grunters (Pomadasya hasta), Perches (Lates calcarifer), Pomfrets (Pampus argentitus), goatfish (Upeneus sulphureus) and eels (Anguill bicolor).

Birds:

The following species of birds are seen in Godavari mangrove ecosystem. Podiceps ruficollis, Pelicanus philippensis, Anhinga rufa, Palacrocorax niger, Ardea cinerea, Egretta sp. Ardeola greylil, Ibis leucocephalus, Pseudibis papillosa, Anser indicus and Anas sp.

Sources of Pollution in Mangrove Ecosystem

Mangrove ecosystems receive pollutants from different sources. These pollutants accumulate in water and sediments and affect the growth of plants and animals. Main sources of pollution include industrial effluents, agricultural runoff, domestic sewage, aquaculture waste, and oil spills.

Table 3: Sources of Pollution & Effects

S.No	Sources	Pollutant	Effect
1	Industry	Lead, Chromium	Toxicity
2	Agriculture	Nitrogen, Phosphorus	Eutrophication
3	Sewage	Organic Waste	Oxygen depletion
4	Aquaculture	Chemicals	Habitat damage

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Industrial waste releases heavy metals, which are toxic to plants and animals. Agricultural runoff increases nutrients, causing eutrophication. Sewage reduces dissolved oxygen and aquaculture chemicals damage mangrove roots. (Tam, N.F.Y. & Wong, Y.S., 2000)

Heavy Metal Accumulation in Mangroves

Mangrove sediments act as sinks for heavy metals because of slow water flow and high organic matter. These metals accumulate in plant and animal tissues and may enter the food chain. Common metals found in mangrove ecosystems include Pb, Cd, Cr, Cu, Zn, and Ni. Heavy metals reduce plant growth, damage roots, and disturb photosynthesis. Animals feeding in mangrove areas accumulate metals, which may cause toxicity and health problems. (MacFarlane, G.R. & Burchett, M.D., 2002)

Table 4: Effects of Heavy Metals

S.No	Metal	Effects on Plants	Effects on Animals
1	Pb	Growth inhibition	Toxic
2	Cd	Chlorosis	Kidney damage
3	Cr	Root damage	Bioaccumulation
4	Zn	Enzyme disturbance	Food Chain Toxicity

Effect of Pollution on Physico-Chemical Parameters

Pollution alters water quality parameters such as pH, dissolved oxygen, salinity, and nutrient levels. These parameters are very important for the survival of mangrove plants and animals.

Table 5: Water quality variation

S.No	Parameter	Normal	polluted
1	pH	7-8	6-9
2	Dissolved Oxygen	High	Low
3	Biological Oxygen Demand	Low	High
4	Salinity	Stable	Variable
5	Nutrients	Low	High

An increase in BOD and nutrients indicates pollution. Low dissolved oxygen affects fish survival. Changes in salinity disturb mangrove plant growth. (Ramanathan, A.L., et.al., 1999)

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Impact of Pollution on Mangrove Biodiversity

Pollution affects all organisms (both flora & fauna) present in mangrove ecosystems.

Effects on Flora:

- Reduced growth
- Leaf damage
- Reduced photosynthesis

Effects on Fauna:

- Fish mortality
- Bird habitat loss
- Crab population decline

Effects on microorganisms

- Reduced decomposition
- Nutrient imbalance

Case Study – Coringa Mangroves

Several human activities that reduce biodiversity and disturb the ecological balance of the Coringa ecosystem are,

- Industrial discharge from Kakinada
- Aquaculture ponds
- Sewage disposal
- Cutting of mangroves
- Hydrological changes

As pollution increases, biodiversity decreases. High pollution reduces plant growth and animal survival.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Degradation of mangroves by Oil spills

Human Disturbances at the Estuary

These images show mangrove destruction due to pollution, oil spills, and human activities. (Satyanarayana, B., et.al., 2012)

Conservation Measures

Effective conservative steps are necessary to protect coastal ecosystems. Some are,

- Effluent treatment plants
- Mangrove plantation
- Pollution monitoring
- Public awareness
- Sustainable aquaculture

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Role of Mangroves in Pollution Control

Mangroves play an important role in controlling pollution in coastal ecosystems. They act as natural filters by trapping sediments, nutrients, and toxic substances carried by rivers and tides. The root system of mangrove plants slows down water flow and allows suspended particles to settle. Because of this, pollutants accumulate in mangrove sediments instead of reaching the open sea.

Mangrove plants also absorb heavy metals and other toxic substances through their roots. Some mangrove species such as Avicennia marina and Rhizophora mucronata are known for their high tolerance to polluted conditions. These plants help in reducing the concentration of pollutants in water and protect marine organisms.

Mangrove ecosystems also support microorganisms that help in decomposition of organic waste. These microorganisms break down pollutants and convert them into less harmful substances.

Table 6. Pollution control functions of mangroves

S.No	Function	Description	Importance
1	Sediment trapping	Roots trap particles	Prevents turbidity
2	Metal Absorption	Roots absorb metals	Reduces toxicity
3	Nutrient cycling	Microbes decompose waste	Maintains balance
4	Shore protection	Roots reduce erosion	Protects habitat

The above data show that mangroves help control pollution by trapping sediments, absorbing heavy metals, recycling nutrients, and protecting shorelines. These functions make mangroves very important for maintaining coastal ecosystem stability.

Seasonal Variation of Pollution in Coringa Mangroves

Pollution levels in mangrove ecosystems change with seasons. During monsoon, river flow increases and brings more sediments, nutrients, and pollutants into mangrove areas. During summer, evaporation increases salinity and pollutant concentration. Seasonal variation affects physico-chemical parameters and biodiversity.

Studies in the Godavari estuary show that dissolved oxygen decreases during summer due to high temperature, while nutrient concentration increases during monsoon because of agricultural runoff.

Table 7: Seasonal variation of water quality

Season	Salinity	DO	Nutrients	Pollution levels
Summer	High	Low	Moderate	High
Monsoon	Low	Moderate	High	High
Winter	Moderate	High	Low	Low

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

During summer, high temperature increases salinity and reduce dissolved oxygen. During the monsoon, runoff increases nutrients and pollutants. Winter shows better water quality compared to other seasons.

Bioaccumulation of Pollutants in Mangrove Organisms

Bioaccumulation refers to the accumulation of toxic substances in living organisms. In mangrove ecosystems, heavy metals present in water and sediments are absorbed by plants, fishes, crabs, and molluscs. These metals move through the food chain and reach higher organisms, including birds and humans.

Mangrove plants absorb metals through roots, while aquatic animals accumulate metals through feeding and respiration. High concentration of heavy metals can cause growth inhibition, reproductive problems, and mortality.

Table 8. Bioaccumulation in mangrove organisms

S.No	Organism	Metal Accumulation	Effect
1	Mangrove plants	Pb, Cd, Zn	Reduced growth
2	Fish	Hg, Pb	Toxicity
3	Crab	Cd, Cu	Bioaccumulation
4	Molluscs	Zn, Pb	Tissue Damage
5	Birds	Hg	Reproductive failure

Different organisms accumulate different metals, which affect growth, reproduction, and survival, leading to a reduction in biodiversity.

Impact of Aquaculture on Coringa Mangroves

Aquaculture is one of the major causes of mangrove destruction in coastal areas. Shrimp farming requires clearing of mangrove forests and construction of ponds. Wastewater from aquaculture contains chemicals, antibiotics, and organic waste which pollute mangrove water.

In Coringa region, large areas of mangroves have been converted into aquaculture ponds. This has resulted in habitat loss, reduction in biodiversity, and changes in water quality.

Table 9. Effects of aquaculture on mangroves

Activity	Impact
Pond Construction	Loss of Mangrove area
Feed waste	Water pollution
Chemicals	Toxicity
Antibiotics	Microbial imbalance

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Aquaculture causes both physical destruction and chemical pollution. Loss of mangrove vegetation reduces habitat for many organisms

Climate Change and Pollution Effects on Mangroves

Climate change increases the effect of pollution on mangrove ecosystems. Rising temperature, sea level rise, and extreme weather events make mangroves more sensitive to pollutants.

High temperature increases chemical reactions and toxicity of pollutants. Sea level rise changes salinity which affects plant growth. Cyclones can carry pollutants into mangrove forests.

Table 10. Climate change effects

Factor	Effect on Mangroves
Rise of Temperature	Stress on Plants
Rise of the sea level	Salinity Change
Cyclones	Sediment disturbance
Rainfall Change	Pollution runoff

Conclusion

Mangrove ecosystems are very important coastal habitats that support rich biodiversity and protect shorelines. However, pollution from industrial discharge, agricultural runoff, sewage, and aquaculture has severely affected mangrove biodiversity. The Coringa mangrove ecosystem is one of the most important mangrove habitats in India but is under threat due to increasing human activities. Heavy metal accumulation, water quality changes, and habitat destruction have reduced plant and animal diversity.

In order to rehabilitate the salt water crocodile which was at the verge of extinction and to protect the other endangered species, such as Olive Ridley turtles and Indian Otter, the Government of Andhra Pradesh declared a part of Godavari mangrove system as Coringa Wild Life Sanctuary in July, 1978. The Coringa Wildlife Sanctuary covers an area of about 208 sq.km. I t is located between Lat. 16°30' and 17° 00' N and Long. 82° 14' and 82° 23' E in the East Godavari District. About 120 species of resident and migratory birds (egrets, cormorants, etc) depend on this area for breeding and nesting.

Proper conservation measures, pollution control, and scientific monitoring are necessary to protect Coringa mangroves. Sustainable management of mangrove ecosystems will help in maintaining ecological balance and protecting coastal resources.

References

1. Alongi, D.M., 2008. Mangrove forests: resilience and responses to global climate change. Estuarine, Coastal and Shelf Science, 76(1), pp.1-13.

2. A.V Raman and team, Marine biology laboratory Andhra University- Dec 2001. Critical habitat information system for Coringa mangroves, Andhra Pradesh, India. Department of Ocean Development, ICMAM Project Directorate, Chennai, Govt of India

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

3. Audrey Azoulay, Director General, UNESCO -2021. International day for the conservation of the mangrove ecosystem

4. K. Siva kumar, Gitanjali Katlam, Tarun Kathula – 2012. A bibliographic review- Identification & prioritization of research gaps in coastal & marine biodiversity conservation in the East Godavari river Estuarine ecosystem (EGREE), Wild life institute of India

5. K.N Murali Sankar - November 17th, 2017. Coringa faces deforestation threat

6. MacFarlane, G.R. & Burchett, M.D., 2002. Toxicity, growth and accumulation relationships of copper, lead and zinc in mangrove plants. Marine Environmental Research, 54, pp.65-84.

7. M. Haritha, Ahmed Nisha, Raja Ps – January 2017. A study on mangrove ecology and socio-economic status of fishing communities in Coringa region of East Godavari District, Andhra Pradesh, India

8. Tam, N.F.Y. & Wong, Y.S., 2000. Spatial variation of heavy metals in surface sediments of Hong Kong mangrove swamps. Environmental Pollution, 110(2), pp.195-205.

9. Ramanathan, A.L., Subramanian, V., Ramesh, R., 1999. Environmental geochemistry of the Pichavaram mangrove ecosystem. Environmental Geology, 37, pp.223-233.

10. Rao, K.M., Rao, G.M., Raju, K.V., 2011. Biodiversity of Coringa Wildlife Sanctuary. Indian Journal of Forestry, 34(2), pp.145-152.

11. Satyanarayana, B., Raman, A.V., Dehairs, F., Kalavati, C., Chandramohan, P., 2012. Mangrove floristic and zonation patterns in Godavari estuary. Estuarine Coastal Shelf Science, 96, pp.15-25.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

EFFECTS OF GLOBAL WARMING ON ECONOMIC GROWTH

M. Bala Swamy
HOD of Economics, GDC, Amalapuram
balaswamy57@gmail.com Cell: 9441481707

ABSTRACT

Towards the end of the second millennium events of historical significance have transformed the landscape of human life. The main events of nations now are to achieve economic development and technological changes with scientific development and innovations. In this context, with the global experience, the main focus areas of all nations are development of economies as well as science and technology. At this juncture, we are seriously ignoring the very essential things for human life of sociological and Global Warming aspects. In recent days, many economies are violating global values and influencing acquire the energy resources.

Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants. Climate change as a result of global warming will significantly impact on conditions of food supply and food security. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation and glacial run-off. The effect of climate on agriculture is related to variability in local climates rather than in global climate patterns.

At this juncture, the role of social science and the social scientists is a wide range of discipline including law, psychology, sociology, Communication, Criminology, Economics, Politics, Public Administration as to create the new areas of study to inculcate the Bio – Socio – Global village into reality.

Key Words: Global Warming, Agricultural Product, Socio-Bio Economic Problems

Towards the end of the second millennium events of historical significance have transformed the landscape of human life. The main events of nations now are to achieve economic development and technological changes with scientific development and innovations.

The racing between the nations, as the challenges that they are facing, may be solved, is to achieve fast growth rates in GDP and PCI. Basically their argument on historical and international comparisons, many economists consider the economic "growth" as the necessary means to the end of greater human welfare.

In this context, with the global experience, the main focus areas of all nations are development of economies as well as science and technology. At this juncture, we are seriously ignoring the very essential things for human life of sociological and Global Warming aspects. In recent days, many economies are violating global values and influencing acquire the energy resources.

Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants. Global warming is the rapid increase in Earth's average surface temperature over the past century, primarily driven by human activities—mainly the burning of fossil fuels—that release greenhouse gases like CO_2 and methane. The planet is warming twice as fast as in previous decades.

Dr. Harendar Raj Gautam has studies on Global Warming is one of the important consequences of climate change and this will adversely affect agriculture and rural life. Its study conducted at the Indian Institute of Technology, Madras, indicates that a major aspect of climate change is sea-levels due to a variety of reasons. India has longest coastline, so people living in the low-elevation coastal zones in India will be affected. The report also suggests that global warming will affect the monsoon patterns in India, causing a significant damage to the health of India's agricultural sector, which plays a

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

dominant role in the country's economy. Climate change as a result of global warming will significantly impact on conditions of food supply and food security. The state of the sea surface determines both temperature and precipitation are the main drivers of crop growth, therefore agriculture has always been highly dependent on climate patterns and variations. Overall, climate change could result in a variety of impacts on agriculture. Changes in production patterns will occur due to higher temperatures and changing precipitation patterns. Agricultural productivity will also be affected due to increased carbon dioxide in the atmosphere. According to the findings of the Inter-governmental Panel on Climate Change (IPCC), the consequences of environmental changes in South-East include an increased risk of floods and droughts in many regions, decreased agricultural productivity, advice impacts on fisheries and adheres effects on many ecological systems. Wheat yields would fall by 5-10 percent with every increase of 1°c and overall crop yields could decrease upto 30 percent in South Asia by the mid-21st Century. India could experience a 40 percent decline in agricultural productivity by 2080 as rise in temperature will affect wheat growing region, placing hundreds of millions of people at the brink of chromic hunger.

Dr. Subbiah A and Jayakumar S has jointly stated that the Climate change impact on Agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation and glacial run-off. The effect of climate on agriculture is related to variability in local climates rather than in global climate patterns. The earth's average surface temperature has increased by 1° F in just over the last century. More favorable effects on yield tend to depend to a large extent on realization of the potentially beneficial effects of carbon dioxide on crop growth and increase of efficiency in water use. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor vulnarization. Several factors directly connect climate change and agricultural productivity which are average temperature increase, change in rainfall amount and patterns, raising atmosphere concentration of Co2, pollutions levels such as tropospheric ozone and change in climate variability and extreme events.

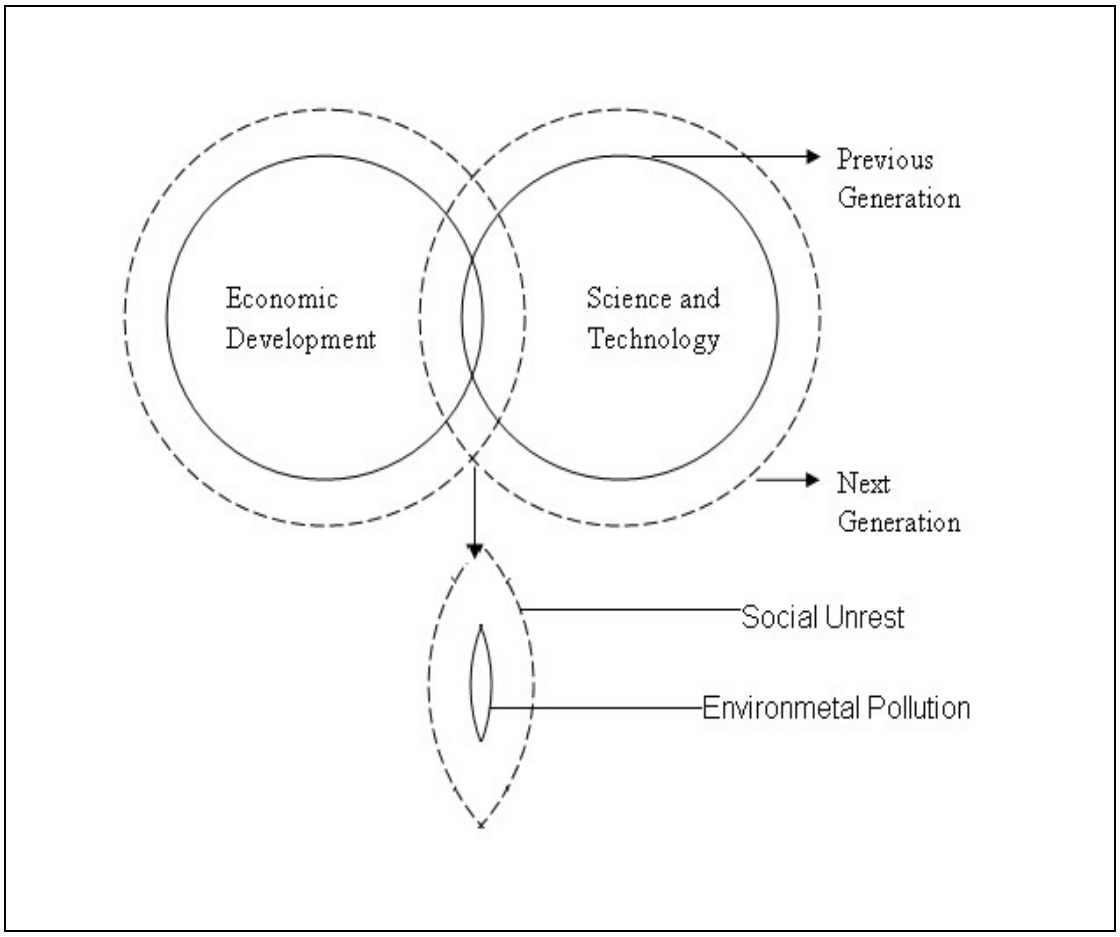
THE LIFE CHAIN AND ECO-SYSTEM:

The origin of human life on this planet marked "three lakh" years till today. The chain of life is being continued with eco- friendly. Till today the links of the ecological chain are very strong but since 19th century, the links of that life chain became so weak and threaten to be broken. Global climate change is a significant challenge to structures of governance at all temporal and spatial scales, particularly in the area of managing natural resources. Advances in understanding of the nature of observed and future climate change has led to a realization that significant future impacts are inevitable and increased efforts towards understanding the process of adaptation to the threatened impacts are required. Its examines the issue of scale of governance relevant for adaptation. The UN Framework Convention on Climate Change is the primary mechanism for co-ordinating international action on the threat of global climate change. The Convention process perceives adaptation as a further rationale for international transfers, in this case to compensate for and prepare for potential or realized impacts. The IPCC Business-as-usual scenario projection of plant usable concentration of CO_2 about 46 PPM by the middle of the next century are also used in the crop model simulation diminish the benefits from climate change that some countries with predicted positive yield effects would otherwise receive.

Origin --→ 19th Century --→ 21st Century

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"



The above diagram shows arrival of economic revolution and arrival of scientific revolution in 19th and 20th centuries respectively, gave as a lot of Fruitful result ever before in the history of human life. But these two gain genetic changes gave birth to very bad children, those are one is environmental pollution and the second social unrest. The above diagram shows two circles intersecting of environment pollution as well as social unrest. As long as the magnitude of economic development and science and technology improved, the intersection area also increased. The increasing pants of intersection area will the scenario of the history lakhs of years of human life.

The club of Rome was group of about seventy five men and seventy five nations, the being eminent scientists, industrialists, economists, sociologists and educators. It predicted the collapse of the world, as a result, a depletion of limited resources and increase in the levels of pollution, will not take very long perhaps only few decades.

CHOICE BETWEEN QUALITY ENVIRONMENT AND GROWTH MANIA:

The provision of environment quality is an opportunity cost. In a more appropriate sense there is a conflict between "Economy" and "Ecology". Ecology studies harmony between nature and mankind where as the present goals of the world nations create disharmonious between nature and mankind.

There is a inverse relationship between the quality of environment and bundle of goods services. If are increase the quantity goods and services with the help of science and technology which the result is the quality of environment will be

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

damage. . The adopted scenario represented an increase in monsoon seasonal mean surface temperature of the order of about 1.5°C, and an increase in rainfall of the order of 2 mm per day, over the state of Kerala in the decade 2040–2049 with respect to the 1980s. The IPCC Business-as-usual scenario projection of plant usable concentration of CO_2 about 460 PPM by the middle of the next century are also used in the crop model simulation. On an average over the state with the climate change scenario studied, the rice maturity period is projected to shorten by 8% and yield increase by 12%. When temperature elevations only are taken into consideration, the crop simulations show a decrease of 8% in crop maturity period and 6% in yield. This shows that the increase in yield due to fertilization effect of elevated CO_2 and increased rainfall over the state as projected in the climate change scenario nearly makes up for the negative impact on rice yield due to temperature rise. The sensitivity experiments of the rice model to CO_2 concentration changes indicated that over the state, an increase in CO_2 concentration leads to yield increase due to its fertilization effect and also enhance the water use efficiency of the paddy. The temperature sensitivity experiments have shown that for a positive change in temperature up to 5°C, there is a continuous decline in the yield. For every one degree increment the decline in yield is about 6%. Also, in another experiment it is observed that the physiological effect of ambient CO_2 at 425 ppm concentration compensated for the yield losses due to increase in temperature up to 2°C. Rainfall sensitivity experiments have shown that increase in rice yield due to increase in rainfall above the observed values are near exponential. But decrease in rainfall results in yield loss at a constant rate of about 8% per 2 mm/day, up to about 16 mm/day.

If we opt for possible economic growth by producing goods and services with the constraint there will be no further damage to the environment quality. But today all the world nations are opting anticipated growth without any constraints to the ecosystem, resulted more economic growth and also the further damage to the quality of environment. And it will leads to the damage the entire global environment.

The ecosystem is being polluted by emission of solid waste, air, water, land, marine, noise, radiation and thermal pollution. The new urgent but complex problems, bearing on very survival, are global warming, acid rains, ozone depletion, Some of the words leading botanists have warned nearly 15,000 plants are dangerously rare, additional 40,000 species could be lost before the end of this century.

The rapid industrialization brought significant and hazardous changes in the biosphere. Biosphere is a part of the earth characterized by the existence of plant and animal life. The IPCC Business-as-usual scenario projection of plant usable concentration of CO_2 about 460 PPM by the middle of the next century are also used in the crop model simulation.

SOCIAL UNREST–THE OTHER PRODUCT OF ECONOMIC DEVELOPMENT AND SCEINCE & TECHNOLOGY:

Right to live is a fundamental right for which is a decent life needs food and shelter provided by nature. There fore the nature should be protected along with the social environment. In the post-cold war period, as earlier said, the second bad child born, to the couple of growth mania and science and technology was "SOCIAL UNREST'. The multidimensional rapid growing social unrest threatens the very survival of human life. Ethical problems like racial, religious and regional problems, violation of human rights, violation against the protection of nature, law and etc, are the contribution to the social unrest. For all these problems, the main reason is '' to curb "the economic power. The above all social problems are not new to the human behavior in course of life.

But the biggest challenge, to moderate societies or to other countries today is posed by '' the international terrorism''. The ideological isms of the 20th century have been replaced by an ism which is the reputation of all ideologies and that is Terrorism. Terrorists exploit the civil liberties, religions tolerance and cultural diversity. We have to recognize the September 11th attack on WTC, the December 13th attack on Indian Parliament, the 12th attack in Bali and recent terrorist atrocities are all the part of global terrorism. In the post cold war, the threat of terrorism is much greater than nuclear war. Yet, a developed nations like USA is not sufficiently prepared to confront with the weapons of mass distraction (WMD).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The cold war conflicts, believes nations, raises their defense expenditure has become a big share of their nations. No country has a master plan to dealing with the collateral impact of global terrorism and war conflicts.

The improved science and technology gave an added strength to the terrorism to open its cruel face in a multidimensional. Those are chemical terrorism and bio- terrorism. The future was weapons are 'COMPUTERS' a darker journey into the world of high level computers hacking and its implication for "cyber terrorism". For example to poison nation's children through accessing the process control system of cereal manufactures. Cyber crime focuses on the growing concern about the use of electronic communication for criminal activities. The social unrest of this type presented priority in developed countries and spreading to the developing nations which disturbs the entire global social environment as well as physical global environment. The IPCC Business-as-usual scenario projection of plant usable concentration of CO_2 about 460 PPM by the middle of the next century are also used in the crop model simulation.

BIO - SOCIAL GLOBAL VILLAGE – A CHOICE;

A stable global political equilibrium only through international democratization gives us global villages which are alternate for preservation of this planet to the orbit of the solar system. We have an ancient slogan – "Vasudhavia Kutumbam" which translate roughly as ""the world is one family". We can see now, how relevant this dictum (slogan) has become, as global inter dependence, the buzz word of the 21st century. A noble laureate Prof. Amartya Sen used the experience of India the illustrate this. Sub continent plagues by famine during its colonial history changed its destiny after opting for democracy. Democracy has proved to be the best form of Governance especially in multicultural, multi religious societies.

In European economic community (EEC) has given place to the European Union at monetary and financial integration with the ultimate goal of full political union. It is right time, the entire human world have to come under a roof of single electoral college. A supreme power, elected by the world population with their representatives, would govern the bio-global village with the motto of protecting the biological and sociological aspects of human life. At this juncture, the role of social science and the social scientists is a wide range of discipline including law, psychology, sociology, Communication, Criminology, Economics, Politics, Public Administration as to create the new areas of study to inculcate the Bio – Socio – Global village into reality.

References

1. Karpagam R.- "Environmental Economics.''
2. Timmy, Katyal, M. Satake- ''Environmental Pollution.''
3. Michael Silvestein,-''Environmental Economic revolutions.''
4. IACIS, December, 2002,-''Contemparary Perspectives of Social Sciences.''
5. Prof. A. Ravindra Nadh,- ''Lecture on Bio- Terrorism.'' In IACIS, Dec, 2002, in Hyderabad.
6. Neil Edger, W – "Scales of governance and environmental justice for adaptation and mitigation of climate change Journal of International Development" Vol: 13, No. 7, p. 921–931, October 2001
7. John Quiggin & John Horowitz –"Costs of adjustment to climate change", Australian Journal of Agricultural and Resource Economics, Vol 47, No. 4, p. 429–446, Dec 2003.
8. S. A. Saseendran, K. K. Singh, L. S. Rathore, S. V. Singh and S. K. Sinha –"Effects of Climate Change on Rice Production in the Tropical Humid Climate of Kerala, India
9. Dr. Harendar Raj Gautam (2009), 'Effect of climate change on Rural India' Kurukshetra, Vol.57,No.9, July 2009,P.3-5.
10. Dr. Subbiah A and Jayakumar S (2009), "Climate change impact on Agricultural Sector" – Kurukshetra Vol.57, No.9, July 2009, P.6-9.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

IMPACT OF BIODIVERSITY LOSS, GLOBAL WARMING, AND RISING POLLUTION: AN INDIAN AND GLOBAL PERSPECTIVE

Dr V.Gurumurthy [1]
Lecturer in Zoology,Government Degree College for women, Madanapalle-517325
L.Vijayalakshmi[2]
Lecturer in Zoology, NTR Government Degree College, Valmikipuram-517299. Andhrapradesh.
Dr.C.VenkataKrishnaiah[3],
Lecturer in Zoology, Govt. Degree College, Puttur-517583, Andhra Pradesh, India.
Dr C.Narasimha Rao[4]
Lecturer in Zoology, Government Degree College, Mydukur, YSR Kadapa Dist. A.P. 516172.
Corresponding Author Email:guru3phd@gmail.com,Phone no: **9441653005**

Abstract

The accelerating degradation of the natural environment due to biodiversity loss, global warming, and rising pollution represents one of the most critical challenges of the 21st century. These issues are deeply interconnected, forming a complex ecological crisis that affects both natural ecosystems and human societies. India, one of the world's megadiverse countries, faces significant environmental threats due to rapid population growth, industrialization, and urbanization. The combined impact of biodiversity loss, global warming, and rising pollution is one of the most serious environmental challenges facing both India and the world today. These issues are deeply interconnected and amplify each other, affecting ecosystems, economies, and human health. This research paper explores the causes, impacts, and interrelationships of biodiversity loss, climate change, and pollution, with a special focus on India in the global context. It also highlights mitigation strategies and policy frameworks necessary for sustainable development.

Keywords: Biodiversity loss, Global warming, Rising pollution, Environmental challenges Environmental degradation, Climate change, Ecosystem crisis, Human impact, Industrialization, Urbanization

1. Introduction

Biodiversity encompasses the variety of life forms on Earth, including genetic, species, and ecosystem diversity. It provides essential ecosystem services such as pollination, climate regulation, and nutrient cycling. However, anthropogenic activities have accelerated biodiversity loss at an unprecedented rate.Global warming, driven by greenhouse gas emissions, and rising pollution levels further intensify this crisis. India, home to approximately 8% of global biodiversity despite occupying only 2.4% of the world's land area, is particularly vulnerable.

Biodiversity is not only crucial to ecosystem functioning, but also plays a role in protection from natural disasters. Extreme weather events such as storms and flooding are projected to become more pervasive threats due to climate change, as is sea level rise. Adger et al. (2005) emphasize the importance of building resilience to natural disasters, particularly in coastal regions. The

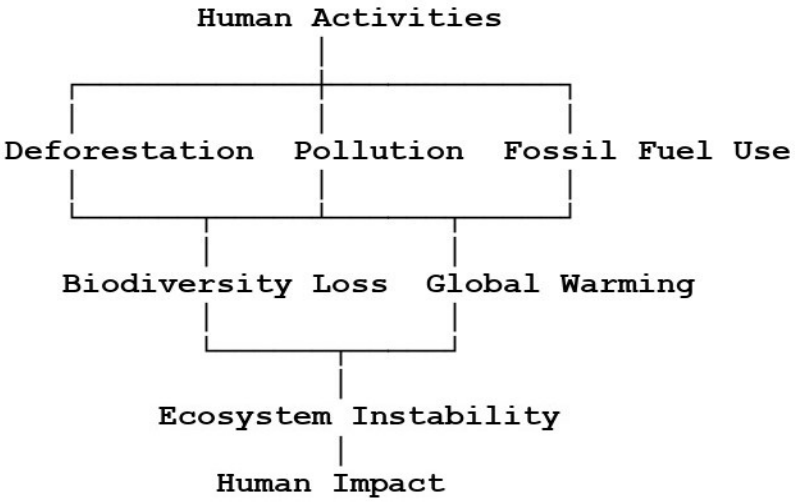
Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

diversity of responses in various species that perform the same ecosystem function is a critical factor in maintaining ecosystem resilience to changes in the environment, particularly when ecosystems are reorganizing (Elmqvist et al. 2003). Munang et al. (2013) list natural hazard mitigation as an important regulating service that ecosystems offer, especially now, when weather patterns are becoming increasingly unpredictable due to climate change. If ecosystems are managed in a way that conserves biodiversity, the effects of flooding, landslides, wildfires, droughts and storm surges can be mitigated more effectively.

2. Conceptual Framework

2.1 Relationship between Key Environmental Issues



This diagram shows how human activities simultaneously drive biodiversity loss, pollution, and climate change, creating a feedback loop.

3. Biodiversity Loss

3.1 Global Scenario

The current rate of species extinction is estimated to be 100–1000 times higher than natural rates. Major causes include:

- Habitat destruction
- Overexploitation
- Invasive species
- Climate change

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

3.2 Biodiversity in India

India is recognized as one of the **17 megadiverse countries**. Key biodiversity regions include:

- Western Ghats
- Eastern Himalayas
- Sundarbans
- Indo-Burma region

However, India faces severe biodiversity threats due to:

- Deforestation
- Urban expansion
- Agricultural intensification

Table 1: Major Threats to Biodiversity in India

Threat Factor	Description	Impact Level
Deforestation	Forest clearing for agriculture	Very High
Urbanization	Expansion of cities	High
Pollution	Air, water, soil contamination	Very High
Climate Change	Altered rainfall & temperature	High
Overexploitation	Hunting, fishing, resource extraction	Medium

4. Global Warming

4.1 Causes

Global warming is primarily caused by increased greenhouse gas emissions:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

4.2 Impacts in India

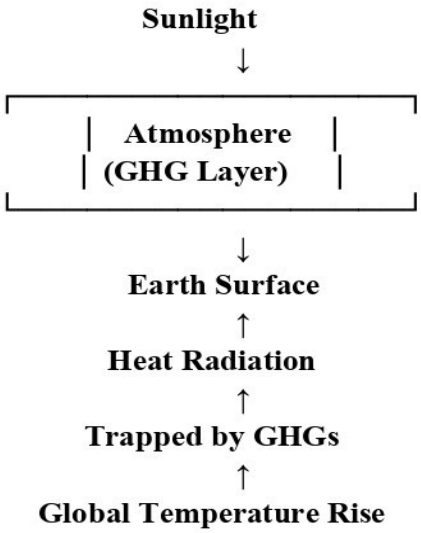
India is highly vulnerable to climate change:

- Rising temperatures
- Erratic monsoon patterns
- Increased frequency of extreme weather events

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Diagram: Green house Effect



The rate of climate change surged alarmingly between 2011-2020, which was the warmest decade on record. Continued rising concentrations of greenhouse gases fuelled record land and ocean temperatures and turbo-charged a dramatic acceleration in ice melt and sea level rise, according to a new report from the World Meteorological Organization (WMO). The report, "the Global Climate 2011-2020: A Decade of Acceleration" emphasizes the need for much more ambitious climate action to try to limit global temperature rise to no more than 1.5°C above the pre-industrial era

Table 2: Temperature Rise Trends in India

Year Range	Avg Temperature Increase
1901–1950	+0.2°C
1951–2000	+0.5°C
2001–2020	+0.7°C
Future (2050)	+1.5°C to +2°C

5. Rising Pollution

5.1 Types of Pollution

Air Pollution

India has some of the most polluted cities globally due to:

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

- Vehicle emissions
- Industrial discharge
- Burning of fossil fuels

Water Pollution

- Industrial waste
- Sewage discharge
- Agricultural runoff

Soil Pollution

- Pesticides
- Chemical fertilizers

Table 3: Pollution Levels in India

Pollution Type	Major Source	Affected Areas	Impact
Air	Vehicles, Industry	Urban cities	Respiratory diseases
Water	Sewage, Chemicals	Rivers, lakes	Aquatic life loss
Soil	Fertilizers	Agricultural land	Reduced fertility

6. Interconnection between the Three Issues

6.1 Feedback Loop

Pollution → Climate Change → Biodiversity Loss
↑ ↓
└──────── **Ecosystem Weakening** ┘

- Pollution contributes to global warming
- Global warming accelerates biodiversity loss
- Loss of biodiversity reduces ecosystem resilience

7. Case Studies from India

7.1 The Sundarbans

- Rising sea levels threaten mangrove forests
- Habitat loss for species like the Bengal tiger

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

7.2 Western Ghats

- Deforestation and mining
- Decline in endemic species

7.3 Delhi Air Pollution Crisis

- Severe smog due to vehicular and industrial emissions
- Health hazards for millions

8. Impacts on Human Society

8.1 Health Impacts

- Respiratory diseases
- Heat stress
- Waterborne diseases

8.2 Economic Impacts

- Agricultural losses
- Increased healthcare costs
- Damage to infrastructure

8.3 Food Security

- Reduced crop yields
- Loss of pollinators

Table 4: Socio-Economic Impacts

Sector	Impact Example
Agriculture	Crop failure
Health	Increased diseases
Economy	Loss of productivity
Environment	Ecosystem degradation

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

9. Mitigation and Policy Measures

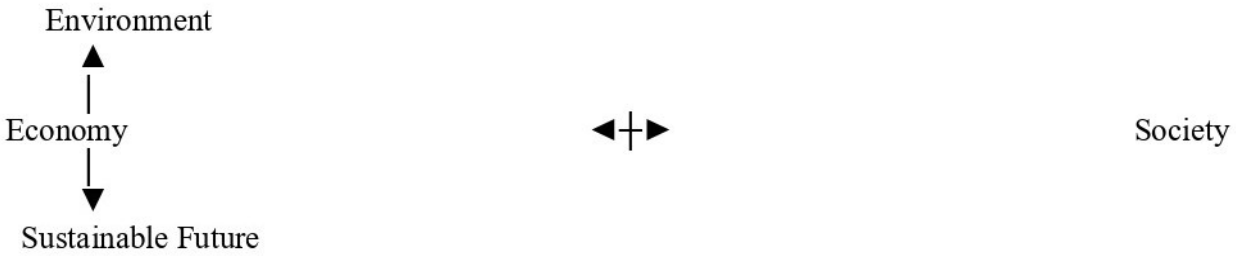
9.1 Global Efforts

- Paris Agreement
- Sustainable Development Goals (SDGs)

9.2 Indian Initiatives

- National Action Plan on Climate Change
- Swachh Bharat Mission
- National Biodiversity Act

Diagram: Sustainable Development Approach



10. Recommendations

10.1 Policy Recommendations

- Strengthen environmental laws
- Promote renewable energy
- Encourage conservation programs

10.2 Individual Actions

- Reduce plastic use
- Save energy
- Support sustainable products

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

11. Conclusion

Biodiversity loss, global warming, and rising pollution are interconnected challenges that require urgent attention. India, due to its ecological richness and population pressure, stands at a critical juncture. Sustainable development, strong policy frameworks, and public awareness are essential to mitigate these issues. A collaborative global effort is necessary to ensure environmental sustainability for future generations. The escalating crises of biodiversity loss, global warming, and rising pollution are deeply interconnected and pose a serious threat to both natural ecosystems and human survival. In India, the impacts are especially severe due to high population pressure, rapid development, and climate vulnerability, while globally these challenges demand urgent and unified action. Protecting biodiversity, reducing emissions, and controlling pollution are not just environmental priorities but essential steps toward sustainable development. A balanced approach involving governments, international cooperation, and responsible individual actions is crucial to ensure a healthier planet for present and future generations.

12. References

1. **1**. Naqvi, S., et al. (2025). *Impact of climate change on endemic birds of the Indian subcontinent.* Journal of Wildlife and Biodiversity.
2. Kumar, A., et al. (2025). *Forest fires and climate change in India: impacts and adaptive strategies.* Environmental Sciences Europe.
3. 3. Das, R., et al. (2022). *Warming effects on vegetation productivity in India*
4. 4. Kanojia, M., et al. (2023). *Agricultural land-use transformation and environmental sustainability.*
5. 5.Study on urbanization reducing carbon sequestration in Indian cities
6. Sannigrahi, S., et al. (2019). *Effects of Green Revolution on ecosystem service values in India.*
7. 6. IPCC (Intergovernmental Panel on Climate Change).(2023).*Climate Change Assessment Report.*
8. 7. UNEP (United Nations Environment Programme). (2022). *Global Environment Outlook.*
9. 8. Sharma, S. K., & Bazaz, A. B. (2012). *Sustainable management of biodiversity in the context of climate change.* Proceedings of the National Academy of Sciences, India.
10. 9. Kumar, V., & Chopra, A. K. (2017). *Impact of climate change on biodiversity of India with special reference to Himalayan region*. Journal of Applied and Natural Science.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

IMPACT OF RICE MILLS AND RICE BRAN OIL REFINERY MILLS ON GLOBAL WARMING AND RISING POLLUTION

K.Babu Rao
Lecturer in Chemistry, Government Degree College, Mandapeta
Kbrchem742@gmail.com

Abstract :

Rice mills and Rice Bran oil refinery Industrial areas are significant contributors to rising pollution and global warming particularly through atmospheric emissions, solid waste and high energy consumption. Research studies indicates that the burning of rice husk in boilers for streaming and parboiling processes releases substantial amounts of particulate matter, Carbon-dioxide and methane. Furthermore, the solvent extraction methods used in oil refineries often employ hexane, contributing to volatile organic compound emissions. Studies show that pollution effects on agricultural productivity and human health are most intense within a 500-meter radius, often impacting local water quality and producing dust that hampers crop photosynthesis. In India, rice mills contribute significantly to Industrial Green House Gases emissions, estimated at roughly 7.55 kt CO_2 annually for a standard cluster. Mitigation strategies, including switching to renewable energy sources, Energy efficient boilers, and better residue management, are crucial for sustainability.

Keywords: Air pollution, Green House Gases, Refinery Impact, Solid waste

1.Introduction

The Hidden Environmental Cost of Rice Processing

Rice(Oryza sativa) is a staple food for over half the global population,with over 90% of production concentrated in Asia.While the agricultural cultivation of rice is well-documented for its methane(CH_4)emissions, the post-harvest processing phase-comprising rice mills and rice bran oil refineries-serves as a significant, often overlooked contributor to global warming, localized air pollution, and water degradation.

1. **The Environmental Footprint of Rice Mills:** Rice mills transform raw paddy into consumable rice through cleaning, dehulling, polishing,and sometimes parboiling.Conventional mills often reliy on fossil fuels(coal or diesel) for energy-intensive processes like drying and whitening, emitting substantial greenhouse gases (GHGs). A key environmental hazard is the burning of rice husk, a byproduct of milling, which releases carbon dioxide, particulate matter(PM), and sulfur dioxide(SO_2)into the atmosphere, contributing to smog and respiratory illnesses in nearby communities.Furthermore, parboiled rice mills release high-strength wastewater (effluent) with high Biological Oxygen Demand(BOD), which,if discharged untreated, severely damages aquatic ecosystems and local water quality.

2. **Environmental Challenges of Rice Bran Oil Refineries:** Rice bran, a valuable by-product of milling, is increasingly used in secondary industries to produce nutritious rice bran oil. However, the refinery process is a hotspot for environmental degradation. The extraction and refining stages (degumming, deacidification, and deodorization) have high thermal energy demands, often satisfied by coal-fired boilers. The refining process, particularly the solvent extraction using hexane, creates toxic volatile organic compound(VOC)emissions. Life cycle assessment(LCA) indicate that the oil refining has a higher environmental impact per ton than the extraction stage itself, contributing to global warming, acidification, and eutrophication due to chemical use and energy demands.

3. **The Urgent Need for Sustainability:** The cumulative population from both sectors-solid ash waste, liquid effluent, and atmospheric VOC/GHG emissions-has led to significant negative impacts on the environment,agriculture,and human health,with the closest surroundings(upto 500 meters) being the most severely affected.Addressing these impacts requires a

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

transition to energy-efficient milling technologies,waste-wealth conversion (e.g., using husk for green energy), and stringent wastewater treatment protocols,aligning the rice processing industry with global sustainability goals.

Key Themes for the Report

Energy Intensive Processing: Heavy reliance on coal and electricity in refining and drying stages.

Waste Management Issues: Burning of rice husk and uncontrolled discharge of industrial effluent.

Localization of Pollution: Significant adverse effects on air quality, local water bodies, and the health of communities within 500m-1km of mills.

Greenhouse Gas Contribution: High-temperature processing contributes to global warming potential(GWP)

Industrial Upgrading: Adoption of energy-efficient,automated technology to reduce the carbon footprint.

2.Green House Effect

The greenhouse effect is a natural process where atmospheric gases-such as CO_2,CH_4,and Water vapour-trap infrared radiation from the Earth's surface, warming the planet to a habitable 15^0C (59^0F).Without this process, Earth average temperature would be roughly-20^0C. However, human activities, primarily fossil fuel combustion, have intensified this, causing global warming.

How the Greenhouse Effect Works

Incoming Energy: Sunlight passes through the atmosphere and warms the Earth's surface.

Outgoing Heat: The warmed surface radiated this energy back towards space as infrared radiation.

Trapping Heat: Greenhouse gases(GHGs) in the atmosphere absorb and re-emit this infrared radiation, preventing it from escaping directly into space and instead trapping it near the surface.

Mechanism: Sunlight(shortwave radiation) passes through the atmosphere. The Earth's surface absorbs this energy and radiates it back as heat (long wave/infrared radiation).Green house gases (GHGs) absorb this infrared radiation,preventing it from leaving the atmosphere.

Analogy: Often compared to a greenhouse or a blanket, though unlike a physical greenhouse, the atmospheric effect works mainly by restricting radiative transfer, not by blocking convection.

Sources of Greenhouse Gases (GHGs):Water Vapor(H_2O): The most abundant and potent, responsible for roughly 60% of the natural greenhouse effect.

Carbon Dioxide (CO_2): Primary driver of anthropogenic climate change, released mainly by burning fossil fuels, deforestation, and industrial processes.

Methane (CH_4): Released from agriculture(livestock), landfills, and natural gas systems.

Nitrous Oxide (N_2O): Primarily from agricultural fertilizer use.

Flourinated Gases (CFCs, HFCs): Synthetic Industrial gases.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

3.Enhanced Greenhouse Effect (Anthropogenic)

Industrial Revolution: Human activity since 18th century has significantly increased GHG concentrations, amplifying the natural process.

Accumulation: Burning fossil fuels acts like a thicker blanket around the Earth, resulting in global warming.

Evidence: Atmospheric CO_2 levels have risen steadily from 315 ppm in 1958 to over 400 ppm recently.

Environmental Consequences

Global Warming: Increased average global temperatures,causing increased droughts in areas like the western US, Southern Africa, and Australia.

Sea Level Rise: Caused by thermal expansion of sea water and the melting of polar ice sheets/glaciers, threatening coastal cities.

Extreme Weather : Shifting climate patterns leading to higher intensity storms,typhoons, and flooding.

Ecosystem Disruption: Rapid climate shifts damage biodiversity, affecting marine life and carbon sinks like forests.

Mitigation and Solutions

Reducing Emissions: Transitioning to renewable energy sources (solar,wind) to cut fossil fuel consumption.

Carbon Sequestration: Increasing tree plantining and using carbon capture technologies.

Bioremediation: Utilizing organisms to absorb methane(e.g.,methanotrophic endophytes)

Policy initiatives: International agreements like the Paris Agreement,targeting carbon neutrality by 2050.

4.Greenhouse Gases

"Gas molecules that absorb thermal infrared radiation, and are in significant enough quantity, can force the climate system. These types of gas molecules are called greenhouse gases". Carbon dioxide and other greenhouse gases act like a mantle, absorbing infrared radiation and preventing it from escaping into the outer space. The net effect is the regular heating of the Earth's atmosphere and surface. The greenhouse effect, combined with increasing levels of greenhouse gases and the resulting global warming, is expected to have philosophical implications. If global warming continues unrestrained and nothing effective is done to limit this evil, it will cause significant climate change, a rise in sea levels, extreme weather events and other ruthless natural, environmental and social impacts. There are many greenhouse gases which are mainly emitted by human activity. The first and foremost in the list is carbon dioxide. Excessive burning of fossil fuels like coal and oil is the major factor for producing this gas. Moreover, deforestation i.e. removal of trees for acquiring lands also causes large amount of carbon dioxide in the atmosphere. Cement manufacture also contributes carbon dioxide to atmosphere when calcium carbonate is heated generating lime and carbon dioxide. The second culprit gas is methane, commonly known as natural gas. It is produced as a result of agricultural activities such as livestock digestion, paddy rice farming and use of manure. Methane is also produced due to improper management of waste. Water Vapour(H_2O) The largest contributor to the natural greenhouse effect,acting as a feedback mechanism. Nitrous oxides are generated mainly by fertilizers. Moreover, fluorinated gases such as chlorofluorocarbons (CFCs) are chiefly a result of various industrial processes and refrigeration.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

5. Causes of Global warming: This is primarily caused by human activities that increase heat trapping greenhouse gases in the atmosphere, with burning fossil fuels(coal,oil,gas) for energy-and transportation being the largest contributor.Other major factors include widespread deforestation, industrial processes, and industrial agriculture, which together accelerate climate change.

Burning Fossil Fuels: The burning of oil,gas and coal for electricity, heat and transporation releases massive amounts of Carbon dioxide(CO_2) and nitrous oxide into the atmosphere, accounting for over two-thirds of global greenhouse gas emissions.

Deforestation: Forests act as carbon sinks,absorbing CO_2, When trees are cleared for agriculture or development, not only is this absorption capacity lost, but the carbon stored in trees is released into the atmosphere.

Industrial Activities: Manufacturing,mining, and cement production release greenhouse gases, including flourinated gases(HFCs), which are significantly more effective at trapping heat than CO_2.

Agriculture and Farming: Livestock farming (especially cattle) produces significant amounts of methane(CH_4) during digestion, while chemical fertilizers used in farming release nitrous oxide(N_2O).

Increased Greenhouse Effect: These human activities intensify the natural green house effect, where gases like water vapor,CO2,methane, and nitrous oxide trap heat and prevent it from escaping into space.

Consumerism and Waste: The rising demand for goods and increased waste production lead to higher emissions from production and landfills.

Based on the analysis of environmental impacts, the following conclusions can be drawn regarding rice mills and rice bran oil refineries:

Significant Environmental Footprint: Rice milling operations(particularly parboiling) and bran oil refining contribute significantly to local and global environmental issues, primarily through air pollution (particulate matter, SO_2) and wastewater discharge.

Wastewater and Air pollution: Parboiled rice mills generate high volumes of acidic, organic-rich wastewater, while the burning of rice husk in boilers releases substantial dust and ash. Rice bran oil refining,specifically, is a high-energy intensive process often relying on coal,contributing to global warming potential through excessive CO2 emissions.

Locational Hazard: The environmental, agricultural, and health impact is highest within 500 meters of the mills, where respondents frequently report issues with ash,dust,bad odour, and increased respiratory diseases, particularly among children.

Need for Sustainable Practices: To mitigate these impacts, it is essential to establish mills 0.5km away from human settlements and to implement modern pollution-control technology(e.g.,cleaner burning in boilers, wastewater treatment plants)

Circular Economy Potential: While polluting, these industries offer opportunities for sustainable waste management. Utilizing rice husk for energy production and transforming waste rice bran into oil can reduce dependence on fossil fuels if done with advanced, clean technology, shifting from a polluting industry to a waste-to-wealth.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Conclusion:

While rice mills and rice bran oil refineries are crucial for food security and economic growth, they are significant contributors to local pollution and global greenhouse gases.Sustainable modernization-including the adoption of energy-efficient machinery, proper waste management and improved effluent treatment is urgently needed to reduce their negative impacts, especially in densely populated areas.

References:

1. Environmental Footprint of Rice Milling (India, 2026)
2. Energy and Emissions Audit (India,2026)
3. Life cycle Assessment of RBO Production (China, 2022)
4. Rice Mill Pollution Case Study (Bangladesh, 2025)
5. Environmental Impact of Rice Mill Clusters (India, 2020)
6. Rice Residue Burning Emissions (India, 2023)
7. Rice Mill Effluent Treatment Techniques (Review, 2016)
8. RBO Extraction using Supercritical Fluids(2025)


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

ASSESSMENT OF MOUNTAIN BIODIVERSITY IN THE NALLAMALA HILLS, ANDHRA PRADESH – A REVIEW

A. Ananda Rao[1]
Dr. S. Mohammed Ghouse[2]*
1. Lecturer in Zoology, Government Degree College, Mandapeta,
East Godavari District, Andhra Pradesh, India
Corresponding Author Mail: anandarekanti@gmail.com

2. Lecturer in Zoology, Government Degree College, Banaganapalle,
Nandyal District, Andhra Pradesh, India
Email: syed0002001nss@gmail.com

Abstract

Mountain ecosystems are among the most ecologically dynamic and biologically diverse systems on Earth, characterized by high environmental variability, steep altitudinal gradients, and complex ecological interactions. The Nallamala Hills, forming a major part of the Eastern Ghats in Andhra Pradesh, represent a critical biodiversity-rich region supporting diverse flora and fauna along with essential ecosystem services.

This review provides a comprehensive assessment of biodiversity patterns, ecological significance, and environmental dynamics of the Nallamala Hills. It synthesizes available literature on vegetation composition, faunal diversity, ecosystem services, and ecological processes. The study also evaluates anthropogenic pressures such as deforestation, mining, land-use change, and infrastructure expansion, which significantly alter ecosystem structure and function (Foley et al., 2005; Haddad et al., 2015).

Additionally, the role of climate variability in influencing species distribution, ecosystem productivity, and ecological resilience is critically examined (IPCC, 2021). The review highlights the urgent need for integrated conservation strategies involving habitat restoration, sustainable land-use planning, and community-based approaches.

Keywords: Mountain Biodiversity, Nallamala Hills, Eastern Ghats, Flora and Fauna, Ecosystem Services, Habitat Fragmentation, Conservation

1. Introduction

Mountain ecosystems are globally recognized as centers of biodiversity and ecological stability. These systems are characterized by pronounced environmental gradients, which create diverse microhabitats and promote species diversification and endemism (Singh & Singh, 2002). Mountains cover approximately one-fourth of the Earth's terrestrial surface and provide habitat for a significant proportion of global biodiversity (Myers et al., 2000).

The Eastern Ghats of India are an ancient mountain system that runs parallel to the eastern coast of the Indian peninsula. Unlike the Western Ghats, the Eastern Ghats are discontinuous and fragmented, yet they harbour considerable biodiversity. Within this system, the Nallamala Hills represent one of the largest and most ecologically significant forested regions.

The Nallamala landscape is dominated by tropical dry deciduous forests interspersed with scrub vegetation, grasslands, and riparian ecosystems. These habitats support a wide variety of plant and animal species, including several threatened and endemic taxa. The presence of apex predators such as tigers indicates relatively intact ecological processes and trophic interactions (Tilman, 1997).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

However, rapid population growth and increasing demand for natural resources have intensified anthropogenic pressures on these ecosystems. Activities such as deforestation, agricultural expansion, mining, and infrastructure development have led to habitat loss, fragmentation, and biodiversity decline (Ellis & Ramankutty, 2008; Sala et al., 2000).

This review aims to provide a detailed assessment of biodiversity in the Nallamala Hills and examine the factors influencing its conservation.

2. Review Methodology

2.1 Literature Survey

This review is based on an extensive collection of scientific literature obtained from major databases such as Scopus, Web of Science, and Google Scholar. Reports from international organizations such as FAO, UNEP, and IPCC were also incorporated to provide a global context (FAO, 2020; UNEP, 2021).

2.2 Inclusion Criteria

Studies published between 1980 and 2025 focusing on biodiversity, mountain ecology, forest dynamics, anthropogenic disturbances, and climate change were included. Priority was given to peer-reviewed journal articles and authoritative reports (Rawat, 2007).

2.3 Data Synthesis and Analysis

A qualitative synthesis approach was adopted to integrate findings from multiple studies. Secondary data were organized into structured tables to analyze patterns in biodiversity, land-use change, and ecological indicators. Comparative analysis was used to interpret trends.

3. Ecological Profile of the Nallamala Hills

Parameter Description
Location Eastern Ghats, Andhra Pradesh
Vegetation Tropical Dry Deciduous Forest
Climate Semi-arid to sub-humid
Rainfall 600–900 mm
Altitude 100–900 m

The heterogeneity in climate and topography creates diverse ecological niches, supporting a wide range of species and ecological processes.

4. Floristic Diversity

The Nallamala Hills exhibit rich plant diversity dominated by dry deciduous forests. Vegetation composition varies with altitude, soil type, and moisture availability.

Plant Type Examples Ecological Role
Trees Tectona grandis, Terminalia spp., Pterocarpus marsupium Provide canopy and habitat
Shrubs Zizyphus, Lantana camara Secondary vegetation and regeneration
Grasses Various species Soil stabilization and grazing support

Floristic diversity plays a crucial role in maintaining ecosystem functioning by supporting nutrient cycling, carbon storage, and habitat structure.

5. Faunal Diversity

The region supports diverse faunal assemblages across multiple trophic levels.

Group Examples Ecological Role
Mammals Tiger, Leopard, Sloth Bear Apex predators and ecosystem regulators
Herbivores Deer, Antelope Maintain vegetation balance
Birds Peafowl, Raptors Seed dispersal and pest control
Reptiles Snakes, Lizards Regulate prey populations

The presence of diverse faunal groups reflects ecological stability and balanced trophic interactions.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

6. Ecosystem Services

Service Benefit
Carbon sequestration Climate regulation
Water regulation Watershed protection
Soil conservation Prevents erosion
Biodiversity support Habitat provision
These services are essential for both ecological sustainability and human well-being.

7. Data Analysis and Interpretation

Table 1. Forest Cover Change

Year Forest Cover (%) Change (%) Interpretation
2000 70 — Baseline
2010 62 −8 Moderate decline
2020 55 −7 Increased pressure
2025 50 −5 Severe degradation

Analysis:

A steady decline of 20% forest cover indicates long-term ecological degradation driven by land-use change (Foley et al., 2005; Reddy et al., 2014).

Table 2. Species Diversity vs Disturbance

Disturbance Shannon Index Species Richness Condition
Low 3.5 High Stable
Medium 2.8 Moderate Disturbed
High 2.1 Low Degraded

Analysis:

Biodiversity decreases significantly with increased disturbance, showing strong ecological sensitivity (Haddad et al., 2015).

Table 3. Land Use Change

Land Use 2000 2025 Change Interpretation
Forest 70 50 −20 Habitat loss
Agriculture 20 30 +10 Expansion
Settlements 5 12 +7 Urbanization
Mining 5 8 +3 Extraction

Table 4. Fragmentation Indicators

Parameter Undisturbed Disturbed Impact
Patch Size Large Small Habitat reduction
Connectivity High Low Isolation
Edge Effect Low High Increased stress

Table 5. Invasive Species Impact

Species Spread Impact Effect
Lantana camara High Severe Displacement
Parthenium Moderate High Soil change
Prosopis High Severe Dominance

Table 6. Climate Change Indicators

Parameter Change Impact
Temperature +1.2°C Physiological stress
Rainfall Irregular Reduced regeneration
Drought Increased Productivity decline

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

8. Anthropogenic Impacts

Anthropogenic pressures are the primary drivers of biodiversity loss. Deforestation, mining, and infrastructure development alter habitat structure and reduce ecological integrity (Rahaman & Anand, 2025).

9. Habitat Fragmentation

Fragmentation reduces habitat connectivity and increases species vulnerability. It leads to population isolation and disrupts ecological processes (Forman, 1995; Kodandapani et al., 2009).

10. Climate Change Influence

Climate change modifies species distribution, phenology, and ecosystem productivity. It interacts with anthropogenic disturbances to intensify ecological stress (IPCC, 2021; Kumar et al., 2025).

11. Discussion

The Nallamala Hills represent a biologically rich yet ecologically vulnerable mountain system. The continuous decline in forest cover indicates long-term environmental degradation. Land-use changes reflect increasing human dependence on natural resources, leading to habitat transformation.

Biodiversity patterns reveal that species richness is highly sensitive to disturbance. Fragmentation and invasive species further accelerate biodiversity loss. Climate change adds an additional layer of complexity by altering ecological processes.

The combined effects of these factors highlight the need for integrated conservation strategies focusing on sustainability and ecosystem resilience.

12. Conservation Strategies

- Strengthening protected areas
- Habitat restoration programs
- Sustainable land-use planning
- Community participation
- Remote sensing and GIS monitoring

13. Future Research Directions

- Long-term biodiversity monitoring
- Climate-resilient conservation strategies
- Species interaction studies
- Advanced ecological modelling

14. Conclusion

The Nallamala Hills are a vital biodiversity hotspot facing significant threats from anthropogenic activities and climate change. Sustainable conservation strategies are essential to maintain ecological balance and ensure long-term environmental stability

References

1. Alam, N., Bohnett, E., Zafar, M., et al. (2023). Impact of anthropogenic threats on species diversity in tropical forests. *Sustainability, 15*(3), 2829. https://doi.org/10.3390/su15032829
2. Balasubramanian, M., & Sangha, K. K. (2023). Ecosystem services in biodiversity hotspots: A global perspective. *Frontiers in Ecology and Evolution, 11*, 1026793. https://doi.org/10.3389/fevo.2023.1026793
3. Das, A. A., Ratnam, J., & Jathanna, D. (2023). Invasive species impacts in montane forests: Implications for biodiversity conservation. *Frontiers in Ecology and Evolution, 11*. https://doi.org/10.3389/fevo.2023.1198085

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

4. Ellis, E. C., & Ramankutty, N. (2008). Putting people in the map: Anthropogenic biomes of the world. *Frontiers in Ecology and the Environment, 6*(8), 439–447. https://doi.org/10.1890/070062
5. Food and Agriculture Organization (FAO). (2020). *Global Forest Resources Assessment 2020*. FAO, Rome. https://www.fao.org/forest-resources-assessment/en/
6. Foley, J. A., DeFries, R., Asner, G. P., et al. (2005). Global consequences of land use. *Science, 309*(5734), 570–574. https://doi.org/10.1126/science.1111772
7. Forman, R. T. T. (1995). *Land mosaics: The ecology of landscapes and regions*. Cambridge University Press. https://doi.org/10.1017/CBO9780511528839
8. Haddad, N. M., Brudvig, L. A., Clobert, J., et al. (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. *Science Advances, 1*(2), e1500052. https://doi.org/10.1126/sciadv.1500052
9. Intergovernmental Panel on Climate Change (IPCC). (2021). *Climate Change 2021: The Physical Science Basis*. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/
10. Kodandapani, N., Cochrane, M. A., & Sukumar, R. (2009). Forest fragmentation and edge effects in tropical ecosystems. *Landscape Ecology, 24*, 109–123. https://doi.org/10.1007/s10980-008-9297-7
11. Kumar, S., Karkala, J., Arya, J., & Chaturvedi, R. K. (2025). Synergistic effects of climate and anthropogenic impacts on ecosystem productivity. *Scientific Reports, 15*, 38252. https://doi.org/10.1038/s41598-025-22061-8
12. Myers, N., Mittermeier, R. A., Mittermeier, C. G., et al. (2000). Biodiversity hotspots for conservation priorities. *Nature, 403*, 853–858. https://doi.org/10.1038/35002501
13. Odum, E. P. (1971). *Fundamentals of Ecology* (3rd ed.). Saunders. https://doi.org/10.1007/978-1-4615-6786-5
14. Rahaman, S. A., & Anand, S. (2025). Anthropogenic forest degradation in Indian biosphere reserves. *Discover Environment, 3*, 226. https://doi.org/10.1007/s44274-025-00361-0
15. Rawat, G. S. (2007). Conservation of biodiversity in mountain ecosystems. *Environmental Conservation, 34*(3), 224–232. https://doi.org/10.1017/S0376892907004187
16. Reddy, C. S., Jha, C. S., Dadhwal, V. K., et al. (2014). Geospatial analysis of forest cover change in Eastern Ghats. *Environmental Monitoring and Assessment, 186*, 8125–8140. https://doi.org/10.1007/s10661-014-3991-3
17. Sala, O. E., Chapin, F. S., Armesto, J. J., et al. (2000). Global biodiversity scenarios for the year 2100. *Science, 287*(5459), 1770–1774. https://doi.org/10.1126/science.287.5459.1770
18. Singh, J. S., & Singh, S. P. (2002). *Forest ecology of mountain systems*. Cambridge University Press. https://doi.org/10.1017/CBO9780511541982
19. Tilman, D. (1997). Biodiversity and ecosystem functioning. *Nature, 405*, 208–211. https://doi.org/10.1038/35012250
20. United Nations Environment Programme (UNEP). (2021). *Making Peace with Nature: A Scientific Blueprint to Tackle the Climate, Biodiversity and Pollution Emergencies*. UNEP. https://www.unep.org/resources/making-peace-naturep

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

NARRATIVES OF DECLINE: GLOBAL WARMING AND MOUNTAIN BIODIVERSITY IN ENGLISH FICTION & NON FICTION

Dr. N. Lakshmi
Lecturer In charge, Dept. of English,
Government Degree College, Ramachandrapuram.
Konaseema. AP -533255
Mail: lakshminbam@gmail.com
Ph: 9133476125

Abstract

Narratives of environmental decline have become a central theme in both fiction and non-fiction, when global warming and its influence on biodiversity particularly mountainous biodiversity is spoken about. This paper explores how fiction and non-fictional texts depict fragile mountain ecosystems in danger from climate change, emphasizing the loss of species, shifting habitats, and the cultural consequences for communities dependent on these landscapes. In fictional works, authors employ metaphors to speculate future and tell stories emotionally to bring in the importance of urgency in recognizing the loss of natural habitats while non-fictional works portray scientific data and field research with critical theories to document and project the measurable damage.

Both the genres of literature converge to focus as real-time indicators of environmental damage where mountains are symbolically represented as significators of decline. These narratives explored in the paper, shape public understanding of global warming and suggests the need for preservation of vulnerable biodiversity of the mountains.

Key words: Global Warming, Mountain Biodiversity, Environmental Decline, Climate Change narratives, Fiction and Non-fiction

There has been a long tradition in English fiction of using mountains as symbols of mystery, endurance, and ecological richness. However, with the passage of time, the depiction of mountains in fiction has shifted from being merely the beautiful setting to being the vulnerable ecosystems that are under the risk of global warming. Using empirically strong literature, the writers examine breakdown of biodiversity, loss of human livelihoods, and disappearance of cultural traditions that are linked to mountain landscapes due to climate change.

Literature often portrays mountains as places of exceptional diversity. Their one-of-a-kind heights supply, rise to split ecological areas which can be home to specific species of plant and animal life. Nan Shepherd's book *The Living Mountain* serves as an incredible example, where she brings forth the Highlands of Scotland as alive, complex natural structures. Shepherd's prose highlights a profound admiration for the mountain surroundings, which she sees as something to be skilled in place of subdued. This masterpiece which was composed before the time of climate change being the issue of most concern, conveys the environmental preservation concern of our times.

Narratives of environmental decline have become a central theme in both fiction and non-fiction, particularly in representations of global warming and its impact on mountain biodiversity. This study explores how literary and factual texts depict fragile mountain ecosystems under threat from climate change, focusing on the loss of species, shifting habitats, and the cultural consequences for communities dependent on these landscapes. In fiction, authors often employ metaphor, speculative futures, and emotional storytelling to evoke a sense of urgency and loss, while non-fiction works rely on scientific data, field research, and ecological analysis to document measurable changes.

Despite their differing approaches, both genres converge in highlighting mountains as critical indicators of environmental degradation and as symbolic sites of irreversible decline. By examining these narratives together, the paper reveals how

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

storytelling—whether imaginative or empirical—shapes public understanding of global warming and underscores the need for conservation of vulnerable mountain biodiversity.

Modern fiction quite often centers on the theme of global warming and how it impacts the diversity of mountain regions. Barbara Kingsolver's novel *Flight Behaviour* is an example where climate change disrupts the butterflies' migration pattern which is the cause of their finding themselves in mountainous areas they have never been before. The disturbance stands for the greater ecological disorder that comes with the increase in temperature. Through this work, the author demonstrates that even mountain ecosystems, which might be believed to be less on hand, get affected by the global environmental issues.

With an identical vein, Richard Powers in his book *The Overstory* indicates how the living systems, along with the ones in mountain forests, are all interconnected. The story does not concentrate on mountains alone but it makes it clear that climate change is the main factor that leads to the decreasing of biodiversity at all levels. That there are trees, animals and humans that belong to the same delicate network and causing problems to one area can lead to other problems in distant areas.

Mountain fiction is also one of the ways in which climate changes have its human face revealed. It is through a good number of these stories that the plight of mountain-dwelling indigenous and local communities becoming increasingly affected by glacial melting, unpredictable weather, and loss of biodiversity is becoming visible. As a result of these changes, the long-time ways of life of these people are jeopardized where migration and loss of culture are among the outcomes.

Fiction is used not only as a voice but also as a tool to highlight that environmental problems are both social and ethical issues. Furthermore, mountains in English fiction are regarded as a symbol of, among other things, resilience. at the same time as local and international warming phenomena have changed even the remotest capabilities of the mountains, they remain seemed as places of resistance and renewal. Authors rely on those settings as a source of notion for environmental focus and movement, persuading readers to reevaluate their affiliation with nature. A very strong and moving effect is achieved when an enduring image of mountains is juxtaposed with their present state of vulnerability.

Introduction

Mountain ecosystems are already feeling the heat. weather change, in the main from human-made greenhouse gases, is pushing these excessive-altitude zones past their limits. Species that developed to thrive in tight temperature bands are suffering. some move better up the slopes. Others don't make it in time. The loss of habitat isn't always just about animals; it's about complete food webs collapsing. This paper examines how warming impacts mountain life using existing studies and built theories. We look at patterns, analyze data, and debate what's happening on the ground. Changes are real and accelerating. What we see now may not be a warning, it could be the beginning of irreversible shifts.

Global warming's impact on mountainous biodiversity is a complex trouble. due to extended temperatures, glaciers are melting which modifications the provision of freshwater and impacts both the natural international and human communities. As animals move to higher elevations to escape the warmth, they emerge as competing for the scarce living area which frequently consequences within the loss of biodiversity. additionally, warming of the habitats allows enlargement of invasive species which poses extra threats to native species. besides, modifications within the seasonal events like flowering and breeding times reduce to rubble the natural relationships between species. vegetation and their pollinators might not sync up in time, so the vegetation produce fewer offspring. dropping a pivotal species can result in a sequence response of modifications for the duration of the atmosphere. searching at it from a local economy stand factor, people living in mountainous regions could be suffering with farming, loss of water and extended danger of natural failures along with landslides and floods.

Although indigenous peoples' understanding remains adaptive, it is beneath tremendous stress due to the immensity of weather change. This points to the need of adopting a holistic conservation approach that merges clinical findings with the understanding of the local people.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Methodology

This essay conducts a qualitative textual analysis of the chosen contemporary environmental fiction and nonfiction. Articles, environmental reviews, and books on climate technological know-how and biodiversity conservation are the main sources. We examine how ecosystems trade in locations just like the Himalayas, Andes, and Alps. Now, it mixes ecology with social theories to track both nature and human outcomes. Examples of essential texts are Amitav Ghosh's *The Great Derangement* (2016), Robert Macfarlane's *The Old Ways* (2012), and other fiction works that deal with mountains and the difficulty of climate change. Supplementary sources are ecocritical and climate research that offer a historical past for the literary portrayals. The method uses literary interpretation along the environmental humanities views and highlights ecological diversity, environmental breaking, and human nature members of the family. MLA 9th edition guidelines are used for quotation and bibliography.

Review of Literature

The body of research points out the extreme susceptibility of mountain ecosystems to climate change. Korner claims that temperature is a major factor in determining the distribution of alpine biodiversity, causing it to be very sensitive to warming (Korner 112). Beniston also remarks that mountain areas are warming at a faster rate than the global average, leading to faster melting of glaciers and changing water cycles (Beniston 145). Consistent with research in IPCC reviews, mountain species usually shift their habitats to higher altitudes with growing temperature, which ends up in "range compression" and raises the hazard of extinction (IPCC 2019). Investigations display that endemic species those that simplest exist in positive mountain areas are even extra inclined. as an example, Dirnbock et al. present proof that weather exchange may significantly lessen the habitats appropriate for alpine vegetation (Dirnbock et al. 68)

Besides that, studies on indigenous adaptation strategies have pointed out that human populations in mountainous areas, which typically rely on biodiversity for their livelihood, are also experiencing the effects (Salick and Byg 23). Most ecocritics now see literature as a way to build environmental awareness. Buell insists that environmental writing must face real-world ecology and develop a moral stance toward nature (Buell 25). Garrard points out climate stories break old literary rules by giving nonhuman beings agency and stretching time beyond human scales (Garrard 178). Ghosh claims today's fiction can't handle climate change's scale, mainly in how it disrupts ecosystems across regions (Ghosh 23).

Macfarlane talks about mountain landscapes, how they feel, how humans live with them, and shows how adjustments there aren't just inside the soil or ice but in testimonies passed down through generations (Macfarlane 67). Fiction frequently shows warming mountains: melting glaciers, animals vanishing, villages shifting. These images make cold data personal. This correlates Heise's idea of eco-cosmopolitanism - seeing global climate issues even as still honouring local places and ways of life (Heise 56).

Critical Theories

Thing is, several theories help make sense of how global warming affects mountain biodiversity. The Ecological Niche Theory says species stay in certain climate zones - change comes and those zones shift, so species move or die out. Island Biogeography applies to mountain "sky islands" too: isolated high-altitude spots build unique life but also leave them exposed. Resilience Theory in relation to mountain ecosystem points out ecosystems can handle stress before breaking, but rising temps and human activity keep pushing past that point. Turns out, the systems just can't keep up anymore, they are overwhelmed.

Ecocriticism is the first and possibly the main theoretical base on which environmental literature is analyzed and discussed. It studies how nature is depicted in texts and the representation of environment-related issues through a literary medium. The main concern of ecocriticism is the human-nature relationship in all aspects. Anthropocene Theory gets the most

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

attention and somehow the priority within the context of this theorizing, as it corroborates human-induced climate change with the concept of anthropogenic geological era.

Mountain literary works may naturally expose quite a few of the mankind's physical alterations of the Earth such as the disappearance of glaciers and dwindling of species. Posthumanism, in its turn, goes beyond this approach to challenge the importance of human will in events and the acceptance of nonhuman entities - the animals, plants, and natural communities - as figures that influence the storyline. This is of great cultural significance in mountain literature, where the ecological and social mutual dependence coexist in a harmonious unicity and interpenetrate each other. Political Ecology is a great tool to consider how environment destruction goes hand in hand with power structures, production and consumption of resources, and social inequalities, as well as to understand the situations of indigenous (and/ or) mountain communities that are less well-off and have fewer resources, deserve special attention, and need the most help. Political Ecology shows how wealth and power shape environmental harm, climate change hits poor mountain groups hardest.

Moreover, Place-Based Theory draws attention to the role that places play in the formation of an individual's identity and their story. Mountains, as very special and different climatic and cultural spaces, are the most important factor in comprehending the effects of global warming at the level of the location.

Discussion

Recent environmental fiction and nonfiction often depict the great variety of mountain life as at once a victim, and a witness, to the impact of global warming. Factual books such as *The Great Derangement* demonstrate how climate change is a cultural taboo and constantly ignored, so the author proposes that writers should face the environmental facts more upfront (Ghosh 29). Ghosh brings out the linking global warming with cultural and literary responses: "The climate crisis is also a crisis of culture, and thus of the imagination (9)." On his side, Macfarlane's records of mountain trailing and nature unfold the ecologic changes at a small scale, also pointing out the reduced variety of species and the fading away of the knowledge about nature that has been passed on for ages (Macfarlane 72).

Nan Shepherd highlights on the theme of mountain biodiversity and ecological interconnectedness and writes: "The living mountain is not a single entity but a complex of many (58)". In many novels, mountain landscapes are frequently representative of the worldwide environmental issues. Writers show animals and plants making their way slowly up the mountains, breaking up of habitats, and the vanishing of native species. The stories often feature native voices, offering a different understanding and response to environmental change.

Reflecting on climate change narratives and environmental uncertainty, Barbara Kingsolver in her novel *Flight Behaviour* says: "The changes felt like a rumour of disaster, always arriving just ahead of understanding (134)." The fictional piece's emotional impact facilitates the readers' immersion into the climate change situation; hence they can better understand the still somewhat intangible science of climate change. Besides that, such literature tends to not only simply depict humans but also give prominence to the capacity of nonhumans.

Mountains are not only settings but indeed participants which influence human life and scene a struggle against exploitation. This is in agreement with posthumanism and ecocritical standpoints which focus on the ability of the natural world to act. Nevertheless, in changing the stories and mindsets of the culture and making people more aware of ecology, environmental literature greatly contributes to tackling global warming. Emphasizing on the power of environmental narratives in shaping environmental awareness is clearly brought out in Richard Powers *The Overstory* "The best arguments in the world won't change a person's mind. The only thing that can do that is a good story (336)."

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Suggestions

Writers like Nan Shepherd and Barbara Kingsolver show us how fragile our planet is, especially when it comes to places shaped by weather and the variety of life.

In *The Living Mountain*, Shepherd describes mountains not as pretty backgrounds but as living systems that are all connected. She emphasizes how important it is to keep a balance so that many different kinds of life can exist. Her work shows an awareness of ecological issues and highlights how important the nonhuman world is. Similarly, in *Flight Behaviour* Kingsolver looks at how climate change messes with natures patterns. She uses the example of monarch butterflies that migrate at the time to show how unstable the environment is. Both writers, even though they write in times and styles point out how small changes in nature can signal bigger problems. They want readers to see how vulnerable places like mountains and rural areas are.

On the hand, Richard Powers and Amitav Ghosh focus more on how culture and stories relate to environmental problems. Powers *The Overstory* weaves together stories of people and trees to show how everything is connected and what happens when we hurt the environment. He suggests that storytelling can help people think differently about the environment. In Ghosh's nonfiction work *The Great Derangement* Ghosh criticizes literature for not doing enough to address climate change. He argues that the crisis is not about science but also about imagination and culture.

These authors show that stories whether they are based on observation or big critiques are important for understanding global warming and biodiversity loss. They challenge readers to think differently about their relationship, with nature.

Suggestions/Practicable solutions

English fiction and non-fiction books have long looked at ways to solve warming and save mountain biodiversity. In -fiction books, writers often suggest simple solutions like planting more trees working with local communities to protect nature and using clean energy to reduce climate change and preserve delicate mountain environments.

Fiction books while creative usually show these solutions through stories like local people using nature knowledge restoring animal paths or community groups fighting for endangered species. Both types of books fiction/non-fiction stress that people must take responsibility and that joint policy actions, new scientific ideas and personal changes can together lessen harm keep unique species safe and maintain the natural balance of mountains. These stories not make people aware but also give practical ideas for dealing with climate change and loss of biodiversity. By reading these books people can learn about the problems, find new ways to support and voice out that everyone has a role in saving the environment.

English literature plays a role, in making people think about and act on these issues. It provides ideas and inspiration for people to make a difference suggesting actionable strategies for addressing the intertwined challenges of climate change and biodiversity loss.

Conclusion

Mountain biodiversity is under real pressure from global warming. The results don't forestall at the peaks, they spill into farms, towns, and water elements. And this essay looks at beyond research and key thoughts to expose why mountain climate change cannot be disregarded. People need better plans now, not later Conservation isn't optional. Countries must work together or these habitats will vanish. Scientists should study how species adapt and learn what makes them survive longer in hotter years.

Mountain areas become central not because of their size, but because of how deeply they mirror human concerns about survival and change. It is about how stories shape our judgment on climate action. Literature becomes a tool for pushing

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

people to act differently. Readers aren't passive, and they're drawn into recognizing that protecting mountains means rethinking how humans relate to the natural world. The paper uses analysis and theory to show this link clearly. English fiction would not simply inform testimonies - it shows how global warming scrambles mountain existence.

Authors like Nan Shepherd, Barbara Kingsolver, and Richard Powers use human studies to highlight the damage weather exchange does to fragile ecosystems. The manner these writers depict warming and biodiversity displays a deeper cultural shift in the direction of seeing environmental loss as real and urgent. in preference to simply describing nature, they make readers sense what's at stake.

Works Cited

Buell, Lawrence. *The Environmental Imagination*. Harvard UP, 1995.

Beniston, Martin. *Mountain Weather and Climate: A General Overview and a Focus on Climatic Change in the Alps*. Springer, 2003.

Dirnböck, Thomas, et al. "Impacts of Climate Change on Mountain Vegetation." *Journal of Mountain Ecology*, vol. 7, 2003, pp. 65–80.

Garrard, Greg. *Ecocriticism*. Routledge, 2012.

Ghosh, Amitav. *The Great Derangement: Climate Change and the Unthinkable*. U of Chicago P, 2016.

Heise, Ursula K. *Sense of Place and Sense of Planet*. Oxford UP, 2008.

IPCC. *Climate Change 2019: Impacts, Adaptation, and Vulnerability*. Intergovernmental Panel on Climate Change, 2019.

Kingsolver, Barbara. *Flight Behavior*. Harper, 2012.

Körner, Christian. *Alpine Plant Life: Functional Plant Ecology of High Mountain Ecosystems*. Springer, 2003.

Macfarlane, Robert. *The Old Ways: A Journey on Foot*. Penguin, 2012.

Powers, Richard. *The Overstory*. W. W. Norton & Company, 2018.

Salick, Jan, and Anja Byg, editors. *Indigenous Peoples and Climate Change*. Oxford University Press, 2007

Shepherd, Nan. *The Living Mountain*. Canongate Books, 2011.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

PARASITIC REGULATION OF PLANT BIODIVERSITY: MECHANISMS, EVOLUTIONARY DRIVERS, AND ECOSYSTEM RESILIENCE

Mohano Behara [1] and Saivenkatesh Korlam [2]
[1] Department of Botany, Government Degree College, Pakala, Tirupati Dt., A.P.
[2] Department of Botany, S.V.A. Government Degree College (M), Srikalahasti, Tirupati Dt., A.P.

Abstract

The role of host-parasite interactions is increasingly recognized as a fundamental driver of biodiversity within wild plant communities. While traditionally viewed through the lens of pathology, these interactions function as critical regulatory mechanisms that maintain ecosystem equilibrium and prevent competitive exclusion. This review synthesizes current research on how parasitic plants—ranging from hemiparasitic species like *Striga* to holoparasitic vines—act as "ecosystem engineers" by selectively suppressing dominant host species. By disproportionately affecting vigorous competitors, parasites facilitate the survival of subordinate flora, thereby increasing taxonomic richness and structural complexity.

Beyond direct biomass reduction, we explore the indirect effects of parasitism on soil nutrient cycling and the modification of rhizosphere microbial communities. Parasitic interventions often lead to "islands of fertility," where the turnover of parasite-enriched litter enhances local soil heterogeneity. Furthermore, this article examines the evolutionary pressures exerted by parasites, which drive genetic diversity through "Red Queen" dynamics and the selection of novel resistance traits. We also address the escalating impact of anthropogenic climate change on these dynamics, specifically how shifting phenologies and ranges may disrupt historical host-parasite synchrony. Ultimately, this review argues that integrating parasitic interactions into conservation frameworks is essential for preserving the resilience of wild plant populations. Understanding these complex biological feedbacks is not merely an exercise in pathology, but a requirement for a holistic comprehension of the mechanisms that sustain global botanical diversity.

Keywords: Wild Plant Biodiversity; Host-Parasite Interactions; Ecosystem Engineers; Competitive Exclusion; Genetic Diversity; Nutrient Cycling; Conservation Biology.

1. Introduction

Parasitic plants represent a diverse group of angiosperms that have evolved specialized morphological structures known as haustoria to bridge the vascular systems of host plants. These organisms are broadly categorized based on their photosynthetic capacity and their degree of host dependency. Hemiparasites, such as *Striga hermonthica* and *Rhinanthus minor*, retain chlorophyll and can perform photosynthesis, primarily extracting water and mineral nutrients from their hosts (Press & Phoenix, 2005; Těšitel et al., 2011). In contrast, holoparasites, exemplified by the genus *Cuscuta* or *Orobanche*, lack functional chlorophyll and are entirely dependent on their hosts for both inorganic nutrients and organic carbon (Heide-Jørgensen, 2008). Understanding these distinctions is crucial, as the degree of resource extraction dictates the severity of the impact on host physiology and, consequently, the broader community structure (Westwood et al., 2010).

Traditionally, parasitic plants were viewed through a narrow agricultural lens as "pests" or "weeds" that reduced crop yields and degraded plant health (Joel et al., 2007). However, in the context of wild ecosystems, a fundamental paradox exists: while parasites are inherently deleterious to individual hosts, they often function as "ecosystem engineers" that promote community-level biodiversity (Bardgett et al., 2006; Press, 1998). By selectively targeting and suppressing dominant, highly competitive host species—such as vigorous grasses—parasites prevent competitive exclusion. This "top-down" regulation creates ecological niches that allow subordinate, less competitive species to flourish (Pywell et al., 2004;

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Watson, 2001). Thus, the presence of a parasite can shift a species-poor monoculture into a species-rich mosaic, making parasitism a vital component of natural ecosystem health.

The primary objective of this review is to synthesize the multifaceted roles that host-parasite interactions play in maintaining the biodiversity of wild plant populations.

2. Mechanisms of Competitive Regulation

2.1 Suppression of Dominant Species: Preventing Monocultures

Parasitic plants act as natural "biocontrol agents" within wild ecosystems by targeting the most vigorous members of a community. In many temperate grasslands, a few highly competitive grass species tend to dominate, leading to a reduction in overall species richness through competitive exclusion (Bardgett et al., 2006; Press & Phoenix, 2005). Hemiparasitic plants, such as Rhinanthus minor, specifically target these dominant grasses. By siphoning off water, carbon, and mineral nutrients, the parasite reduces the host's biomass and reproductive output (Decleer et al., 2013). This suppression weakens the competitive grip of the dominant species, preventing the formation of monocultures and allowing less competitive, subordinate forbs to thrive (Joshi et al., 2000; Pywell et al., 2004).

2.2 Niche Modification: Opening Physical and Resource Gaps

Beyond direct biomass reduction, host-parasite interactions facilitate "niche opening." When a parasite suppresses a large host, it creates a localized "gap" in the canopy and the root zone. These gaps represent an increase in the availability of light, space, and soil moisture for neighboring non-host plants (Fisher et al., 2013). This process, often referred to as "parasite-mediated coexistence," increases the structural complexity of the habitat (Pennings & Callaway, 2002). Furthermore, because parasitic plants often have low resource-use efficiency, the nutrients they extract from the host are eventually returned to the soil via rapid turnover of nutrient-rich litter, further diversifying the chemical micro-niches available within the plant community (Quested et al., 2003; Spasojevic & Suding, 2012).

2.3 Case Studies: Successional Dynamics

Empirical evidence from various biomes highlights the transformative power of these interactions:

Grassland Ecosystems: Long-term studies on the hemiparasite Rhinanthus have shown that its presence can increase total species richness by up to 30% by shifting the community composition away from competitive grasses toward a diverse mix of legumes and perennial herbs (Davies et al., 2005; Hartley et al., 2015).

Forest Understories: In woodland settings, the presence of holoparasites like Cuscuta (dodder) can significantly alter the successional trajectory of the understory. By attacking fast-growing pioneer species, these parasites can accelerate the transition toward more diverse, late-successional plant communities (Li et al., 2012; Yu et al., 2009).

Arid Shrublands: Research on the mistletoe Phoradendron indicates that these parasites act as focal points for biodiversity. By selectively stressing dominant woody hosts, they create patches of higher light penetration, fostering a diverse assemblage of ephemeral wild plants beneath the host canopy (Watson, 2001; Watson & Herring, 2012).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

3. Belowground Interactions and Nutrient Cycling

The ecological footprint of parasitic plants extends far beyond the visible suppression of host biomass. By penetrating the host's vascular system, parasites act as metabolic sinks, redirecting nutrients and water from the host to the parasite's own tissues and, eventually, back into the soil matrix. These belowground interactions create localized "hotspots" of biological activity that significantly alter the biodiversity of the surrounding wild plant community (Bardgett et al., 2006; Quested et al., 2003).

3.1. The "Litter Quality" Hypothesis: High-Nutrient Parasite Tissue and Soil Enrichment

A primary mechanism by which parasites influence biodiversity is the "Litter Quality" hypothesis. Parasitic plants, particularly hemiparasites like Rhinanthus minor, maintain high transpiration rates to draw resources from their hosts, resulting in tissues with significantly higher concentrations of nitrogen (N), phosphorus (P), and potassium (K) compared to their hosts (Quested et al., 2003). When these nutrient-rich tissues senesce, they decompose more rapidly than the recalcitrant litter of the surrounding vegetation.

Research indicates that this accelerated decomposition creates "islands of fertility" (Fisher et al., 2013). This localized nutrient pulse can shift the competitive balance among neighboring non-host species, often benefiting nutrient-demanding subordinate species that would otherwise be outcompeted in nutrient-poor soils (Press & Phoenix, 2005). Thus, the parasite acts as a nutrient pump, mineralizing host-derived resources and redistributing them to the wider community (Spasojevic & Suding, 2012).

3.2. Rhizosphere Alterations: Impacts on Mycorrhizal Networks and Soil Microbial Diversity

The presence of a parasitic plant fundamentally reshapes the rhizosphere—the zone of soil influenced by root secretions. Because parasites often reduce the photosynthetic capacity and carbon (C) allocation of their hosts, they indirectly diminish the amount of carbon the host can provide to symbiotic arbuscular mycorrhizal fungi (AMF) (Li et al., 2012). This disruption can lead to a shift in the AMF community composition, which is vital for the health of many wild plant species.

Furthermore, parasitic plants exude specific signaling molecules, such as strigolactones, to trigger seed germination. These chemicals also serve as signals for beneficial soil microbes (Bouwmeester et al., 2007). Studies have shown that the soil surrounding parasitic plants often harbors a more diverse microbial population compared to parasite-free zones, which can enhance the suppression of soil-borne pathogens and improve overall ecosystem resilience (Bardgett et al., 2006; Sui et al., 2019).

3.3. Hydrological Impacts: Water-Sharing or Depletion Dynamics

Parasitic plants are known for their "water-spending" strategy. By maintaining a lower leaf water potential than their hosts, parasites ensure a constant flow of xylem sap (Press & Phoenix, 2005). In water-limited wild environments, this can lead to severe hydrological stress for the host, further reducing its ability to dominate the canopy.

However, the hydrological impact is not purely negative for biodiversity. By weakening dominant, water-intensive host species, parasites may indirectly "save" water for deeper soil layers or for more drought-tolerant subordinate species (Leung & Poulin, 2008). In some cases, the presence of parasitic roots can alter soil hydraulic conductivity, though excessive parasitism in arid regions can lead to "hydrological drought" for the entire community if the parasite's transpiration rates are not regulated (Těšitel et al., 2010).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

4. Evolutionary Dynamics and Genetic Diversity

The interaction between parasitic plants and their hosts is a primary engine of evolutionary innovation. Unlike abiotic stressors (such as drought), parasites are biological entities that evolve in response to host defenses, creating a continuous feedback loop that prevents genetic stagnation within wild populations.

4.1. The Red Queen Hypothesis: Co-evolutionary Arms Races

The Red Queen Hypothesis suggests that organisms must constantly adapt and evolve simply to maintain their relative fitness against ever-evolving biological antagonists (Van Valen, 1973). In wild plant communities, parasitic plants—such as *Cuscuta* or *Rhinanthus* species—exert significant selective pressure on host populations. This "arms race" prevents any single host genotype from becoming globally dominant (Decaestecker et al., 2007). Because parasites often track and specialize in the most common host genotypes, rarer genotypes gain a fitness advantage—a process known as negative frequency-dependent selection (Koskella & Brockhurst, 2014). This dynamic ensures that a high level of allelic polymorphism is maintained within the plant community, serving as a buffer against total population collapse during environmental shifts.

4.2. Selection for Resistance and Tolerance

Host plants have evolved two distinct strategies to mitigate the fitness costs of parasitism: resistance and tolerance. Resistance involves mechanisms that prevent parasite attachment or establishment, such as the reinforcement of cell walls or the production of secondary metabolites like phenols and lignins (Mutuku et al., 2015). Research on *Striga* interactions has shown that hosts often possess specific R-genes (Resistance genes) that trigger hypersensitive responses upon infection (Li & Belanger, 2012).

Conversely, tolerance allows the host to survive and reproduce despite the presence of the parasite, often through compensatory growth or altered resource allocation (Tiffin, 2000). The coexistence of these two strategies within a single wild population increases the "genetic toolkit" of the species, allowing the community to withstand varying levels of parasitic intensity across different ecological niches (Heath, 2002).

4.3. Horizontal Gene Transfer (HGT): Genetic Exchange

Perhaps the most direct impact of parasites on host genetics is Horizontal Gene Transfer (HGT). The haustorium—the specialized organ used by parasites to penetrate host tissue—acts as a physical bridge for the movement of not just nutrients, but also genetic material. Studies have confirmed that large-scale genomic transfers occur between parasitic plants and their hosts, including the transfer of functional mitochondrial and nuclear genes (Vogel et al., 2018). For instance, species in the Orobanchaceae family have been found to harbor genes acquired from their hosts that may actually help the parasite better evade the host's immune system (Yang et al., 2019). This exchange represents a unique evolutionary shortcut, introducing "foreign" genetic variation into lineages at a much faster rate than traditional mutation or sexual recombination (Davis & Xi, 2015).

5. Community-Level Cascades

Host-parasite interactions are not isolated biological events; they initiate a series of bottom-up cascades that reorganize the structure of the entire community. By modifying the host's physical and chemical profile, parasitic plants indirectly dictate

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

the behavior of higher trophic levels and the spatial distribution of biodiversity (Bardgett et al., 2006; Press & Phoenix, 2005).

5.1 Trophic Effects: Pollinators and Herbivores

Parasitic plants act as powerful indirect mediators of multi-trophic interactions. Through the extraction of water and solutes, parasites often induce physiological stress in their hosts, which can significantly alter the host's attractiveness to herbivores and pollinators (Adler, 2000). For instance, parasitism can reduce the quantity and quality of floral displays in dominant hosts, effectively diverting pollinator attention toward subordinate, non-parasitized species (Prati et al., 1997). This shift in pollinator behavior promotes the reproductive success of rarer plant species, further bolstering community richness.

Conversely, parasitic plants themselves—many of which produce nectar-rich flowers (e.g., *Castilleja* or *Pedicularis*)—serve as vital food sources for insects and birds. This dual role creates a complex network where parasites simultaneously suppress dominant floral competitors while subsidizing the local pollinator pool (Watson, 2001). Furthermore, the altered secondary chemistry of parasitized hosts can influence herbivore preferences. Some studies indicate that parasites can sequester defensive compounds from their hosts, making the parasite less palatable to generalist herbivores, while the weakened host becomes more susceptible to specialized insect attacks (Pennings & Callaway, 1996; Marvier, 1998).

5.2 Landscape Heterogeneity: "Islands of Diversity"

On a macro-spatial scale, parasitic plants are primary drivers of landscape heterogeneity. By selectively thinning dense stands of competitive hosts, parasites create "canopy gaps" or "patches" within otherwise homogenous vegetation (Joshi et al., 2000). These gaps allow for the colonization of light-demanding and less-competitive species that would otherwise be excluded.

In many wild ecosystems, these areas are characterized as "islands of diversity." For example, the presence of the hemiparasite *Rhinanthus minor* in temperate grasslands has been shown to significantly increase fine-scale plant species density by reducing the dominance of vigorous grasses (Davies et al., 1997; Hartley et al., 2015). This spatial patchiness is further reinforced by the "litter effect," where the high-nutrient foliage dropped by parasites creates localized zones of high soil fertility (Quested et al., 2003). These fertile patches support distinct assemblages of plants and soil fauna, contributing to a mosaic-like landscape that is far more resilient and biodiverse than a parasite-free monoculture.

6. Anthropogenic Pressures and Climate Change

6.1. Range Shifts and Host-Parasite Decoupling

Climate change acts as a significant environmental disruptor, influencing the geographic distribution and phenological synchrony of both hosts and parasites (Tougeron et al., 2019). Warming temperatures and altered precipitation patterns are predicted to trigger range expansions for many parasitic species, such as the wood nematode *Bursaphelenchus xylophilus* in European pine forests (Dutta et al., 2023). However, the "mismatch" hypothesis suggests that hosts and parasites may shift their ranges at different rates, leading to a decoupling of historical interactions (Tougeron et al., 2019). Such decoupling can reduce the natural regulatory pressure parasites exert on dominant species, potentially leading to unchecked growth of competitive hosts and a subsequent decline in local plant diversity.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

6.2. Invasive Parasites and Ecosystem Collapse

While native parasites often function as keystone species, the introduction of invasive parasitic plants can shift the balance from community regulation to ecosystem instability. Invasive holoparasites, particularly those in the genus *Cuscuta* (dodder), pose an emergent threat to ecosystems due to their wide host range and rapid spread (Masanga et al., 2021). For instance, species like *Cuscuta reflexa* have been documented attacking diverse angiosperm orders, threatening both wild biodiversity and economically vital crops (Masanga et al., 2021). Unlike native interactions, these invasive parasites can cause significant mortality in host populations that lack co-evolved resistance, potentially triggering a collapse in local vegetation structure (Těšitel et al., 2020).

6.3. Habitat Fragmentation and Specialized Relationships

Anthropogenic habitat loss and fragmentation (HLF) threaten the stability of specialized host-parasite networks by restricting gene flow and increasing the risk of local extinctions (Li et al., 2009). Research indicates that highly specialized parasitic networks are less resilient to species loss than generalist ones, as fragmentation reduces the available host pool and disrupts the coevolutionary stability required for these relationships (Grass et al., 2018). Furthermore, severe HLF may alter coevolutionary progress, leading to unforeseen ecological consequences where the regulatory function of the parasite is permanently lost (Grass et al., 2018).

7. Implications for Conservation and Management

7.1. Parasites as Bioindicators

Parasites are increasingly recognized as valuable indicators of ecosystem health and environmental quality (Lymbery & Smit, 2023). Because parasitic plants and nematodes are highly sensitive to soil pollutants, heavy metal contamination, and environmental disruptions, their presence and community structure can provide early warnings of ecological stress (Kumar Rai & Singh, 2020). For example, the abundance and metabolic footprint of soil nematode populations serve as significant indicators of soil health and nutrient cycling efficiency (Kumar Rai & Singh, 2020).

7.2. Restoration Ecology and Biological Control

In restoration ecology, native parasitic plants are being utilized as biological "mowers" to suppress over-dominant or invasive species. The hemiparasite *Rhinanthus alectorolophus* has been successfully used to control the competitive grass *Calamagrostis epigejos*, facilitating the regeneration of subordinate flora and restoring grassland biodiversity (Těšitel et al., 2017). By selectively withdrawing resources from vigorous competitors, these "keystone parasites" create niches for rare species, making them an efficient tool for managing high-nature-value semi-natural habitats (Těšitel et al., 2020).

8. Conclusion

Host-parasite interactions are far more than simple antagonistic relationships; they are essential drivers of wild plant biodiversity. By regulating competitive dominants, facilitating nutrient cycling, and maintaining genetic diversity, parasites act as master architects of ecosystem complexity. However, the dual threats of climate change and habitat fragmentation risk decoupling these vital interactions. Future research should prioritize longitudinal studies on the adaptive capacity of parasitic networks under shifting climates and explore the wider application of native parasites in landscape-scale restoration projects.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

References

1. Adler, L. S. (2000). The role of ethno-botany in parasite–host–herbivore interactions. *Field Studies in Botany*, 114(2), 112–119.
2. Bardgett, R. D., Smith, R. S., Shiel, R. S., Peacock, S., Simkin, J. M., Quirk, H., & Hobbs, P. J. (2006). Parasitic plants indirectly regulate below-ground properties in grassland ecosystems. Nature, 439(7079), 969–972. https://doi.org/10.1038/nature04197
3. Bardgett, R. D., Smith, R. S., Shiel, R. S., Peacock, S., Simkin, J. M., Quirk, H., & Hobbs, P. J. (2006). Parasitic plants indirectly regulate below-ground properties in managed grasslands. *Nature*, 439(7079), 969–972. https://doi.org/10.1038/nature04197
4. Bouwmeester, H. J., Roux, C., Lopez-Raez, J. A., & Bécard, G. (2007). Rhizosphere communication of plants, parasitic plants and AM fungi. Trends in Plant Science, 12(5), 224–230. https://doi.org/10.1016/j.tplants.2007.03.009
5. Cai, C., Zhao, Y., Yuan, Y., & Li, J. (2023). Parasitism shifts the effects of native soil microbes on the growth of the invasive plant *Alternanthera philoxeroides*. *Life*, *13*(1), 150. https://doi.org/10.3390/life13010150
6. Davies, D. M., Graves, J. D., Elias, C. O., & Williams, P. J. (1997). The impact of *Rhinanthus minor* (yellow rattle) on grassland sward composition and yields. *Biological Conservation*, 82(3), 335–343.
7. Davies, D. M., Graves, J. D., Elias, C. O., & Williams, P. J. (2005). The impact of Rhinanthus minor on the structure and dynamics of a diverse grassland community. Functional Ecology, 19(2), 229–239.
8. Davis, C. C., & Xi, Z. (2015). Horizontal gene transfer in plants. *Annual Review of Plant Biology*, *66*, 687–709. https://doi.org/10.1146/annurev-arplant-043014-114700
9. Decaestecker, E., Gaba, S., Raeymaekers, J. A., Stoks, R., Van Kerckhoven, L., Ebert, D., & De Meester, L. (2007). Host–parasite Red Queen dynamics archived in pond sediments. *Nature*, *450*(7171), 870–873. https://doi.org/10.1038/nature06291
10. Decleer, K., Bonte, D., & Hoffmann, M. (2013). Evidence for the 'keystone' role of the root-hemiparasite Rhinanthus angustifolius in restoring wet meadow plant diversity. Applied Vegetation Science, 16(1), 126–136.
11. Dutta, T. K., Vicente, C. S. L., Maleita, C. M. N., & Phani, V. (2023). Editorial: Impact of global climate change on the interaction between plants and plant-parasitic nematodes. *Frontiers in Plant Science*, *14*. https://doi.org/10.3389/fpls.2023.1195970
12. Fisher, J. P., Phoenix, G. K., Childs, D. Z., Press, M. C., Smith, S. W., & Hartley, S. E. (2013). Parasitic plant litter input: a novel indirect mechanism influencing plant community structure. New Phytologist, 198(1), 222–231. https://doi.org/10.1111/nph.12143
13. Grass, I., Jauker, B., Steffan-Dewenter, I., Tscharntke, T., & Jauker, F. (2018). Past and potential future effects of habitat fragmentation on structure and stability of plant–pollinator and host–parasitoid networks. *Nature Ecology & Evolution*, *2*(9), 1408–1417. https://doi.org/10.1038/s41559-018-0631-2
14. Hartley, S. E., Eschen, R., Horák, O., Gange, A. C., & Hill, E. M. (2015). Infestation by a parasitic plant, *Rhinanthus minor*, alters the composition of the soil microbial community. *Plant and Soil*, 387(1-2), 403–415.
15. Hartley, S. E., Green, J. P., & Helgason, T. (2015). The parasite Rhinanthus minor alters the community composition of its hosts and their associated soil microbes. Journal of Ecology, 103(6), 1702–1714.
16. Heath, M. C. (2002). Cellular interactions between biotrophic fungal pathogens and host or nonhost plants. *Canadian Journal of Plant Pathology*, *24*(3), 259–264.
17. Heide-Jørgensen, H. S. (2008). *Parasitic Flowering Plants*. Brill Academic Publishers.
18. Joel, D. M., Hershenhorn, J., Eizenberg, H., Aly, R., Ejeta, G., Rich, P. J., Ransom, J. K., Sauerborn, J., & Rubiales, D. (2007). Biology and management of weedy root parasites. *Horticultural Reviews*, 33, 267–349.
19. Joshi, J., Matthies, D., & Schmid, B. (2000). Root hemiparasites and plant diversity in experimental grassland communities. *Journal of Ecology*, 88(4), 634–644.
20. Koskella, B., & Brockhurst, M. A. (2014). Bacteria–phage coevolution as a driver of ecological and evolutionary processes in microbial communities. *FEMS Microbiology Reviews*, *38*(5), 916–931.
21. Kumar Rai, P., & Singh, J. S. (2020). Invasive alien plant species: Their impact on environment, ecosystem services and human health. *Ecological Indicators*, *111*, 106020. https://doi.org/10.1016/j.ecolind.2019.106020
22. Leung, T. L., & Poulin, R. (2008). Parasitism, biodiversity and conservation. Biological Conservation, 141(5), 1141–1145. https://doi.org/10.1016/j.biocon.2008.03.003
23. Li, A. R., Guan, K. Y., Stonor, R., Smith, S. E., & Smith, F. A. (2012). Direct and indirect influences of arbuscular mycorrhizal fungi on phosphorus uptake by two root hemiparasitic Pedicularis species. Plant, Cell & Environment, 35(6), 1147–1158. https://doi.org/10.1111/j.1365-3040.2011.02479.x
24. Li, J., Jin, Z., & Song, W. (2012). Do parasites destabilize ecosystems? A case study of Cuscuta on forest successional dynamics. Ecological Monographs, 82(3), 341–355.
25. Li, R., & Belanger, R. R. (2012). Quince and Apple: Exploring the resistance of Maloideae to powdery mildew. *Plant Signaling & Behavior*, *7*(12), 1600–1603.
26. Li, W. X., Nie, P., Wang, G. T., & Yao, W. J. (2009). Communities of gastrointestinal helminths of fish in historically connected habitats: habitat fragmentation effect in a carnivorous catfish *Pelteobagrus fulvidraco* from seven lakes in flood plain of the Yangtze River, China. *Parasites & Vectors*, *2*, 22. https://doi.org/10.1186/1756-3305-2-22
27. Lymbery, A. J., & Smit, N. J. (2023). Conservation of parasites: A primer. *International Journal for Parasitology: Parasites and Wildlife*, *21*, 255–263. https://doi.org/10.1016/j.ijppaw.2023.07.001

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

28. Marvier, M. A. (1998). Parasite–host interactions: Effects of hosts on parasite herbivore community. *Ecology*, 79(8), 2616–2623.
29. Masanga, J., Mwangi, B. N., Kibet, W., Sagero, P., Wamalwa, M., Oduor, R., et al. (2021). Physiological and ecological warnings that dodders pose an exigent threat to farmlands in Eastern Africa. *Plant Physiology*, *185*(4), 1457–1467. https://doi.org/10.1093/plphys/kiab034
30. Mutuku, J. M., Spallek, T., & Shirasu, K. (2015). Settlement of parasitic plants: The role of the haustorium. *Plant and Cell Physiology*, *56*(7), 1256–1263.
31. Pennings, S. C., & Callaway, R. M. (1996). Impact of a parasitic plant on the structure and dynamics of a salt marsh vegetation community. *Ecology*, 77(5), 1410–1419.
32. Pennings, S. C., & Callaway, R. M. (2002). Parasitic plants: Parallels and contrasts with herbivores. Oecologia, 131(4), 479–489.
33. Press, M. C. (1998). Dracula or Robin Hood? The role of parasitic plants in terrestrial ecosystems. *Oikos*, 82(3), 609–611.
34. Press, M. C., & Phoenix, G. K. (2005). Impacts of parasitic plants on natural communities. New Phytologist, 166(3), 737–751. https://doi.org/10.1111/j.1469-8137.2005.01358.x
35. Pywell, R. F., Bullock, J. M., Walker, K. J., Coulson, S. J., Gregory, S. J., & Stevenson, M. J. (2004). Facilitating grassland diversification using the hemiparasitic plant *Rhinanthus minor*. *Journal of Applied Ecology*, 41(5), 880–887.
36. Quested, H. M., Cornelissen, J. H., Press, M. C., & Callaghan, T. V. (2003). Decomposition of sub-arctic plants with differing nitrogen economies: A comparison of leaf litter environmental and species effects. Ecology, 84(11), 3067–3077. https://doi.org/10.1890/02-0453
37. Spasojevic, M. J., & Suding, K. N. (2012). Inferring community assembly mechanisms from functional diversity patterns: the importance of multiple attributes to carry out tasks. Ecology, 93(3), 637–645. https://doi.org/10.1890/11-1183.1
38. Sui, X., Zhang, T., Yang, G., & Li, A. (2019). Arbuscular mycorrhizal fungi and nitrogen addition affect the growth of the root hemiparasite Pedicularis kansuensis. Frontiers in Plant Science, 10, 383. https://doi.org/10.3389/fpls.2019.00383
39. Těšitel, J., Li, A. R., Knotková, K., McLellan, R., Bandaranayake, P. C. G., & Watson, D. M. (2020). The bright side of parasitic plants: what are they good for? *Plant Physiology*, *185*(4), 1309–1324. https://doi.org/10.1093/plphys/kiaa069
40. Těšitel, J., Mládek, J., Horník, J., Těšitelová, T., Adamec, V., & Tichý, L. (2017). Suppressing competitive dominants and community restoration with native parasitic plants using the hemiparasitic *Rhinanthus alectorolophus* and the dominant grass *Calamagrostis epigejos*. *Journal of Applied Ecology*, *54*(5), 1487–1495. https://doi.org/10.1111/1365-2664.12889
41. Těšitel, J., Plavcová, L., & Cameron, D. D. (2010). Interactions between hemiparasitic plants and their hosts: The role of carbon. Plant Signaling & Behavior, 5(9), 1072–1076.
42. Tiffin, P. (2000). Mechanisms of tolerance to herbivory: Role of resource reallocation and compensatory growth. *Evolutionary Ecology*, *14*(4-6), 523–542.
43. Tougeron, K., Brodeur, J., Le Lann, C., & van Baaren, J. (2019). How climate change affects the seasonal ecology of insect parasitoids. *Ecological Entomology*, *45*(2), 167–181. https://doi.org/10.1111/een.12792
44. Van Valen, L. (1973). A new evolutionary law. *Evolutionary Theory*, *1*, 1–30.
45. Vogel, A., Schwacke, R., Denton, A. K., Usadel, B., Hollmann, J., Fischer, K., & Krause, K. (2018). Footprints of parasitism in the genome of the parasitic flowering plant *Cuscuta campestris*. *Nature Communications*, *9*(1), 1–11.
46. Watson, D. M. (2001). Mistletoe—A keystone resource in forests and woodlands worldwide. *Annual Review of Ecology and Systematics*, 32, 219–249.
47. Westwood, J. H., Yoder, J. I., Timko, M. P., & dePamphilis, C. W. (2010). The evolution of parasitism in plants. *Trends in Plant Science*, 15(4), 227–235.
48. Yang, Z., Wafula, E. K., Honaas, L. A., Zhang, H., Das, M., Fernandez-Aparicio, M., ... & dePamphilis, C. W. (2019). Convergent evolution of a metabolic switch between parasitic and free-living lifestyles. *Science Advances*, *5*(7), eaav9744.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

FOLK MEDICINAL PLANTS OF UTTARANDHRA: PRESERVING TRADITIONAL KNOWLEDGE FOR MODERN THERAPEUTICS

Anna Samuel Lanka[1]
Department of Botany- AP Model School & Junior college, Purohitunivalasa- Salur, Andhrapradesh, India .
annasamuel.lanka@gmail.com

Sara Palaparthy[2]
Lectuer in Botany,Government Degree Cllege,Ramachandrapuram,botany.sara@gmail.com

Abstract:

The growing demand for plant-based pharmaceuticals has exerted significant pressure on certain high-value medicinal plant populations, particularly in the wild, due to over-harvesting. Many medicinal plant species are now at risk of extinction, primarily due to their slow growth rates, low population densities, and restricted geographic distributions. Furthermore, the rich therapeutic knowledge of numerous folk medicinal plants in north coastal Andhra Pradesh remains largely undocumented. Traditionally, this knowledge has been passed orally from one generation to the next. However, due to changing attitudes and socioeconomic shifts, this traditional wisdom is in decline, as it is not being actively recognized or adopted by younger generations. This underscores the urgent need to document and preserve this valuable knowledge for the sustainable development of the medicinal plant sector. The present study aims to explore and systematically document the folk medicinal plants used by the native communities of Uttarandhra (northern coastal Andhra Pradesh) for herbal remedies.

Keywords: Folk medicinal plants, North coastal Andhra Pradesh, Uttarandhra, Herbal remedies, Vizianagaram, Visakhapatnam

1. 0 .Introduction

Nature provides an abundant wealth of resources, many of which are essential to human well-being and readily available at no cost. Among these, medicinal plants have long served as remedies for a wide array of diseases. The current study seeks to document the folk medicinal preparations traditionally used to treat various ailments in indigenous communities of the north costal Andhra Pradesh region mainly Vizianagaram districts.

In recent times, the reliance on natural remedies has declined due to the growing preference for synthetic medicines, which, although effective in some cases, have often led to undesirable side effects and compromised health outcomes (1). This trend has prompted a re-evaluation of traditional medicine, highlighting the enduring relevance of ancient natural remedies. As the adage suggests, "there is nothing new under the sun"—many present-day health practices are rooted in the medicinal knowledge of the past. Historically, humans have depended on plants not only for nutrition but also for therapeutic purposes (2).

In developing countries, the practice of complementary and alternative medicine has seen rapid growth, spurred in part by directives from the World Health Organization (WHO). Numerous pre-clinical studies have reinforced the scientific basis for the efficacy of many plants used in traditional medicine, particularly for treating infectious diseases (3).

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Research into medicinal plants has garnered significant interest due to their widespread use in the treatment of various conditions, including pain, fevers, skin infections, and other ailments in both humans and animals. The use of plants as therapeutic agents is a practice that transcends cultural boundaries, highlighting its universal application (4).

The people of North Coastal Andhra Pradesh hold a deep-rooted belief in the efficacy of folk medicinal plants(5). Traditional healers, known as Natu Vidyalu in Telugu, are widely recognized, and many individuals seek their services for common health issues (6). Despite the availability of modern medical facilities and government healthcare programs, the community continues to place their trust in these folk practitioners. This region boasts a diverse geographical landscape that supports a rich variety of medicinal plants. However, despite this wealth of natural resources, there has been insufficient documentation of the local knowledge surrounding these plants. Therefore, this study aims to systematically document the knowledge of folk medicinal plants, with a particular focus on the Vizianagaram district.

2.0 Materials and methods:

2.1. Topography of Study area: *Uttarandhra* - North Coastal Andhra Pradesh , the sub-region consists of three north coastal districts in the Coastal Andhra region of Andhra Pradesh state in south India, namely *Srikakulam, Vizianagaram,* and *Visakhapatnam* (7). This region is also called *Kalingandhra* and skirted to a distance by rivers Kandivalasagedda, Vamsadhara, and Bahuda at certain stretches of their courses while a line of heights of the great Eastern Ghats run from North East. East Godavari District flanks in the south and west while Odisha bounds it on the north and Bay of Bengal on the East (8).

Srikakulam district is in the northern extreme of this region located between 18.3000^0 N and 83.9000^0 E. A portion of this district is plain terrain with intense agriculture, another portion is hilly terrain covered with forests. Some of the Mahendragiri Hills also cover Srikakulam district. Kotthuru, Hiramandalam, Pathapatnam, Kalingadal reservoir, and some other areas are covered with dense forests that are a rich source of medicinal plants(9).

Visakhapatnam district is a strip of land along the coast with both plain region and hilly areas of the Eastern Ghats with an altitude of about 900 meters but peaks exceeding 1200 meters located between 17.6863^0N and 83.2186^0E. Sankaram forest area Paderu, G.Madugula, Pedabayalu, Hukumpeta, Araku Valley, Koyyuru, Ananathagiri, Chinthapalli mandals have mountain peaks about 1615 meters high. Machkhand, Sarada, Varaha, and Thandava rivers wet the districts. More than one-third area is covered by forest. The forest is of moist and dry deciduous type (10).

Vizianagaram district is in the north of Andhra Pradesh located between 17º- 45' to 19º - 10' N and 83º - 10' to 83º - 50'E. It is bound on the south by the Bay of Bengal, on the north by Koraput district of Odisha. Physiographically, it is divided into hilly, plain, and coastal region. The district is within the network of Perennial Rivers like Nagavali, Jhanjavathi, Suvarnamukhi, Vegavathi, Vattigedda, Champavathi and Gosthani rivers.(11).

Forest(s) and soil types: The vegetation of the district is mostly 'Sal' forest. According to Champion and Seth Nomenclature of forest type (1968) the vegetation of Vizianagaram has seven types namely Southern tropical secondary dry mixed deciduous forest, Dry Peninsular Sal, Southern secondary moist mixed deciduous, Southern thorn forest, Dry evergreen forest, Dry grassland forest and Littoral forest. The forest distribution is mostly patches of degraded forest with a few pockets of dense forests, which is divided into four forest ranges namely Kurupam forest range, Parvathipuram forest range, Vizianagaram forest range and Saluru forest range (10).

Soils: Soil types in the district have a mixed distribution with more of Red sandy loams and others including Sandy loams, Black soil and less of Lateritic soil. The climate is characterized by high humidity all through the year besides oppressive

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

summer and rainfall. The district with a few rich forest areas provide suitable habitat for a variety of folk medicinal plants (12).

2.1 Documentation of Folk Medicinal Plants

This study aimed to document folk medicinal plants in the Uttarandhra region. Field visits were conducted across different seasons to tribal villages and homes to collect traditional knowledge. A semi-structured questionnaire was used to gather information from randomly selected informants, with no prior notice given. Many villages had established practitioners of plant-based medicine.Data were collected through interactions with local tribal and rural healers, although some were initially reluctant to share their knowledge due to concerns about misuse. After assuring them of the study's purpose, they provided valuable insights. The primary tribal groups in the region are the Khond and Savara communities.Information was gathered in Telugu, with respondents identifying plants by their local names. Photographs were taken, and specimens were collected for botanical analysis. Voucher specimens were identified using standard floras, including the "Flora of the Presidency of Madras" (Gamble and Fischer, 1915-1936) and the "Flora of Andhra Pradesh" (Pullaiah et al., 1997), as well as local floras such as the "Flora of Srikakulam District" (Rolla S. Rao & Harasriramulu, 1986). Specimen copies were deposited in the herbarium of the Botany Department at AP Model School& Junior college. Table 1.0 lists 63 plant species reported by local respondents for the treatment of various diseases.

3.0.Results and Discussion

The current investigation identifies 63 folk medicinal plants belonging to 31 families, recognized for their therapeutic potential by local communities in the north coastal region of Andhra Pradesh. While some plant species from this area have been documented, the Kurupam and Parvathipuram forest range in the Vizianagaram district remains underreported, despite hosting a significant number of traditional healers (6). Data were gathered from 86 male and 49 female informants, with assistance from local students, although some provided overlapping information. The tribal villagers possess extensive knowledge of herbal remedies for various ailments, including pain, itching, skin infections, swelling, fever, jaundice, gastrointestinal issues, insect and snake bites, toothaches, hair loss, fracture reduction, headaches, and other health conditions. This information has been systematically documented and is presented in Table 1.

Among the recorded plants, the family Amaranthaceae is represented by 7 species, making it the most prevalent in this study, followed closely by Fabaceae with 6 species. This finding marks a notable distinction from previous studies, which have generally identified Fabaceae as the dominant family. The findings of this study indicate a shift in dominance toward Amaranthaceae, a family that has not been extensively reported in previous studies. While Sivakumar et al. noted Fabaceae as the dominant family in the Uttarandhra region, this study shows that Amaranthaceae is more prevalent, with Fabaceae following as the second most represented family.Similar trends have been observed in neighboring districts of Odisha. Kandi et al. (2013) identified Fabaceae as the second most common family among 49 medicinal plant species, while Biswas et al. (2010) highlighted the prominence of Fabaceae in the Chittagong Hill Tracts. Thus, this study emphasizes the importance of Amaranthaceae in the local medicinal flora and suggests further exploration of its therapeutic potential..The present study underscores the predominance of leaves as the most frequently utilized plant part among traditional healers in North Coastal Andhra Pradesh. Ethnomedicinal practitioners employ different plant components either singly or in combination. The present study reveal that leaves are the most commonly used, with 26 recorded instances, followed by roots (8), seeds (6), flowers (4), fruits (3), and a variety of combinations, such as flowers and leaves (3), bark (3), roots and leaves (2), seeds and roots (2), seeds and leaves (1), flowers and roots (1), rhizomes (2), latex (1), and whole plants (1). This highlights the significant role of leaves, particularly in treating diverse ailments.Earlier studies also support these findings. Pragala et al. (2011) documented the extensive application of leaves in treating dysentery and infections across the region. Additionally, studies conducted by Chandra Babu et al. (2012) emphasized that both leaves and roots are frequently employed by tribal communities in Vizianagaram for managing a variety of health conditions. This consistent pattern

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

suggests a region-specific preference for certain plant parts in folk medicine, particularly leaves, which may be due to their accessibility and effectiveness in traditional therapeutic practices.Traditional medicinal practitioners often rely on plant-based preparations to treat various ailments, with the highest percentage (39.6%) being used for skin infections, wound healing, and itching (Figure-2) in the present study. These conditions are prevalent among villagers and tribal populations due to poor sanitation and hygiene practices (Samuel et al., 2011). Following skin infections, the most commonly treated ailments include cough (7.9%), snake or insect bites (7.9%), asthma (6.3%), diarrhea (6.3%), de-worming (4.7%), constipation (4.7%), diabetes (3.17%), itching (3.17%), inflammation (3.17%), and a variety of other conditions such as dysentery, jaundice, night blindness, and sore throat (1.5% each).Cough, particularly prevalent among tribal communities, is often attributed to geographic and environmental factors. These groups tend to rely on traditional herbal treatments for respiratory conditions, with *Adhatoda vasica* frequently used to manage cough and bronchitis (Kumar et al., 2019). This reflects the indigenous knowledge passed through generations, especially in communities that prefer herbal remedies over modern medical practices (Khare, C. P. 2007).Herbal healers also effectively address health conditions like asthma, constipation, parasitic infections, diarrhea, and dysentery through the use of natural remedies. It is also reported in other studies that plant extracts are effectively used in treating Asthama, *Adhatoda vasica* is well-known for its benefits in treating asthma, while *Cassia angustifolia* is employed for its laxative properties to alleviate constipation. These methods are deeply integrated into traditional healing systems that use local plant species for everyday health management (De Silva, A. D., et al. (2019).Other studies also show that tribal populations often utilize plant-based extracts to treat venomous snake and insect bites. Indigenous groups in the Western Ghats, for example, use plants like *Andrographis paniculata* and *Rauvolfia serpentina* to neutralize venom, showcasing the extensive medicinal knowledge within these cultures (Samuel, et al. (2011). Such findings are in line with broader ethnomedicinal research, demonstrating that traditional healing practices offer effective treatment options, particularly in areas where access to modern healthcare is limited. These practices highlight the potential for integrating indigenous medical knowledge into broader healthcare systems for improved health outcomes.Conclusion : this study identifies 63 folk medicinal plant species from 31 families used by local communities in north coastal Andhra Pradesh, with Amaranthaceae emerging as the dominant family, unlike previous reports favoring Fabaceae. The predominant use of leaves for treating ailments like skin infections and respiratory issues highlights the practical significance of indigenous plant-based remedies.The study also emphasizes the urgent need to document traditional medicinal knowledge, which is at risk of being lost due to changing attitudes and socioeconomic shifts. Preserving this knowledge is crucial for developing plant-based therapeutics to address modern health challenges. Future research should focus on validating the pharmacological properties of these plants to integrate traditional and modern healthcare practices effectivelyFurthermore, this study highlights the urgent need to document the diverse traditional knowledge possessed by folk medicine practitioners, as such knowledge is declining and becoming obsolete due to a lack of recognition by younger generations and ongoing socioeconomic changes. Thus, there is a pressing need to review and preserve this valuable knowledge to foster the development of plant-based therapeutics for various debilitating ailments faced by humanity.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in

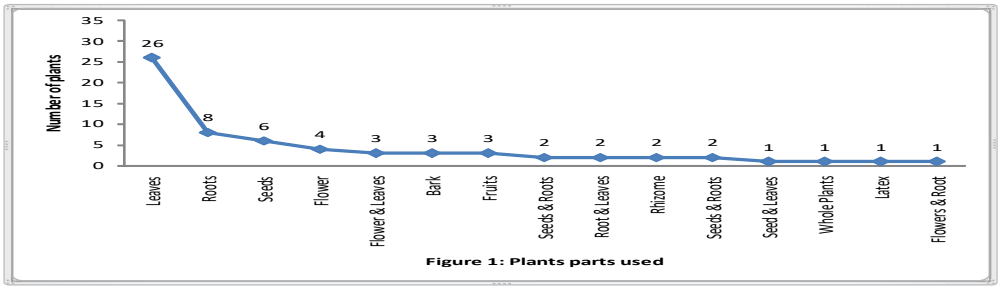


Figure 1: Plants parts used

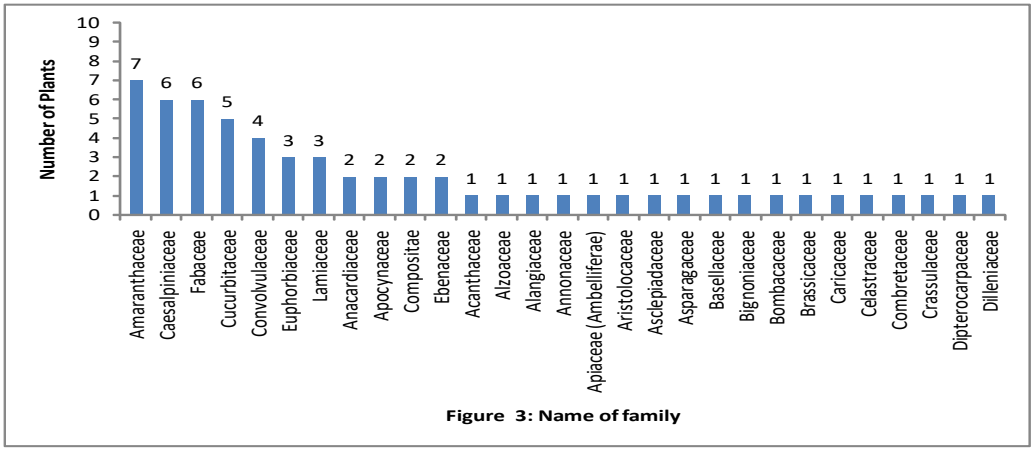


Figure 3: Name of family

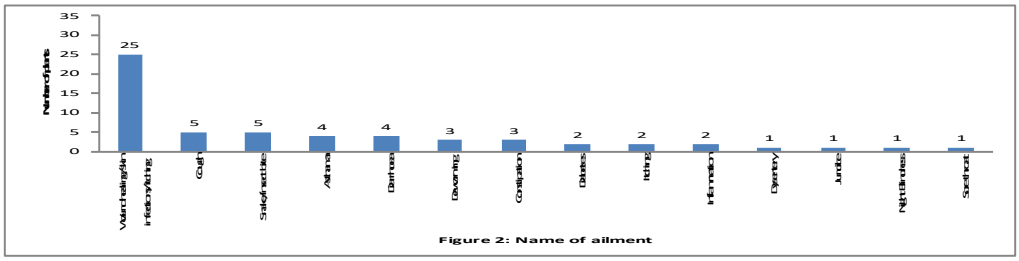


Figure 2: Name of ailment

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Table : 2.. Family wise analysis of the plants under study

S.No	Name of the folk medicinal plant	Family	Vernacular name in Telugu & collection number	Plant part used in folk medicinal preparation.	Folk medicinal use
1.	*Justicia adhatoda*	**ACANTHACEAE**	Adda sarum APMS-G-FM-1	Flowers	A concentrated decoction is prepared by infusing fifty grams of flowers in half a cup of water. This decoction, combined with a spoonful of honey, is administered for seven days to alleviate cough symptoms
2.	Trianthema portulacastrum L.	Aizoaceae	Ambati kura APMS-G-FM-2	Leaves	The leaves are utilized for the treatment of inflammation and serve as an ascetic.
3.	Alangium salviifolium (L.f.) Wang.	Alangiaceae	Vooduga APMS-G-FM-3	Root	A paste made from the bark and root mixed with lemon juice is consumed two hours before breakfast and supper to aid in asthma treatment.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

4.	Achyranthes aspera L.	Amaranthaceae	Uttareni APMS-G-FM-4	Seeds & Roots	i) The seeds are ground into a paste and applied to areas affected by poisonous insect bites, functioning as an antidote. (ii) The entire plant is immersed in water and boiled to create a decoction, which, when consumed at night, promotes urination and lowers blood pressure. (iii) One hundred grams of dried roots are powdered, and a pinch taken daily aids in the treatment of night blindness.
5.	Aerva lanata (L.) Juss ex Schult	Amaranthaceae	Pindikura APMS-G-FM-5	Entire plant	(i) The entire plant serves as an anthelmintic for children. (ii) A stew or curry made from this plant is effective in treating renal stones.
6	Alternanthera sessilis (L.) R. Br. ex DC	Amaranthaceae	Ponnagantikura APMS-G-FM-6	Shoot& leaves	i) Young shoots are highly nutritious and can be prepared as a table dish. (ii) The leaves are slightly heated and applied to the eyes to alleviate itching.
7.	Amaranthus spinosus L.	Amaranthaceae	Mulluthotkura APMS-G-FM-7	Roots	(i) The roots are cleaned, boiled to prepare a decoction, which is subsequently strained and consumed on an

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					empty stomach in the morning to alleviate unusual abdominal pain and menstrual discomfort. (ii) A decoction of the roots, combined with turmeric, is employed for vaginal washing to treat itching.
8.	Amaranthus viridis L.	Amaranthaceae	Chilakathotakura APMS-G-FM-8	Leaves	i) The leaves are gently heated and ground into a paste, which is applied topically to relieve pain caused by insect bites. (ii) This herb is provided as feed for tamed birds, as it is believed to enhance their reproductive capabilities.
9.	Celosia argentea L.	Amaranthaceae	Gunugu APMS-G-FM-9	Seeds	i) The seeds are processed into a paste and administered orally for the treatment of mouth ulcers, facilitating rapid healing. (ii) A combination of forty grams of seeds mixed with 40 ml of sugarcane juice and added to a cup of milk is consumed daily for forty days to improve sexual desire in males.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

10.	Celosia cristata L.	Amaranthaceae	Kodejuttu thotakura APMS-G-FM-10	Flowers	i) A dosage of five grams of dried flower powder, mixed with rice wash water, is taken five times daily to control diarrhea.
11.	Anacardium occidentale L.	Anacardiaceae	Jeedi mamidi APMS-G-FM-11	Bark , leaves and Gum	(i) Pulverized bark combined with Pongamia pinnata seed oil is used to treat sores and ulcers. ii) The leaves are boiled with sesame oil and applied to tender tendons to reduce swelling. (iii) Gum from bruised bark mixed with coconut milk is used to relieve pain and swelling in tender tendons.
12	Lannea coromandelica (Houtt) Merr	Anacardiaceae	Gumpena APMS-G-FM-12	Leaves & Gums	i) Leaves boiled with sesame oil are applied to tender tendons for swelling relief. (ii) Gum from bruised bark mixed with coconut milk is used to alleviate pain and swelling.
13	Annona squamosa Linn	Annonaceae	Seetafalam APMS-G-FM-13	Seeds, root	(i) A paste of seeds is applied to the scalp and rinsed after one hour, recommended every other day for one month

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					to eliminate dandruff and lice. (ii) A paste made from roots is utilized as an abortifacient.
14	Centella asiatica (L.) Urban	Apiaceae	Saraswathi aaku APMS-G-FM-14	Leaves	i) A spoonful of crushed leaves mixed with a cup of lukewarm milk and a bit of sugar, taken thrice daily, helps in revitalization. (ii) Two to three drops of leaf juice mixed with cow ghee is believed to enhance memory in children.
15	*Alstonia scholaris* (L.) R.Br	Apocynaceae	Edakula pala APMS-G-FM-15	Leaves	Tender leaves are warmed over a flame, made into a paste, and applied on boils to reduce swelling. 2. Latex is used as a purgative.
16.	*Hemidesmus indicus* (Linn) R.Br. var. indicus	Apocynaceae	Sugandipala APMS-G-FM-16	Roots	1. Roots and two petals of garlic are made into a paste and consumed twice daily for 15 days to regulate the menstrual cycle. 2. Roots increase breast milk production in nursing mothers. 3. Root bark and 10 pepper seeds are made into a paste and consumed on an empty stomach for seven days

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					to treat jaundice symptoms.
17	*Aristolochia indica*	Aristolochiaceae	Esari APMS-G-FM-17	Roots& Leaves	1. Equal amounts of roots and leaves are made into a paste, which is used to treat whooping cough. 2. Leaf extract and root paste are used to treat snakebite, fever, and skin infections.
18.	*Pergularia daemia* (Forsk)	Asclepiadaceae	Dhustaputhega APMS-G-FM-18	Flower, leaves	1. Floral extract (5 grams) mixed with Vamu [Ajowan] and breast milk is given to infants to cure cold and cough. 2. Six drops of leaf extract with honey act as a de-worming agent in infants. 3. Leaf paste is used as a cough expectorant. 4. Leaf paste helps ripen carbuncles to burst.
19.	*Asparagus racemosus* Willd	Asparagaceae	Pillathegalu APMS-G-FM-19	Roots	1.A mixture of root powder, *Justicia adathoda* leaves, and sugar cubes is boiled and taken to cure dry cough. 2. Roots mixed with milk and sugar cubes increase breast milk in nursing mothers. 3. Boiled roots in milk are taken to treat menstrual issues

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

20.	*Tylophora indica* (Burm.f.) Merr	Asclepiadaceae	Verrepala APMS-G-FM-31	Leaves	1. Leaves are used for asthma treatment. 2. Chewing leaves aids in clearing the stomach (gastric lavage). 3. Heated leaves made into a paste are applied to the forehead to relieve headaches.
21	*Basella alba* L.	Basellaceae	Yerra baccali APMS-G-FM-20	Leaves	1. Leaf sap is traditionally applied for the treatment of urticaria (skin allergy) and constipation in children. 2. Leaves possess demulcent and diuretic properties.
22	*Oroxylum indicum* (L.) Benth ex Kurz	Bignoniaceae	Pampini APMS-G-FM-32	Leaves	1. A paste made from the leaves is gently massaged over the joints to relieve arthritis-related pain
23.	*Ceiba pentandra* (L.) Gaertn	Bombacaceae	Tella Booruga APMS-G-FM-45	Roots	1. Five grams of root powder mixed with five drops of lemon juice, if taken twice daily for forty days, helps to manage diabetes.
24.	*Brassica nigra* (L.) Koch	Brassicaceae	Nalla avalu APMS-G-FM-63	Seeds	1. The seeds are used as a stimulant and are traditionally applied as an antidote for snakebite. 2. The oil extracted from seeds is applied on the body to provide warmth and treat skin disorders.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

25	*Cassia alata* L. .	Caesalpiniaceae	Seema avisa APMS-G-FM- 33	Leaves	1. A fresh paste made from the leaves mixed with lemon juice is applied to the affected area to treat skin diseases over a seven-day course
26	*Tamarindus indica* L. .	Caesalpiniaceae	Chinta chettu APMS-G-FM-34	Fruit	1. Paste made from the drupe is applied to inflamed areas to reduce swelling
27.	*Cassia occidentalis* L.	Caesalpiniaceae	Kasintha, Kolla dalasari aaku APMS-G-FM-35	Leaves	1. Crushed leaves are used to extract sap, which is applied to bleeding wounds, while the leaf remnants are bandaged over the wound. 2. Root bark powder mixed with cow ghee is administered twice daily to treat filariasis.
28	*Cassia fistula*	Caesalpiniaceae	Raela chettu, Kakkechettu APMS-G-FM-21	Leaves	1. Fresh young leaves are crushed and mixed with rice-washed water to treat allergic skin reactions. 2. A paste of tender leaves is consumed as a laxative, particularly when taken two hours after meals at night.
29	*Cassia auriculata* Linn	Caesalpiniaceae	Avaramchettu APMS-G-FM-23	Flower	1. Shade-dried flower powder soaked overnight in water is consumed in the morning for forty days to manage diabetes. 2. Shade-dried flowers are boiled into a decoction and mixed with milk to increase

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					male potency when consumed daily for forty days.
30.	*Cassia tora* Linn	Caesalpiniaceae	Thanteturodda APMS-G-FM-22	Seeds	1. Seeds soaked in buttermilk and made into a paste are applied to infected skin areas, left for an hour, and washed with lukewarm water to treat skin infections
31	Carica papaya L.	Caricaceae	Boppayi APMS-G-FM-24	Fruit	(i) A cup of well-ripened fruit juice provides relief from constipation. (ii) One spoon of latex from unripe fruit mixed with sugar is taken regularly to treat dysentery.
32.	Celastrus paniculata Willd	Celastraceae	Teegapalleru APMS-G-FM-26	Seeds	Consumption of two drops of seed oil for 90 days enhances memory power.
33	Quisqualis indica L.	Combretaceae	Rangun malle APMS-G-FM-25	Leaves	(i) The sap of the leaves serves as a liniment for ulcers and boils.
34.	Ageratum conyzoides Linn (Asteraceae)	Compositae	Pumpullu APMS-G-FM-27	Leaves	he leaf sap acts as a liniment for cuts and wounds

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

35	Eclipta prostrata Linn	Compositae Asteraceae	Gunta galagara APMS-G-FM-29	Leaves	i) A spoon of leaf sap mixed with ¼ spoon of honey is administered to treat sore throat in infants
36	Argyreia nervosa (Burm.f.) Boj	Convolvulaceae	Samudrapala APMS-G-FM-28	Roots& Leaves	i) Powdered matured roots mixed with a cup of milk is taken twice daily for forty days to alleviate pain and burning sensations in the joints. (ii) Application of leaf extract facilitates the maturation and necrosis of inflammatory tumors and peduncle
37.	Merremia aegyptia Linn Urban	Convolvulaceae	Elukachevi aaku APMS-G-FM-30	Leaves	i) Residue from freshly plucked leaves is used as ear drops to treat ear sores. (ii) Leaves are included in remedies for treating neuralgia (Vedhanan
38					
39.	Cuscuta reflexa Roxb	Convolvulaceae	Seetamma pogu aku APMS-G-FM-31	Seeds & leaves	i) Dried and pulverized seeds act as a purgative. (ii) Warmed leaves are applied to treat itchy skin sores. (iii) Leaves soaked in warm water are used to wash sloughing and purulent sores.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

40	Kalanchoe pinnata (Lam.) Pers	Crassulaceae	Ranapala APMS-G-FM-37	Leaves	i) A paste made from ten grams of leaf extract, ten grams of cumin seeds, and two teaspoons of cow's ghee regulates irregular menstrual cycles. (ii) Fresh leaf extract aids in controlling bleeding and promotes wound healing.
41	Benincasa hispida (Thunb)	Cucurbitaceae	Budidagummadi APMS-G-FM-38	Fruit	i) The juice of the fruit is used in treating insanity and nervous disorders. (ii) It is effective in the treatment of epilepsy. (iii) Preparations of the fruit are utilized for diabetes and asthma.
42	Citrullus colocynthis (L.) Schr	Cucurbitaceae	Verripuccha APMS-G-FM-39	Roots	(i) The roots serve as a purgative. (ii) The raw fruit is consumed at night after dinner to alleviate constipation. (iii) A fine paste of freshly plucked root is applied to boils and inflamed peduncles to promote ripening and bursting.
43.	Corallocarpus epigaeus (Rottl & Will) Clarke	Cucurbitaceae	Nagadonda APMS-G-FM-40		(i) The root is a remedy for snake bites, where a fine paste is applied to the bitten area, and a small pellet of the same paste is consumed. (ii) A paste made from the root, with a pinch of cumin seeds, one

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					tablespoon of castor oil, and an onion, is applied to joints in cases of chronic rheumatism.
44	Cucurbita moschata Duch. ex Lam	Cucurbitaceae	Rachagummadi APMS-G-FM-41	Leaves	(i) The leaves are used externally as a liniment for burns. (ii) Dried seeds are made into a paste, with peanut-sized pellets taken for deworming
45	Diplocyclos palmatus (L.) Jeffrey	Cucurbitaceae	Linga donda APMS-G-FM-42	Leaves	i) Freshly plucked leaves heated on low flame are applied to inflamed areas to reduce swelling. (ii) An extract or stew prepared from powdered dried leaves serves as a tonic for treating fever and flatulence.
46	Zehneria maysorensis (Wight & Arn.) Arn	Cucurbitaceae	Kuturu budama APMS-G-FM-44	Roots	i) Decoction prepared from freshly cut roots is beneficial for flatulence. (ii) Chewing the roots on an empty stomach helps protect teeth from dental caries.
47	Costus speciosus Koenig Smith	Costaceae	Bhokkachukka APMS-G-FM-46	Rhizome	(i) A paste of the rhizome, taken in small amounts after meals, acts as a deworming agent. (ii) The paste is also applied to the head to relieve headaches. (iii) It acts as a contraceptive when a pinch of pulverized rhizome is taken daily

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					from the first to the fifteenth day of the menstrual cycle.
48	Shorea robusta Gaertn	Dipterocarpaceae	Guggilam APMS-G-FM-49	Bark	i) A paste made from pulverized bark, egg white, and alcohol (brandy) is applied to affected areas to relieve pain from chronic rheumatism.
49	Dillenia indica Linn	Dilleniaceae	Uvva chettu APMS-G-FM-48	Fruits	Fruits are known to possess laxative properties and can alleviate abdominal pain.
50	Diospyros malabarica (Desr) Kostel	Ebenaceae	Nitta tumik APMS-G-FM-47	Fruits	(i) Two spoons of fruit made into a paste and taken twice a day helps control blood dysentery.
51	Diospyros melanoxylon Roxb	Ebenaceae	Beedi aaku APMS-G-FM-50	Bark & Leaves	i) A spoonful of decoction made from the bark is taken thrice daily for three days to control loose stools in diarrhea. (ii) Decoction of the leaves acts as a laxative and is used for constipation
52	Euphorbia hirta Linn	Euphorbiaceae	Pachabottlu Cukkamokka APMS-G-FM-59	Leaves	i) Two teaspoons of freshly prepared leaf extract mixed with half a teaspoon of honey taken twice daily for forty days cures asthma and cough. (ii) Two teaspoons of leaf extract mixed with sugar is taken thrice daily for

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					three days to cure dysentery.
53	Acalypha indica L.	Euphorbiaceae	Kuppinta APMS-G-FM-58	Leaves	i) Five drops of leaf sap poured into the ear relieve earache. (ii) A spoon of leaf sap mixed with two drops of lemon juice is applied to the skin to treat painful swellings.
54	Euphorbia nivulia Buch.-Ham	Euphorbiaceae	Aku jemudu APMS-G-FM-57	Latex	(i) Application of latex enhances the healing of sores and ulcers
55	Abrus precatorius L.	Fabaceae	Gurivinda APMS-G-FM-51	Seeds	i) Soaking the seeds in fresh water for twenty-four hours and preparing a fine paste, which is applied to the skin, relieves pain and inflammation.
56	Atylosia scarabaeoides (L.) Benth	Fabaceae	Pedda adavi kandi) APMS-G-FM-52	Leaves	(i) A cup of leaf decoction taken four times a day helps control loose stools in dysentery.
57	Trigonella foenum-graecum L.	Fabaceae	Menthulu APMS-G-FM-53	Seeds	(i) Ten grams of paste made from seeds is taken twice daily for forty days to control diabetes.
58	Pueraria tuberosa (Roxb. ex Willd)	Fabaceae	Nelagummadi APMS-G-FM-55	Rhizome	(i) One spoonful of pulverized rhizome mixed with cow ghee in a

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					1:1 ratio and added to a cup of milk is taken daily (usually before sleep) for strength and revitalization. (ii) The warmed paste of pulverized rhizome is applied to painful joints in arthritis.
59.	Sesbania grandiflora (Linn) Poir	Fabaceae	Avisa APMS-G-FM-54	Leaves	i) Regular application of leaf sap on the affected skin for seven days provides relief from irritation. (ii) A cup of thin leaf decoction taken daily before sleep helps avoid constipation.
60.	Clitoria ternatea Linn	Fabaceae	Sankampuvula chettu APMS-G-FM-56	Roots	i) Roots made into a paste with rice-washed water and taken on an empty stomach twice daily for forty days treat renal calculi. (ii) Three grams of dried root powder with half a cup of sweet curd taken early in the morning for seven days helps treat jaundice
61	lectranthus amboinicus	Lamiaceae	Vammu aku mokka) APMS-G-FM-62	Leaves	(i) Chewing two leaves daily after meals aids digestion. (ii) Five drops of leaf extract mixed with a little sugar enhances digestion in children.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

					(iii) Ten drops of leaf extract combined with honey, taken on an empty stomach for thirty days, treats Leucorrhea.
62	Anisochilus carnosus	Lamiaceae	Reechu rodda APMS-G-FM-61	Leaves	(i) A spoonful of fresh leaf sap with a sugar cube alleviates cough and serves as an expectorant.
63	Leonotis nepetifolia	Lamiaceae	Ranabheri APMS-G-FM-43	Flower & leaves	i) Applying ashes of the flower mixed with a few drops of coconut oil on scalds and burns reduces burning sensation. (ii) A decoction of the leaves functions as a febrifuge.

Table : 3 Different parts of the plant used in the study

S. No	Name of the family	Number of plants studied
1	**ACANTHACEAE**	1
2	**AIZOACEAE**	1
4	**ALANGIACEAE**	1
5	**AMARANTHACEAE**	7
6	**ANACARDIACEAE**	2
7	**ANNONACEAE**	1
8	**APIACEAE (Ambelliferae)**	1
9	**APOCYNACEAE**	2
10	**ARISTOLOCACEAE**	1
11	**ASCLEPIADACEAE**	1
13	**ASPARAGACEAE**	1
14	**BASELLACEAE**	1
15	**BIGNONIACEAE**	1
16	**BOMBACACEAE**	1

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

17	**BRASSICACEAE**	1
18	**CAESALPINIACEAE**	6
19	**CARICACEAE**	1
20	**CELASTRACEAE**	1
21	**COMBRETACEAE**	1
22	**COMPOSITAE**	2
23	**CONVOLVULACEAE**	4
24	**CRASSULACEAE**	1
25	**CUCURBITACEAE**	5
26	**DIPTEROCARPACEAE**	1
27	**DILLENIACEAE**	1
28	**EBENACEAE**	2
29	**EUPHORBIACEAE**	3
30	**FABACEAE**	6
31	**LAMIACEAE**	3

References:

1. Vijaya K and Ananthan S (1997). "Microbiological screening of Indian medicinal plants with special reference to entero pathogens". *Journal of Alternative and Complementary Medicin, 3(1): 13-20*
2. Hoareau L and E J DaSilva (1999). Medicinal plants: A re-emerging health aid. *Electronic Journal of Biotechnolgoy* (Elect. J. Biotechnology), 2: 56-70
3. Schippmann U, Leaman D J and Cunningham AB (2002). Impact of cultivation and gathering of medicinal plants in biodiversity: global trends and issues. In: FAO ed. *Biodiversity and the ecosystem approach in agriculture, forestry, and fisheries*. FAO, Interdepartmental working group on biological diversity for food and agriculture, Rome, 142-167
4. Srivastava T N, Rajasekharan S, Badola D P, Shah Dc (2012). An Index of the Available Medicinal Plants, Used In Indian System of Medicine from Jammu And Kashmir State. *Ancient Science of Life*. 6(1):49-63
5. Sheeba E (2010). Antibacterial activity of Solanum surattense burm. F. Kathmandu university *journal of science, engineering and technology,* 6(1): 1-4.
6. Venkaiah M (2005). Studies on the Vegetation and Flora of Vizianagaram district, Andhra Pradesh. University press, 1:19-49.
7. Venkaiah, K. (2005). Ecological characteristics and biodiversity in the North Coastal Andhra region. *Indian Journal of Ecology*, 32(1), 45-52.
8. Kumar, A., & Reddy, B. (2010). Landform analysis and soil characteristics of coastal Andhra Pradesh. *Journal of Coastal Conservation*, 14(2), 89-96. https://doi.org/10.1007/s11852-010-0091-4.
9. Kumar, A., et al. (2019). "Ethnomedicinal investigation of medicinal plants of Chakrata region (Uttarakhand) used in traditional medicine." *National Product Bioprospect* 9(3), 175–200
10. Rao, P. S., & Rao, K. S. (2012). Forest types and conservation strategies in Andhra Pradesh. *Journal of Forestry Research*, 23(4), 653-660. https://doi.org/10.1007/s11676-012-0322
11. Prasad, M., & Devi, T. (2018). Geographical and ecological diversity in the Eastern Ghats: A case study of Visakhapatnam. *Journal of Indian Geographical Society*, 21(1), 23-30.
12. Reddy, B. K., & Kumar, P. (2017). Documentation of folk medicinal plants used by tribal communities in Uttarandhra, India. *Journal of Ethnobiology and Ethnomedicine*, 13(1), 15. https://doi.org/10.1186/s13002-017-0161-9
13. Venkaiah, K., & Harasriramulu, D. (2019). Traditional knowledge of medicinal plants among the Khond and Savara tribes of Andhra Pradesh. *Indian Journal of Traditional Knowledge*, 18(3), 450-458.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

14. Sharma, A., & Raju, N. (2020). Ethnomedicinal practices and plant utilization by rural healers in coastal Andhra Pradesh. *Asian Journal of Pharmaceutical and Clinical Research*, 13(5), 78-85. https://doi.org/10.22159/ajpcr.2020.v13i5.36820
15. Patil, M. J., & Suresh, D. (2021). A survey of folk medicine: Documentation of indigenous knowledge in the tribal villages of Uttarandhra. *Journal of Medicinal Plants Studies*, 9(2), 101-110.
16. Sivakumar. D & P. Seetharam (2024). Ethnicity of tribal's on Indigenous medicinal plants: A review. Annals of Phytomedicine 13(1): 325-336, 2024, DOI: http://dx.doi.org/10.54085/ap.2024.13.1.32.
17. Kandi, B., Dhal, N.K. and Mohanty, R.C. (2013). A case study on indigenous phytotherapy for skin diseases in Nuapada District, Odisha, India. Int J Herb Med. 1(2):117-123.
18. Biswas, A., Bari, M.A., Roy, M and Bhadra, S.K. (2010). Inherited folk pharmaceutical knowledge of tribal people in the Chittagong hill tracts, Bangladesh. J Ethnobiol Ethnomed. 9 (1):77-89
19. Prayaga Murty Pragada , Duvvada Srinivasa Rao, Malleboyina Venkaiah.,(2012) , Study of some ethnomedicinal plants for treatment of dysentery of North Coastal Andhra Pradesh, India. International Journal of Biosciences (IJB) ISSN: 2220-6655 (Print) 2222-5234 (Online) Vol. 2, No. 1, p. 18-24, 2012 http://www.innspub.net .
20. Chandra Babu, N., Tarakeswara Naidu, M. and Venkaiah, M. (2011). Ethnomedicinal plants used by the tribals of Vizianagaram district, Andhra Pradesh, Ann. Pharm. & Pharm. Sci., 2 (1& 2) : 1- 4
21. Samuel, S., et al. (2011). "A study of traditional medicinal plants used by the tribes of Western Ghats, India." *Journal of Ethnobiology and Ethnomedicine*, 7(1), 2. DOI: 10.1186/1746-4269-7-2.
22. Kumar, A., et al. (2019). "Ethnomedicinal practices and their implications in modern healthcare." *Journal of Ethnopharmacology*, 234, 235-247. DOI: 10.1016/j.jep.2018.12.001.
23. Khare, C. P. (2007). *Indian Medicinal Plants: An Illustrated Dictionary*. Springer.
24. De Silva, A. D., et al. (2019). "Traditional knowledge of medicinal plants among indigenous communities in the Western Ghats." *ournal of Ethnobiology and Ethnomedicine*, 15, 34. DOI: 10.1186/s13002-019-0320-2.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

TOWARDS A SUSTAINABLE AND HEALTHY FUTURE: E-WASTE MANAGEMENT IN INDIA IN THE ARTIFICIAL INTELLIGENCE ERA

[1]M.Samuel John
Lecturer in Computer Science
Government Degree College
Tiruvuru
write2samuel@gmail.com

[2]K.AdiLakshmi
Lecturer in Computer Applications
Govt Degree College
Tiruvuru
kattaadilakshmi@yahoo.com

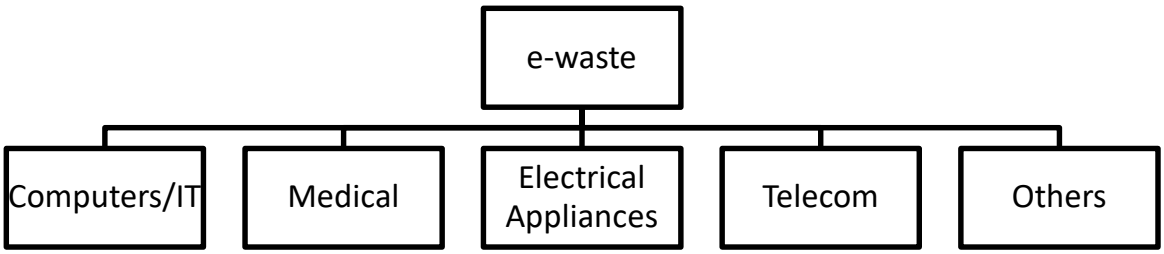
Abstract:

Now a days, almost all companies in India are using electronic devices like computers, printers, scanners and other appliances. Rapid digital transformation is bringing forth the invention of a wide variety of new electronic products every year. These electronic devices deteriorate over the years and ultimately cease functioning. When these unused components are thrown outside, they produce a lot of waste material which can contain toxic chemicals and other hazardous heavy metals. If they are properly repaired and recycled, they can reduce environmental hazards. India is facing so many difficulties in implementing proper e-waste management practices. Recent advancements in Artificial Intelligence enable us in developing potential solutions to curb environmental pollution. Integrating the capabilities of AI, IoT, computer vision, and other technologies results in high precision classification of electronic components in the e-waste. In this paper, we discuss the current state of e-waste management in India and how the technology, especially, Artificial Intelligence can help us in a sustainable and healthy future.

Keywords:e-waste, Artificial intelligence, sustainability, environment, recycle, pollution.

Introduction:

e-waste or electronic waste consists of any discarded electronic component. Common e-waste includes the unused components of computers, personal devices like cell phones, batteries, large household appliances, small household appliances[Fig 1]. E-waste can be categorized into hazardous and non-hazardous e-waste. Hazardous e-waste contains toxic materials, where non-hazardous e-waste doesn't contain toxic elements[1]. E-waste may also contain valuable materials like gold, nickel and copper. Some of the waste components can be recycled, some can be reused and remaining are to be disposed. As the technology grows rapidly and new devices are being manufactured, the electronic items that come under e-waste category are increasing rapidly through the years. For example, battery vehicles are producing EV waste which is not there in the last decade. Generally, three fourths of e-waste is generated by public and private sector companies and the remaining one fourth is generated by household devices. Among the 28 states in our country, Maharashtra, Tamil Nadu, and Andhra Pradesh are in the first three places in producing the most e-waste. The reason could be that these three states have many industries, IT companies, and manufacturing hubs.



(Fig 1: Major Components of e-waste)

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Health hazards of e-waste:

Electronic waste contains many hazardous materials that can not only cause serious health problems to humans but also pollute the environment[2]. Sadly, some of the poor and daily wage workers who work in garbage segregation do not have personal protective equipment and use improper and dangerous methods for recycling[3]. Ultimately thousands of such informal workers are becoming sick every year. Even during disposal of e-waste material, chemical pollutants are released and pollute air, water and soil.

The substance lead is found in CRT monitors and batteries which can cause neural diseases. The element mercury is found in many electric and electronic devices which can cause brain diseases. Other toxic substances like arsenic, selenium, barium, and cadmium can cause various cancers and damage important organs in our body.[4]

e-waste management in India:

After China and US, India is the third largest producer of electronic waste. According to the data released by the Central Pollution Control Board of India, during the year 2025-26, India has generated 1.4 million metric tonnes of e-waste and out of which less than one million metric tonnes has been recycled. The figure Fig.2 shows the e-waste generated vs recycled in the last five fiscal years. The upward trend in recycling is due to the green initiatives taken by the Government.

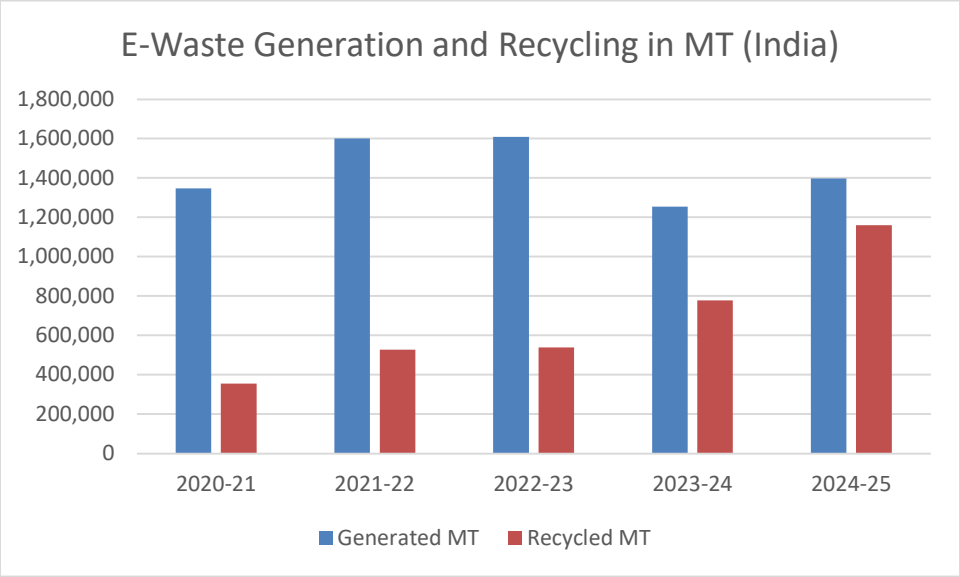


Fig 2: MoEF&CC, Rajya Sabha Question[5]

AI-driven robotics and sensors

Robots can be used to disassemble harmful materials which humans generally afraid to touch with their hands. Robots can use ML and DL algorithms to classify electronic waste with a high rate of accuracy. AI driven prediction tools use historical data, statistics and machine learning algorithms to forecast e-waste generation patterns.

AI enabled segregating systems can identify and separate different types of e-waste by using computer vision and ML algorithms.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Smart bins[6] are sensor equipped dust bins that can be used to alert the authorities of municipality when they reach their full capacity. Then, the municipal workers can come and collect the garbage. These are very useful in crowded cities. In tradition waste collection, trucks follow specific timings and specific routes and some times they collect the garbage even when the dust bin is not full in capacity. Smart bins overcome these problems.

In any electronic component with a circuit board, if a small component is damaged, the repairers are demanding the customers to change the entire board instead of repairing the small component, which also leads to increase of e-waste. If that particular component is replaced then we can reduce lot of e-waste.[7]

Challenges and solutions in using AI enabled devices in e-waste management:

Nearly 95% of the e-waste management is handled by the informal sector and they employ dangerous methods to recover valuable metals from the waste components [8]

Huge investment costs: To buy AI enabled robots and other IoT enabled devices, companies need to invest a lot of amounts. That's why municipalities and other agencies are still using manual approaches to segregate waste. If the government support with a subsidy in buying these machines, then positive changes may happen in waste management.

Variability of waste components: It's a challenging task to accurately segregate the components because they are in different shapes and different sizes. Machine learning algorithms can be trained on large data to predict the components.

Infrastructure gap: Lack of infrastructure in integrating the recycling facilities with AI equipped machines [9].

Faster upgradation rate: People often discard the old electronic devices when a new version is released into the market with more advanced features than any other furniture or other equipment. We see cell phones or laptops are more frequently discarded whenever a new model is released. That's why so much of e-waste is piling up everywhere.

Conclusion:

E-waste is the fastest growing waste than any other kind of garbage out there. Only a small portion of the e-waste is properly collected, and recycled. A large chunk of electronic waste is just thrown away into landfills, polluting the air, water and soil with poisonous elements. This can lead to serious health problems like cancers and neurological disorders. Artificial Intelligence can be used in precisely identifying and determining which parts are reusable. Since AI enabled robots can be used in disassembling hazardous electronic components, human workers need not be exposed to toxic stuff and such unsafe environments. AI can also help governments and other companies to take more smarter decisions for sustainable waste management.

References:

[1] Singh, Yatin and S, Parimala, E-Waste Management (March 26, 2025). Available at SSRN: https://ssrn.com/abstract=5196804 or http://dx.doi.org/10.2139/ssrn.5196804

[2] Parvez, S. M., Jahan et al, P. D. (2021). Health consequences of exposure to e-waste: an updated systematic review. *The Lancet. Planetary health*, *5*(12), e905–e920. https://doi.org/10.1016/S2542-5196(21)00263-1

[3] Diyasha Sengupta et al, Circular economy and household e-waste management in India. Part II: A case study on informal e-waste collectors (Kabadiwalas) in India,Minerals Engineering, Volume 200,2023,108154,ISSN 0892-6875, https://doi.org/10.1016/j.mineng.2023.108154.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

[4] Ibraheem Kehinde Sherifat et al, Journal Name: Microbiology Archives, an International Journal, https://doi.org/10.51470/MA.2025.7.2.48

[5] Ministry of Environment, Forest and Climate Change of India , Answer for Rajya Sabha Question, https://sansad.in/getFile/annex/269/AU525_93snO8.pdf?source=pqars

[6] Abderrahim Lakhouit, Revolutionizing urban solid waste management with AI and IoT: A review of smart solutions for waste collection, sorting, and recycling, Results in Engineering, Volume 25,2025,104018,ISSN 2590-1230, https://doi.org/10.1016/j.rineng.2025.104018

[7] Quinto S, Law N, Fletcher C, Le J, Antony Jose S, Menezes PL. Exploring the E-Waste Crisis: Strategies for Sustainable Recycling and Circular Economy Integration. *Recycling*. 2025; 10(2):72. https://doi.org/10.3390/recycling10020072

[8] https://www.meity.gov.in/static/uploads/2024/02/7ab.pdf

[9] The Role of Artificial Intelligence in Revolutionising E-Waste Management, https://www.attero.in/blog/artificial-intelligence-e-waste-management,

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

CRAFTING SUSTAINABLE SKINCARE FROM NATURE'S PALETTE

Dr.Sara[1] and Kavati Usha Sri[2]

1. Dr.Sara Palaparthy, Lecturer in Botany. Government Degree College, Ramachandrapuram,botany.sara@gmail.com
2. Kavati Usha Sri, Lecturer in Botany, . Government Degree College,Pithapuram,myduushasri@gmail.com

Abstract

Growing awareness of the harmful effects of synthetic chemicals in commercial cosmetics has encouraged many consumers to adopt homemade beauty products. As individuals seek natural, affordable, and sustainable alternatives, homemade cosmetics have emerged as practical solutions that reduce chemical exposure while supporting overall wellness. A castor-oil-soaked wick is lit in a diya, and the soot deposited on a metal plate above the flame is collected and blended with ghee or coconut oil to form a smooth paste. Free from preservatives, artificial dyes, and chemical additives, natural kajal is considered gentler on the eyes and is traditionally believed to offer cooling and soothing benefits. Its chemical-free formulation makes it suitable for individuals with sensitive or easily irritated eyes.Similarly, compact powder used to mattify the skin can be prepared using natural absorbents such as rice flour, cornstarch, and cocoa powder. These ingredients provide effective oil control without the talc, parabens, fragrances, and fillers commonly found in commercial powders. The shade can be customized by varying the amount of cocoa powder, allowing the product to suit a range of skin tones.. Beetroot juice or powder is combined with bases like beeswax, shea butter, or coconut oil to create a tinted, moisturizing balm. This formulation provides natural color while nourishing and protecting the lips. Unlike many commercial lipsticks that may contain synthetic dyes and chemical preservatives, beetroot lipstick is entirely plant-based and skin-friendly. Overall, this paper highlights that homemade kajal, compact powder, and beetroot lipstick offer significant benefits, including reduced chemical exposure, personalization, cost-effectiveness, and environmental sustainability.

Keywords: Homemade cosmetics, DIY beauty products, Natural ingredients, Kajal preparation, Beetroot lipstick, Natural compact powder, Traditional formulations, Eco-friendly cosmetics, Natural pigmentation

Introduction

In recent years, growing awareness of the harmful effects of synthetic chemicals and preservatives in skincare and cosmetics had encouraged many individuals to explore natural, homemade alternatives. This shift toward chemical-free beauty reflected a broader interest in sustainability, personal well-being, and environmentally responsible consumption. This paper discussed the preparation of three popular natural beauty products homemade kajal, compact powder, and beetroot lipstick highlighting their ingredients, preparation methods, and reported benefits. By relying on accessible, natural materials, these products offered safer, customizable, and eco-friendly options for daily use.

Section 1: Homemade Kajal

1.1 Ingredients

- Castor oil (or other natural oils)
- Cotton wick
- Metal (or heat-resistant) plate
- Diya or small oil lamp
- Ghee, coconut oil, or other natural oil/fat for mixing soot

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

1.2 Methodology

Step 1: The Diya was filled with castor oil (or ghee), a cotton wick was inserted, and the lamp was lit. The Diya was placed between two metal glasses (or similar shields) to concentrate the flame.
Step 2: A metal plate was positioned over bricks (or supports) close enough so that soot from the flame would accumulate on the plate's underside. The soot gradually gathered as a fine black deposit.
Step 3: After sufficient soot deposition, the soot was carefully scraped into a clean container. A small quantity of ghee, coconut oil, or castor oil was added — and mixed — until a smooth paste was formed.
Step 4: The resulting kajal was stored in an airtight container and used with clean applicators, applied gently to the eyelids or waterline.

1.3 Traditional Benefits

- **Chemical-free alternative:** Because the soot-based kajal used only natural oils and soot, it avoided synthetic preservatives, heavy metals, or artificial dyes commonly found in many commercial kajals.
- **Cooling and soothing effect:** Traditional formulations (e.g., almond or castor oil–based kajal) were said to cool the eyes, soothe irritation, reduce dryness, and provide relief to tired or strained eyes.
- **Nourishment and eye-care benefits:** Oils such as castor oil, ghee, or almond oil provided moisturizing and emollient effects around the delicate skin of the eyes, which could help in maintaining skin health and possibly reducing dryness or irritation.
- **Sustainability and simplicity:** The method required only basic materials (oil lamp, plate, oil), so it avoided the packaging waste and chemical load associated with mass-produced cosmetics aligning with eco-friendly and sustainable practices.

Section 2: Homemade Compact Powder

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

2.1 Ingredients (as proposed)

- Rice flour
- Corn-starch
- Cocoa powder (optional, for tint)
- Essential oils for fragrance or skin benefits

2.2 Methodology

A mixture of rice flour and corn-starch was prepared (e.g., equal parts), with optional cocoa powder added to give a slight tint suitable for medium to deeper skin tones. Essential oils could be introduced for fragrance or added skin benefits. The mixture was then sifted to remove clumps and ensure a smooth, fine powder. The final product was stored in an airtight container and applied using a soft powder brush.

3: Homemade Beetroot Lipstick

3.1 Ingredients

- Fresh beetroot (juice or blended) **or** beetroot powder (dried & finely ground) as pigment
- Beeswax (or another wax / butter for structure)
- Coconut oil, olive oil, or other natural oils for moisturizing and base
- Essential oils (e.g., for fragrance) or vitamin E (as antioxidant / preservative)

3.2 Preparation Process

- The beetroot was peeled, chopped, and blended into a smooth paste; or powdered beetroot was used directly as pigment.
- In a double boiler or heat-safe bowl over simmering water, beeswax was gently melted along with coconut or olive oil (and optionally shea or cocoa butter to form the base.
- Beetroot juice or powder was added to the melted oil-wax base; essential oil or vitamin E could be incorporated for fragrance and antioxidant protection.
- The mixture was stirred thoroughly to ensure even pigment distribution, then poured into small containers or lipstick molds and allowed to cool and solidify.
- The resulting lipstick or tint balm was stored in a cool, dry place or refridgerated, depending on moisture content and used as a natural lip colour.

Conclusion

In summary, traditional and homemade beauty formulations such as soot-based kajal, rice-flour compact powder, and beetroot-based lipstick had long offered natural, customizable, and eco-friendly alternatives to mass-produced cosmetics. For people concerned about exposure to synthetic chemicals, preservatives, dyes, or heavy metals, these approaches provided a viable path to safer and simpler beauty practices. At the same time, the benefits strongly depended on meticulous preparation, hygiene, and the quality of raw ingredients. When made and applied carefully, these natural products combined ancient wisdom with modern conscious-beauty sensibilities offering chemical-free, skin-friendly, and sustainable beauty solutions.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

References:

- Mokashi A., Fellows K. M., Chin R. J., Whittaker S. G., Simpson C. D., Ceballos D. M. (2025). *Lead in traditional eyeliners: An investigation into use and sources of exposure in King County, Washington.* PLOS Global Public Health, 5(6): e0004643. PLOS
- "Kohl, Kajal, Al-Kahal, Surma, Tiro, Tozali, or Kwalli — Any Name, Beware: Lead Poisoning." U.S. Food and Drug Administration. U.S. Food and Drug Administration
- Centers for Disease Control and Prevention (CDC). (2024). *Lead Poisoning in a Mother and Her Four Children Using a Traditional Eye Cosmetic — New York City, 2012–2023.* MMWR, 73(30), 667–671. CDC
- Chalke, P. M., & Mulla, J. A. S. (2023). "Beetroot-infused herbal lipstick: Formulation and evaluation." *World Journal of Applied Pharmaceutics*, 1(1): 25–29. ResearchGate
- Tejaswi, A., Subrahmanyam, N. S., & Navuduri, S. J. (2025). "Formulation and characterization of lipstick using Beta vulgaris." *International Journal of Pharmacognosy and Chemistry*, 6(3). saapjournals.org
- "Rice Flour for Skin: Benefits, How to Use It, Drawbacks of Using It." Healthline. (2025) Healthline
- "Rice flour: 4 benefits of rice flour for flawless & radiant skin." JD Institute. (2021) JD Institute of Fashion Technology
- Harshitha R., Harshitha P., Bindu N., Poojitha K. J., Shreedevi N., Shubhashini J. (2024). *Formulation and Evaluation of Natural Rice Flour Face Scrub.* International Journal of Research and Review, 11(12), 484–493. IJRR Journal
- de Bellefonds, C. (2020, Nov 18). *Rice Flour for Skin: Benefits, How to Use It, Drawbacks of Using It.* Healthline. Healthline
- Kuldeep Kaur. (2025). *Use of Rice Water in Cosmetology: A Review.* International Journal for Research in Applied Science and Engineering Technology, 13(8), 1399–1421. ResearchGate
- Tejaswi A., Subrahmanyam S., Navuduri S. J. (2025). *Formulation and Characterization of Lipstick Using Beta vulgaris (Beetroot).* International Journal of Pharmacognosy and Chemistry, 6(3): 19–24. saapjournals.org+1
- Karwate G. D., Muthal P. V., Deshmukh S. P., Wankhade M. B. (2024). *Formulation and Evaluations of Beet-Root Herbal Lipstick.* [Journal] (see Wankhade et al.). IJPS Journal
- Nahak A., Padhi A. N., Mahapatra A. K., Sahu A., Kakinada S. K., Prusty A. (2025). *Harnessing Beet Root Pigments as Natural Colorant for a Glossy Herbal Lipstick: Formulation and Evaluation.* Journal of Young Pharmacists, 17(3), 627–635. Journal of Young Pharmacists+1
- Prakash Kumar, Aradhya, Sandeep Kumar & Rohini Mishra. (2025). *Formulation and Evaluation of Herbal Lipstick by Using Beta-Vulgaris (Beetroot): A Review Paper.* International Journal of Scientific Research in Science & Technology, 12(4), 139–150. ijsrst.com+1
- "Heavy metals in cosmetics and tattoos: a review of historical background, health impact, and regulatory limits." (2023). *[Journal]*. — documents lead (and other heavy metal) contamination risk in traditional kohl/kajal products. ScienceDirect
- "Cobalt and lead concentrations in cosmetic products sold at local markets in Saudi Arabia." (2021). *[Article, ScienceDirect]* — found some kajal samples exceeded permissible heavy-metal limits. ScienceDirect

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

BY THE SEA AND BEYOND: COASTAL LANDSCAPES, CLIMATE VULNERABILITY, AND EXILE IN ABDULRAZAK GURNAH'S NOVELS

Dr S Hemalatha
Prasaranga- Centre for Publications
Dravidian University Kuppam AP 517426 India
Mail: drshemalathapenchalaiah@gmail.com

K S Narayana
Lecturer in English
GOVT DEGREE COLLEGE MANDAPETA
Konaseema Dist AP 533308 INDIA
Mail: myselfksn@gmail.com

Abstract

This article speaks about Abdulrazak Gurnah's fiction—especially *By the Sea* but also *Paradise* and *Afterlives*—through an ecocritical and climate-justice perspective arguing that coastal landscapes function as places of memory, ecological vulnerability, and political segregation. These works earned Gurnah the 2021 Nobel Prize in Literature for his sharp take on colonialism's effects. Coastal landscapes serve as powerful sites. As Gurnah describes and inscribes the Indian Ocean coast with histories of colonial trauma and extraction, environmental degradation, and forced migration, the paper portrays how climate alienation becomes inseparable from the experience of exile. The essay proposes that Gurnah's *coastal landscapes* and maritime settings do not only frame displacement but also sharply shape the temporal and spatial setting of his characters, while offering story from the Global South that challenges Europe-centered views on the climate crisis.

1. Introduction: "By the Sea" as Ecological Verge

Gurnah's *By the Sea opens* with an elderly man arriving on the coast of England, a migrant as a refugee who has crossed oceans yet remains attached mentally to the shores of East Africa. The novel's title signals that the sea is not a neutral backdrop but a dynamic verge: between continents, between past and present, between belonging and exclusion. mural.maynoothuniversity+2

In the recent ecocritical readings, scholars begin to highlight how Gurnah's fiction encodes the material and symbolic burden of coastal ecosystems—tidal zones, shorelines, and mangroves—that are specifically vulnerable to climate change and sea-level rise. Rendering *By the Sea,* along with *Paradise* and *Afterlives*, the article maintains that Gurnah's coastal landscapes are both:

- fragile spaces where exile and climate precarity intersect and
- remains of colonial resource extraction and ecological imbalance,

Rather than treating the ocean as a romantic symbol of freedom, Gurnah portrays it as a zone of hoarded historical and environmental debt that conditions his characters' psychological and material vulnerability.

2. Colonial Coasts and the Wounds of the Land

In *Paradise* and *Afterlives*, Gurnah portrays the colonial coast as a site of violent economic transformation. Plantations, ports, and trade routes reshape coastal ecosystems, altering forests and wetlands into economic and extractive zones that serve imperialist and capitalist interests. The coastal landscapes of these novels are marked by:

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

- pollution and disruption of marine life around harbors;
- deforestation and soil erosion linked to export agriculture;
- the displacement of coastal communities whose livelihood depends on fishing and small-scale farming.

Critics such as F. Ozlem Pala-Dogan and others have noted that Gurnah's fiction focuses on the shifting weather patterns and "warm-up" of the sea, effects that echo contemporary climate-change narratives. The representations suggest that colonial modernity not only reshapes political borders but also inaugurates a long-term environmental crisis; the "warming" of the sea is not merely meteorological but historical—a product of imperial regimes.

Thus, for Gurnah, the coastal landscape bears the imprint of both colonial violence and emerging climate precarity, complicating any nostalgic return to the homeland.

3. Exile, the Hostile Environment and Climate Precarity

In *By the Sea*, the old man as a protagonist's journey from the Indian Ocean to the English coast emphasizes the entanglement of migration and environmental instability. The protagonist's inner reflections reveal an inner self formed by the memory of droughts, shifting coastlines, and the loss of coastal livelihoods—an experience of "internal climate change" that prefigures his later sense of alienation in Britain.

Gurnah's picture of exile thus challenges the idea that climate-induced migration is a current phenomenon. However, he shows how colonial and postcolonial political economies long produced environmentally precarious populations who are already "displaced" before they cross official borders. The "hostile environment" policy in Britain, often understood as a purely racial or bureaucratic mechanism, appears in Gurnah's fiction as the continuation of an older political and ecological logic: the criminalization of those whom climate and empire have rendered homeless.

In this sense, the coastal landscape of exile functions as a bridge:

- Locally, the erosion of sand-shores and mangrove swamps mirrors the erosion of social and familial ties.
- Globally, the same coastal zone becomes a war zone for climate-induced migration that is policed and document-weighed rather than protected. Gurnah's coastal migrants are not just helpless victims of climate change. They are active people. Their stories connect to centuries of colonial exploitation. Their insecurity comes from both nature and politics.

4. Memory, Tides, and Narrative Time

Gurnah's narrative structure in *By the Sea* and *Afterlives* showcases the tidal rhythms of coastal landscapes. The novels move in waves and tides of memory and forgetting, advancing and receding in time much like the shoreline itself. This tidal temporality fights linearity: The coast's past does not stay in the past. It floods into the present. It lives again in the characters' thoughts. It shows up in the environment's physical decay. Ecocritical readings of *Afterlives* highlight one key point. Gurnah connects war, empire, and the "wounded earth." He shows that harm to people and land happen together.

In *By the Sea*, this woundedness travels across the ocean. The protagonist carries an image of a damaged coastline in his mind. The English shore becomes a place of late realization. It is not a place of renewal.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

The sea does not give a clean break from the past. It acts as a surface for memory. Every new coastline reflects old scars. These scars are both ecological and mental. This fits Global South climate stories. They stress continuity over breaks. They say climate insecurity only makes sense through history.

5. Climate Justice from the Global South

Recent studies place Gurnah in a larger talk on "worldmaking from the south." They say his stories give new views of climate and belonging.

Gurnah focuses on coastal groups in East Africa and the Indian Ocean. He moves away from Europe-centered climate stories. Those stories often treat environmental change as a universal problem without history.

In By the Sea, climate insecurity is not a future risk. It is a everyday reality. It comes from three things:

- Colonial ways of using land.
- Uneven building of infrastructure.
- Global North rules that criminalize movement.

This essay states that Gurnah's coastal places argue for climate justice. Care for the environment links to fixing histories. It links to decolonial memory. It links to the right to migrate with dignity.

Climate justice in Gurnah's work goes beyond technical rules. It is about narrative ethics. It asks: Whose pasts do we recognize? Whose losses do we grieve? Whose futures do we picture on the shared, but unevenly harmed, coast?

Conclusion:

Coastal Futures in Gurnah's Fiction

By the Sea and Beyond argues that Abdulrazak Gurnah's coastal landscapes are not merely scenic settings but critical nodes where colonial history, environmental degradation, and climate precarity converge. His novels show that exile is forged not only in border controls and xenophobia but also in the slow violence of eroding coasts and shifting seasons.

By reading Gurnah ecocritical, this article positions his fiction as a crucial Global-South response to climate-crisis literature, one that insists on the entanglement of memory, land, and sea. In doing so, it invites future research to trace how Gurnah's maritime worlds can be read alongside other Indian-Ocean writers and climate-justice narratives, forging a connected literary cartography of coastal resilience and resistance.


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

URBANIZATION AND ITS IMPACT ON BIODIVERSITY: CHALLENGES AND SUSTAINABLE SOLUTION

L.Vijaya Lakshmi
Lecturer in Zoology, NTR Government Degree College, Valmikipuram, 517299.

Dr.V.Gurumurthy
Lecturer in Zoology, Govt. Degree College for Women, Madanapalle, 517325.

K. Indu Muktha Rao
B.Tech, MIITS Madanapalle,-517325.
Email: lvijayalakshmi7@gmail.com

Abstract

One of the most significant anthropogenic activities causing significant changes in ecosystems and biodiversity worldwide is urbanisation. Due to population increase and economic development, urban areas are being rapidly expanded, changing natural landscapes and causing habitat loss, fragmentation, and ecological degradation. This topic critically reflects the various ways that urbanisation impacts biodiversity, such as changes in land use, pollution of the environment, the introduction and spread of invasive species, and the escalation of climate-related pressures like the urban heat island effect. Together, these elements lowers species richness, upset ecological balance, and hinder ecosystem function. The study assesses sustainable and adaptable approaches reducing biodiversity loss in urban settings in addition to identifying important obstacles. This study includes using cutting-edge technologies like Geographic Information Systems (GIS), remote sensing, and environmental DNA (e DNA) for efficient monitoring and conservation, as well as developing green infrastructure and incorporating biodiversity considerations into urban planning and policy frameworks. In order to ensure long-term sustainability, the article highlights the significance of participatory initiatives including local communities. In order to attain ecological resilience and sustainable urban futures, the study emphasises the critical necessity to refocus urban growth towards biodiversity-sensitive planning.
Keywords: Urbanization, Biodiversity, Habitat fragmentation, Sustainable development

A) Introduction

Urbanization is one of the most dominant global trend rapidly transforming natural ecosystems into built environments in the name of development causing biodiversity loss. It refers to the increasing concentration of human populations in cities and towns. Urban growth supports economic development, but it foists serious threats to biodiversity. Biodiversity, incorporating genetic, species, and ecosystem diversity, is essential for balancing ecosystem stability and human well-being. However, altering of natural landscapes into urban environments leads to land-use changes, environmental degradation, and ecological imbalance. Biodiversity plays a critical role in maintaining ecosystem stability, resilience, and the provision of ecosystem services. Urban expansion often occurs at the expense of biologically rich habitats, particularly in ecologically sensitive regions. Increasing evidence suggests that interactions between urbanization and climate change will further intensify biodiversity loss in the coming decades. This paper aims to critically analyze the multiple pathways through which urbanization affects biodiversity, including habitat fragmentation, pollution, biological invasions, and climate-related stresses and accentuates the importance of participatory approaches involving local communities to ensure long-term sustainability.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

B) Impacts of Urbanization **on Biodiversity**

1. Habitat Modification and Fragmentation

Urban growth typically implicates the transformation of natural habitats into residential, industrial, and commercial zones. Fragmented landscapes hold back species movement and disrupt ecological connectivity, making species more vulnerable to extinction. Such fragmentation weakens ecological networks and increases the vulnerability of species populations. This process leads to

a. Reduction in natural ecosystem
b. Formation of small isolated species population
c. Limits in species reproduction
d. Decrease in genetic diversity

2. Pollution and Environmental Degradation

Urban areas are major sources of environmental contaminants. These pollutants negatively affect terrestrial life, aquatic life, and overall ecosystem health. Urban areas contribute significantly to:

a. Air pollution (e.g., particulate matter, NOx, SO_2)
b. Water pollution from industrial and domestic waste
c. Soil contamination due to heavy metals

3. Introduction of Invasive Species

Urban environments facilitate favourable conditions for the spread of non-native species. The dominance of invasive species is a common feature in highly urbanized landscapes. These invasive species often:

a. Outcompete native organisms for resources
b. Alter food webs causing disturbance in ecological relationship
c. Reduce native biodiversity leading to coalescence of all biota

4. Climate Change Interactions

Urbanization contributes to climate change through greenhouse gas emissions and the urban heat island effect altering precipitation patterns. These changes create stress on already disturbed ecosystems. Invasive plants and urban-adapted animals that dominate disturbed habitats,

- Alters species distribution
- Affects breeding cycles and food webs
- Influence on the distribution of flora and fauna
- Urban biodiversity is thus influenced by both local and global environmental changes increasing extinction risks.
- Recent findings indicate that urban heat intensifies climatic stress on species and can reshape biodiversity patterns at fine spatial scales. These conditions can exceed the tolerance limits of many organisms, especially sensitive taxa.

5. Loss of Ecosystem Services

Biodiversity loss in cities reduces essential ecosystem services such as:

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

- Pollination
- Air and water purification
- Climate regulation
- This directly impacts human health and quality of life.
- Predator–prey relationships
- Nutrient cycling

Loss of these functions directly affects human well-being and sustainability.

C) Urban Biodiversity: Opportunities and Adaptations

Despite challenges, cities are not ecological deserts, these Adeveloping areas can support biodiversity through:

- Urban parks and green spaces
- Wetlands and urban forests
- Rooftop gardens and vertical greenery
- Certain species adapt to urban environments, demonstrating ecological resilience. Birds, insects, and small mammals often thrive in modified habitats.

D) Sustainable Way out for Biodiversity Conservation

1) Development of Green Infrastructure

Incorporating natural elements into urban design can significantly benefit biodiversity. Green infrastructure, urban planning, and community participation can help conserve biodiversity. These approaches improve habitat availability and environmental quality.

- Vegetated rooftops and walls
- Urban forests and green corridors
- Rain gardens and permeable landscapes

2) Urban Planning and Policy Approaches

Policies aligned with frameworks like the Convention on Biological Diversity can guide conservation efforts. Sustainable urban planning should:

- Integrate biodiversity into land-use planning
- Protect natural habitats
- Promote eco-friendly development
- Limiting unplanned expansion

3) Community Participation

Citizen science initiatives help monitor biodiversity and promote stewardship. Local communities play a vital role in:

- Conservation awareness
- Habitat restoration
- Sustainable resource use

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

- Enhance biodiversity data collection

4) Application of Advanced Technologies in Biodiversity Monitoring

Advanced technologies are transforming biodiversity assessment. These tools improve accuracy, scalability, and efficiency in biodiversity monitoring.

- GIS and remote sensing enable large-scale habitat analysis
- Environmental DNA eDNA allows detection of species presence without direct observation
- Artificial Intelligence enhances predictive modeling and conservation planning

E) Urban Biodiversity in Developing Countries

Urbanization in developing regions presents unique challenges due to rapid and often unplanned growth. In countries like India, urban expansion has led to significant loss of natural habitats. However, it was observed in Cities like Bengaluru and Delhi demonstrate contrasting trends. Initiatives like lake restoration and urban forestry have improved biodiversity. urban forestry have improved biodiversity by performing urban afforestation, wetland restoration, and framing biodiversity parks demonstrate the potential for ecological recovery.

F) Future Perspectives

Future urban biodiversity conservation should focus on:

- Nature-based solutions
- Climate-resilient cities
- Interdisciplinary research
- Strong policy implementation
- Balancing development with ecological sustainability is essential for long-term environmental health.

G) Conclusion

Sustainable urban development must integrate biodiversity conservation for long-term ecological balance. Urbanization significantly impacts biodiversity through habitat loss, pollution, and climate change. The dominance of invasive species is a common feature in highly urbanized landscapes. Urban ecosystems often host adaptable species capable of surviving in modified environments. Such processes reduce regional biodiversity and weaken ecosystem resilience. However, sustainable solutions such as green infrastructure, wetlands, and roadside vegetation, effective policies, community participation, and modern technologies such as artificial Intelligence can mitigate these effects and preserve the species. Cities have the potential to become biodiversity-friendly spaces if conservation is integrated into urban development strategies. Incorporating green corridors, rain gardens improve habitat availability and ecological connectivity providing climate regulation. Research shows that urban ecosystems can support unique biodiversity assemblages, particularly when green spaces are present. So designing ecological corridors significantly influences species distribution, particularly for birds and other mobile organisms. Future urban systems must be designed to support both human needs and ecological integrity. Achieving sustainable urbanization requires a paradigm shift from viewing cities as ecological threats but to recognizing them as potential hubs for biodiversity conservation. Public participation is essential for successful conservation. These examples emphasize the importance of balancing development with ecological conservation into urban policy frameworks. Participatory approaches ensure long-term success and social acceptance of conservation strategies.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

Overall, the study highlights the urgent need to reorient urban development towards biodiversity-sensitive planning in order to achieve ecological resilience and sustainable urban futures

References

1. McKinney (2008). Effects of urbanization on biodiversity.
2. United Nations (2018). World Urbanization Prospects.
3. Convention on Biological Diversity (2020). Global Biodiversity Outlook.
4. McKinney, M. L. (2008). Effects of urbanization on species richness.
5. Grimm, N. B. et al. (2008). Global change and the ecology of cities.
6. Seto, K. C. et al. (2012). Global forecasts of urban expansion.
7. McKinney, M. L. (2008). Urbanization and species diversity.
8. Grimm, N. B., et al. (2008). Urban ecological systems.
9. Seto, K. C., et al. (2012). Urban expansion and environmental change.
10. Mainwaring, M. C., Song, G., & Zhang, S. (2024). Urban biodiversity in the Anthropocene. *Scientific Reports*.
11. Urban, M. C., et al. (2024). Climate change and urbanization impacts on biodiversity. *Nature Climate Change*.
12. Brown, L. M., & Anand, M. (2024). Urban land-cover and biodiversity. *Landscape Ecology*.
13. Perry, G., & Cox, R. D. (2024). Urban ecosystem regeneration. *Diversity*.
14. Dietzel, A., et al. (2025). Urban heat and biodiversity risk. *npj Urban Sustainability*.
15. Buenaño-Mariño, C. P., et al. (2025). Urban structure and biodiversity. *Biodiversity and Conservation*.
16. Nagendra, H., Sudhira, H. S., Katti, M., Tengö, M., & Schewenius, M. (2014). Urbanization and its impacts on land use, biodiversity and ecosystems in India. *INTERdisciplina, 2*(2), 78–98. https://doi.org/10.22201/ceiich.24485705e.2014.2.46532
17. Sharma, S., & Arya, A. K. (2025). Impact of urbanization on biodiversity in the global biodiversity hotspot of Sikkim Himalaya, India: A review. *Research in Ecology, 8*(1), 232–258. https://doi.org/10.30564/re.v8i1.11720
18. Mukherjee, J. (2015). Beyond the urban: Rethinking urban ecology using Kolkata as a case study. *International Journal of Urban Sustainable Development, 7*(2), 131–146. https://doi.org/10.1080/19463138.2015.1011160
19. Anujan, K., Velho, N., & Nagendra, H. (2024). Beyond the metropolis: Street tree communities and resident perceptions on ecosystem services in small urban centers in India. *Journal of Urban Ecology, 10*(1), juae004. https://doi.org/10.1093/jue/juae004
20. Dave, R., Soni, K., Thakar, M., Patel, M., & Sindhav, G. (2025). Probing sustainable urban development by assessing avian diversity, limnology, and remote sensing. *Journal of Basic and Applied Zoology, 86*, 35. https://doi.org/10.1186/s41936-025-00454-5
21. Patel, J. B., & Raval, Z. (2024). The impacts of urbanization on ecological systems: A comprehensive study of the complex challenges arising from rapid urban growth. *Research Review Journal of Indian Knowledge Systems, 1*(1), 1–10. https://doi.org/10.31305/rrjiks.2024.v1.n1.001


Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

CLIMATE CHANGE AND POLLUTION AS DRIVERS OF HOST–PARASITE DYNAMICS: IMPLICATIONS FOR DISEASE BURDEN AND BIODIVERSITY LOSS

K. Anusha[1,2*],V. Durga Praveena[3,4] ,Sai Shreeya Pudi[1,2], D.S.D Swaroop[1,2], K. Harsha Vardhan[1,2]
[1]Department of Biotechnology, Government College (A), Rajahmundry, A. P, India.
[2]Central Instrumentation Laboratory–I, Government College (A), Rajahmundry, A. P, India.
[3]Department of Chemistry, Government College (A), Rajahmundry, A. P, India.
[4]Research in Advanced Material Science Centre (RAMC), Government Degree College (A), Rajahmundry, AP, India.
Corresponding author: lekhaanu79@gcrjy.ac.in

Abstract

Climate change is now a tangible, daily reality, manifesting through extreme weather, rising temperatures, and disrupted routines, rather than just distant scientific reports. Climate change shifts host-parasite dynamics by accelerating parasite development and expanding their geographical range, resulting in enhanced disease prevalence, new host-switching instances, and extreme ecosystem imbalances. This phenomenon causes ecological disruption, in which altered temperatures and habitats favour parasites over their hosts. Fluctuating climates can change disease transmission by impacting host versus parasite survival, whereas Pollution impairs host immunity by damaging epithelial barriers, inducing chronic stress, and causing immunotoxicity, which makes organisms vulnerable to diseases and reduces reproductive success. More than 58% of documented human infectious diseases, encompassing 277 pathogens, are increased by climate-related risks, resulting in millions of fatalities annually from diseases such as influenza, Ebola, and dengue. These impacts disproportionately affect vulnerable populations—particularly children and lower-income people who bear around 88% of the burden due to prolonged transmission periods and more frequent outbreaks. The synergistic effects of global warming and pollution on host–parasite interactions represent a critical pathway through which environmental change drives biodiversity loss. In order to maintain ecosystem health and stability, integrated climate action, pollution mitigation, and ecological research are crucial. These interactions not only accelerate disease spread and novel outbreaks but also weaken the resilience of global biodiversity, demanding immediate, multifaceted interventions.

Keywords: Climate change, Parasite–host interaction, Infectious diseases, Pollution, Biodiversity loss, Ecosystem resilience, Disease transmission, Environmental stress, Global warming.

1.Introduction

Climate change has emerged as one of the most significant global environmental challenge, profoundly affecting ecosystems, species distribution, and disease dynamics [1,2]. Rising temperatures, changed rainfall patterns, habitat destruction, and growing pollution are reshaping interactions between hosts and parasites, thereby influencing the emergence and spread of infectious diseases. One of the primary ways organisms respond to global change is through phenotypic plasticity. Parasites, including viruses, bacteria, protozoa, fungi, and helminths, are highly sensitive to environmental conditions, and climatic variations can quicken their growth, survival, reproduction, and transmission [3]. Whereas, Environmental stress caused by climate change includes host immunity, intensifying host–parasite interactions that play a major role in regulating population dynamics and ecosystem stability. Warmer temperatures make it possible for disease vectors to spread into previously inappropriate areas, exposing new populations to infectious diseases. [4]. Altered habitats and climate-induced ecological pressures are increasing the likelihood of parasites adapting to new hosts, thereby causing the emergence of zoonotic diseases. Host–parasite interactions influenced by climate change have far-reaching consequences for both ecosystem and public health. Increased disease transmission and the emergence of unknown pathogens threaten humans, animals, and wildlife alike. At the same time, these disturbances contribute to biodiversity

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

erosion, species decline, and disruption of ecological stability [1.5]. A deeper understanding of climate-driven disease dynamics is essential for developing sustainable approaches to biodiversity conservation and future disease management.

2. Climate Change and Host–Parasite Interactions

Global climate change is significantly reshaping host–pathogen interactions by altering the metabolic activity and developmental rates of pathogens and their vectors. Rising temperatures accelerate pathogen replication, shorten incubation periods, and increase the maturation rates of vectors, thereby enhancing disease transmission and vector abundance[3,4]. However, pathogen survival is strongly influenced by thermal thresholds, as excessively high temperatures can reduce survival in free-living stages. Climate change is also driving major geographic expansions of disease vectors[4,6]. These range shifts increase the risk of emerging infectious diseases in previously unaffected regions. Additionally, fluctuating microclimatic conditions often influence disease transmission more strongly than average temperature increases alone. The effects of warming are further intensified by environmental pollution, which weakens host immune defences. Chemical pollutants can disrupt physiological barriers, induce chronic stress responses, and impair immune function, increasing susceptibility to infections[7,8]. Thermal stress may also amplify the toxicity of environmental contaminants, further compromising host health. Host genetic variation additionally influences disease outcomes under changing climates[9]. Certain populations may show greater resistance or susceptibility to pathogens depending on their genetic background, leading to localized population declines and altered species survival patterns.

Table 1: Effects of Climate Change on Parasite–Host Interactions

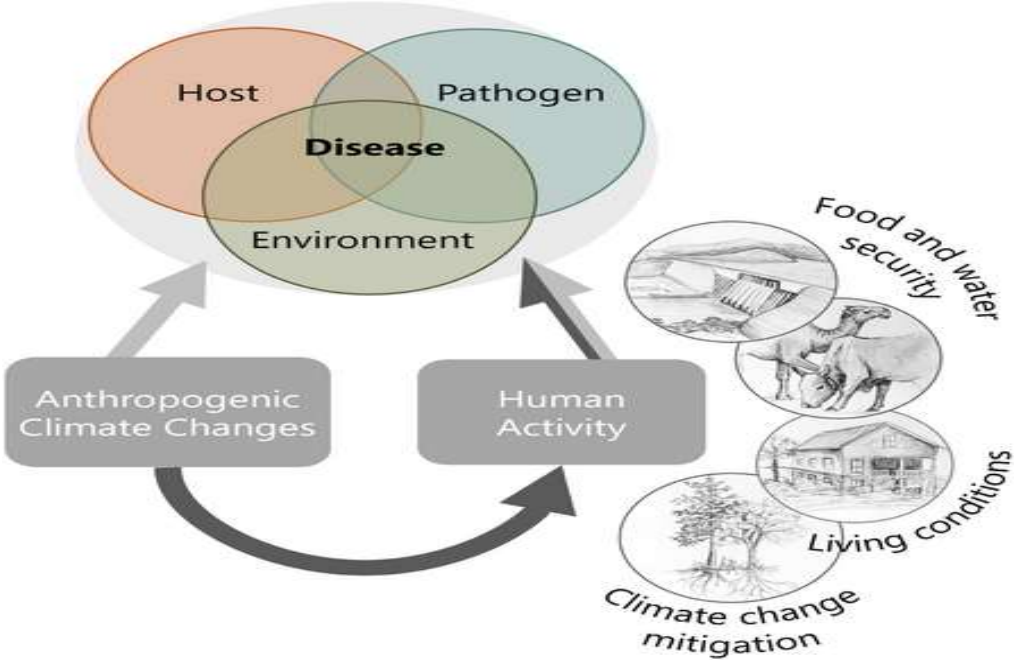
Climate Factor	Effect on Parasites	Effect on Hosts	Ecological Outcome
Rising temperature	Faster development and reproduction	Heat stress and weakened immunity	Increased disease transmission
Altered rainfall	Expanded breeding habitats for vectors	Water scarcity and habitat disruption	Vector-borne disease outbreaks
Habitat fragmentation	Increased host-switching opportunities	Species displacement	Emergence of novel diseases
Extreme weather events	Enhanced parasite spread	Increased physiological stress	Ecological instability
Ocean warming	Increased aquatic parasite survival	Coral and fish stress	Marine biodiversity decline

3.Ecological Disruptions and Disease Dynamics

Ecological disturbances accelerated from changes in climate are revolutionising host–parasite interactions by modifying species distribution, seasonal biological timing, and community structure[1,10]. Ecosystems depend on balanced interactions among species, but environmental disturbances alter food webs, habitat conditions, and species distribution, creating favourable environments for pathogens. Climate-driven extreme weather events and habitat reshuffling are acting as powerful catalysts for infectious disease outbreaks due to disruption of the synchronized timing of biological events .

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"



The above illustration depicts the effects of climate change and human responses to climate change on infectious disease transmission. While climate changes are known to directly influence host, pathogen, and environmental components of the infectious disease triad, climate change may also significantly affect disease through a pathway mediated by human actions. Warmer temperatures, can accelerate the development rates of vectors potentially expanding the temporal window for disease transmission[4,11]. Severe precipitation fluctuations such as floods and droughts compromise sanitation, degrade water safety, and expand vector breeding sites, frequently sparking spikes in waterborne illnesses. Such range shifts bring previously isolated host species into closer contact, enabling parasites to infect new and immunologically naive hosts. Forecasting studies predict a substantial rise in novel host parasite interactions, many of which have already been documented. Climate-driven habitat fragmentation and changing animal movement patterns further increase contact among wildlife, livestock, and humans. These altered ecological interactions facilitate host-switching events, allowing pathogens to infect new species and contribute to the emergence of novel diseases, including infections in previously unaffected wildlife populations[12].

4. Role of Pollution in Disease Susceptibility

Pollution is a critical anthropogenic stressor that interacts synergistically with climate change to compromise host immune defences and increase susceptibility to parasitic infections. Environmental pollutants significantly weaken both innate and adaptive immunity, increasing susceptibility to parasitic infections[7,8]. Air pollution, particulate matter, pesticides, and other contaminants can disrupt epithelial barriers in the lungs, skin, and gut, causing inflammation, oxidative stress, and altered microbiome composition. These pollutants also impair immune functions such as macrophage activity, neutrophil response, and cytokine regulation, thereby creating favourable conditions for parasite invasion and infection. Aquatic ecosystems are highly vulnerable to the combined effects of pollution and parasitism because contaminants accumulate in water bodies and disrupt ecological balance[13]. Agrochemicals, pesticides, fertilizers, and pollutants can eliminate natural predators of parasite hosts, alter algal communities, and promote the growth of intermediate hosts such as freshwater snails, thereby increasing the transmission of diseases like schistosomiasis. Pollution also weakens immune defences in fish, amphibians, and other aquatic organisms by damaging physiological barriers and altering disease susceptibility. The combined effects of pollution and climate change increase vulnerability to diseases such as Leishmaniasis (*Sandfly-borne*

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

parasitic infection), Lyme disease (*Tick-transmitted bacterial disease)*, and Chytridiomycosis *(Deadly amphibian fungal infection)* by disrupting host–parasite balance, weakening immunity, and degrading ecosystems in wildlife, livestock, and human populations[4,14,15]. Along with climate-induced stress, these factors amplify parasite transmission, disease outbreaks, biodiversity loss, and ecological instability in aquatic environments.

5. Climate-Related Infectious Diseases in Humans

Climate change is significantly altering global disease dynamics through increasing temperatures, changing precipitation patterns, intensified water cycles, and atmospheric disturbances[2,4]. These environmental changes enhance the spread of vector-borne, waterborne, and foodborne diseases while enabling pathogens to expand into new geographic regions.

Direct Climate Drivers of Disease

- Vector-Borne Diseases: Rising temperatures increase malaria and dengue transmission[4,16].
- Aquatic Pathogens: Warmer waters promote waterborne diseases like cholera.
- Foodborne Diseases: Heat increases microbial growth and foodborne infections.

Atmospheric Changes and UVBR Effects

Higher UVBR weakens human immunity and may increase dengue transmission efficiency in surviving ***Aedes aegypti*** mosquitoes.

Human Adaptation and Emerging Health Risks

- Dams and rainwater harvesting support vector breeding and waterborne diseases[17].
- Renewable energy mining increases ecosystem disruption and zoonotic risks.
- Expanding poultry farming may increase avian influenza and antimicrobial resistance[18].

Socioeconomic and Healthcare Challenges

Developing countries face greater disease risks due to weak healthcare and poor climate resilience[22].

Future Public Health Strategies

- Integrated disease warning systems
- Climate-focused medical education
- Balanced research on adaptation risks and benefits

Overall, climate change and human adaptation are increasing global infectious disease risks.

6. Biodiversity Loss and Ecosystem Resilience

Climate-driven biodiversity loss fundamentally threatens ecosystem stability and function, with profound consequences for host-parasite dynamics and disease regulation. As global change accelerates species extinctions and alters community composition, the intricate relationships between biodiversity, ecosystem resilience, and parasite transmission become critical for effective conservation and public health strategies. The dilution effect hypothesis suggests that higher

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

biodiversity reduces disease transmission by limiting parasite spread and controlling susceptible host populations[19,20]. Diverse species interactions can decrease contact between infected and susceptible hosts, thereby lowering infection risk. A large meta-analysis across multiple host–parasite systems support a strong negative relationship between biodiversity and parasite abundance. Biodiversity loss increases ecosystem instability favours resilient, fast-reproducing species that frequently act as competent reservoirs for disease-causing organisms[1,19]. Reduced species diversity weakens natural disease regulation mechanisms, increases parasite transmission, and elevates the risk of zoonotic spillover among wildlife, domestic animals, and humans. Additionally, habitat fragmentation and environmental disturbance create complex ecological imbalances that can both intensify disease outbreaks and increase extinction risks in vulnerable species. Healthy and resilient ecosystems are not parasite-free; parasites are an important component of biodiversity and contribute to ecosystem stability by regulating host populations, supporting nutrient cycling, and influencing community structure[1,21]. Terrestrial and Marine ecosystems, forests, wetlands, and coral reefs are particularly threatened by climate-induced changes. Protecting biodiversity is therefore critical for maintaining ecological balance and supporting human survival . Climate change disrupts these host–parasite relationships by altering parasite life cycles, host distribution, and transmission patterns. Although advances in medicine and parasite control improve human health, environmental degradation caused by global change may ultimately reduce long-term ecosystem resilience and disease stability.

7. Conservation Measures and Emerging Challenges

7.1 Conservation Measures

Effective conservation measures are essential to reduce the impacts of climate change on parasite–host interactions, biodiversity, and ecosystem stability. Integrated environmental management strategies are necessary to control disease transmission and ecological imbalance[22,23], like:

1. **Climate Change Mitigation** – Reduce greenhouse gas emissions, use renewable energy, and promote reforestation.
2. **Biodiversity Conservation** – Protect forests, wetlands, coral reefs, and wildlife habitats.
3. **Pollution Control and Environmental Management** – Reduce industrial waste, pesticides, and plastic pollution.
4. **Disease Surveillance and Early Warning Systems** – Monitor vectors and predict disease outbreaks.
5. **Public Health and Community Awareness** – Improve sanitation, vaccination, and healthcare access.
6. **Sustainable Resource Management** – Promote sustainable agriculture, fisheries, and water management.
7. **International Collaboration and Research** – Strengthen global cooperation and ecological research.

7.2 Emerging Challenges

Climate change is creating multiple emerging challenges that threaten global biodiversity, ecosystem stability, and public health, increasing the risk of disease transmission and environmental disruption worldwide[23,24]. The major challenges include:

1. **Emergence of Novel Infectious Diseases** – Climate change increases zoonotic spillovers and host-switching events.
2. **Expansion of Disease Vectors** – Mosquitoes, ticks, and fleas are spreading diseases into new regions.
3. **Rapid Biodiversity Loss** – Habitat destruction and species extinction weaken ecosystem resilience.
4. **Antimicrobial and Pesticide Resistance** – Resistant pathogens and vectors reduce disease control effectiveness.
5. **Extreme Weather Events** – Floods, droughts, and heatwaves increase disease outbreaks and ecological stress.
6. **Urbanization and Habitat Fragmentation** – Human expansion increases wildlife contact and disease transmission.
7. **Limited Healthcare and Economic Inequality** – Poor infrastructure and poverty increase vulnerability to climate-related diseases.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

8. **Insufficient Global Policy Implementation** – Weak enforcement of environmental policies delays effective action.

Conclusion

Global environmental shifts influence host–parasite dynamics differently across ecosystems, with wildlife in natural habitats often facing greater ecological stress than humans and invasive species adapted to human-modified environments. Climate change exerts differential impacts on host–parasite systems depending on ecological context, host characteristics, and parasite life history strategies. Research shows that climate change does not always create a uniformly "warmer and sicker world," as the effects of temperature and precipitation on parasitism vary across species and ecological conditions. Variables such as feeding behaviour and ecological conditions play a major role in shaping disease transmission patterns. Modern research increasingly focuses on integrated approaches such as One Health and epidemiological surveillance to gain a deeper understanding of host–parasite relationships and large-scale ecosystem disease processes. Although considerable progress has been made, several research gaps still exist in understanding the combined impact of climate change, biodiversity decline, and infectious diseases. Future research should focus on detailed host–parasite interactions, long-term ecological studies, advanced monitoring methods, and improved prediction models to better understand changing disease patterns. Effective management requires interdisciplinary and ecosystem-based approaches that link environmental protection, animal health, and human well-being. Weak implementation of global environmental policies also remains a major challenge to effective climate and disease management. Conserving biodiversity, reducing pollution and greenhouse gas emissions, and supporting vulnerable communities are essential for maintaining ecological balance and global health.

References:

[1]Intergovernmental Panel on Climate Change. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Cambridge University Press, 2022.

[2]World Health Organization. *Climate Change and Health*. WHO Report, 2023.

[3]Byers JE. *Effects of Climate Change on Parasites and Disease Dynamics*. Annual Review of Ecology, Evolution, and Systematics, 2020.

[4]Short EE, Caminade C, Thomas BN. *Climate Change Contribution to the Emergence or Re-emergence of Parasitic Diseases*. Infectious Diseases, 2017.

[5]United Nations Environment Programme. *Global Environment Outlook*, 2021.

[6]Ogden NH et al. *Climate Change and Vector-Borne Diseases*. Trends in Parasitology, 2014.

[7]Noyes PD et al. *The Toxicology of Climate Change*. Environmental International, 2009.

[8]Rohr JR et al. *Frontiers in Climate Change–Disease Research*. Trends in Ecology & Evolution, 2011.

[9]Manlik O et al. *Host Genetic Variation and Climate-Driven Disease Dynamics*. Ecology Letters, 2023.

[10]Hoberg EP, Brooks DR. *A Macro-Evolutionary Mosaic of Emerging Infectious Diseases*. Journal of Parasitology, 2007.

[11]Centers for Disease Control and Prevention. *Climate Effects on Health*, 2023.

[12]Carlson CJ et al. *Climate Change Increases Cross-Species Viral Transmission Risk*. Nature, 2022.

[13]Halstead NT et al. *Agrochemical Pollution and Disease Transmission*. Nature Communications, 2018.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881(Print); IMPACT FACTOR :10.16(2026); IC VALUE:5.16; ISI VALUE:2.286
Peer-Peer Reviewed, Refereed & Open Access International Journal - As per UGC Norms
(Fulfilled Suggests Parameters of UGC by IJMER)
Volume:15, Issue:5(4), May 2026
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: Reviewed: Accepted
Publisher: Sucharitha Publication, India
Online Copy of Article Publication Available: www.ijmer.in
International Seminar: "IMPACT ON BIODIVERSITY IN THE CONTEXT OF GLOBAL WARMING AND RISING POLLUTON"

[14]Lyme disease – CDC Factsheet.

[15]chytridiomycosis – IUCN Amphibian Specialist Group Report.

[16]malaria – WHO Malaria Report, 2023.

[17]cholera – WHO Cholera Factsheet.

[18]avian influenza – FAO Disease Monitoring Report.

[19]Civitello DJ et al. *Biodiversity Inhibits Parasites: Broad Evidence for the Dilution Effect*. PNAS, 2015.

[20]Keesing F et al. *Impacts of Biodiversity on Disease Emergence and Transmission*. Nature, 2010.

[21]Hudson PJ et al. *Is a Healthy Ecosystem One That Is Rich in Parasites?* Trends in Ecology & Evolution, 2006.

[22]Convention on Biological Diversity. *Global Biodiversity Framework*, 2022.

[23]World Organisation for Animal Health. *Disease Surveillance Guidelines*, 2021.

[24]Cohen JM et al. *Meta-analysis of Climate Change and Parasitism*. Proceedings of the Royal Society B, 2019.