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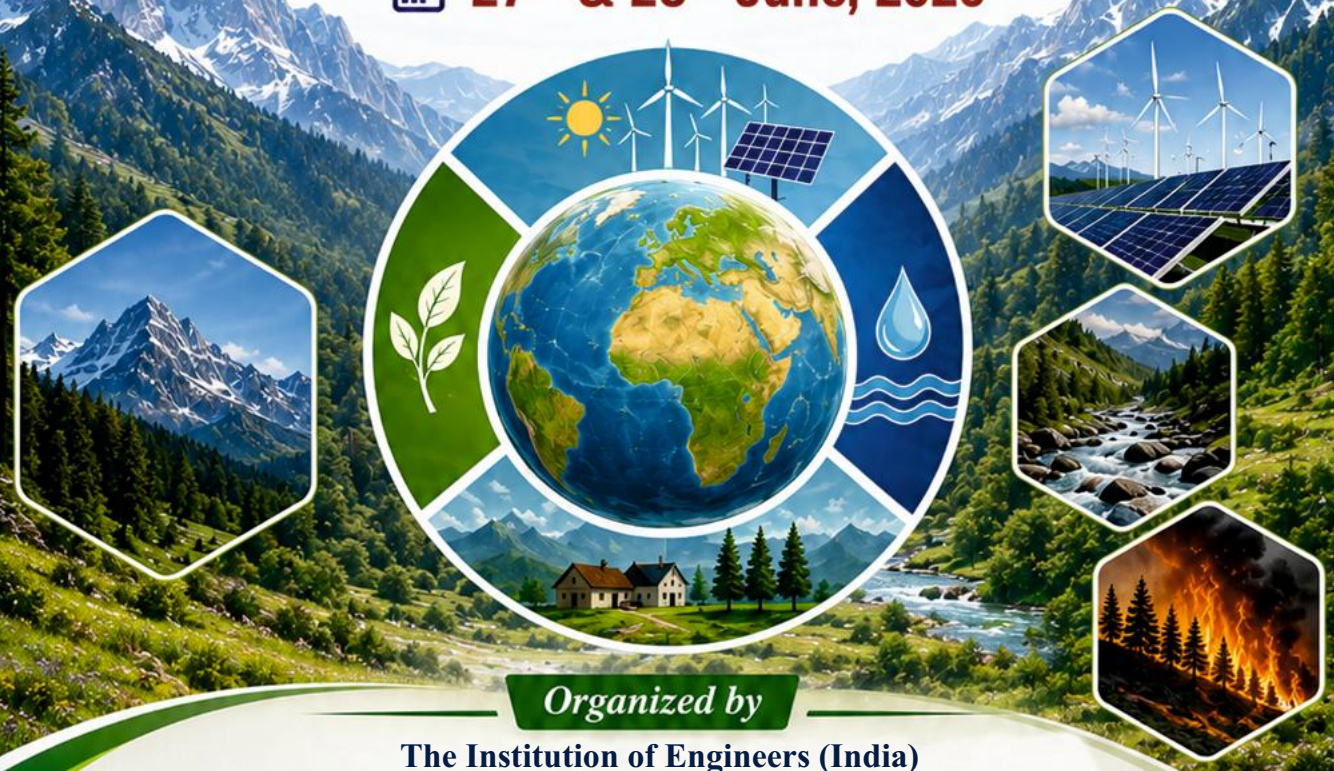
on

Sources of Planet Energy, Environmental & Disaster Science : Hills Ecosystem and Human Survival

(SPEEDS-2026)

on

27th & 28th June, 2026



Organized by

The Institution of Engineers (India)
UP State Centre, Lucknow
and
School of Management Sciences, Lucknow
in
association with
Dr. A.P.J. Abdul Kalam Technical University
Uttar Pradesh, Lucknow

Venue
SCHOOL OF MANAGEMENT SCIENCES
19th Km. Stone, Sultanpur Road, Kashimpur Biruha
Post-Gosainganj, Lucknow-226501 (U.P.)
www.smslucknow.ac.in

SOUVENIR

डॉ0 ए0पी0जे0 अब्दुल कलाम प्राविधिक विश्वविद्यालय, उत्तर प्रदेश, लखनऊ

Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow

(Formerly Uttar Pradesh Technical University)



Dr. A.P.J. Abdul Kalam Technical University (AKTU) (formerly UPTU) was established by the Government of Uttar Pradesh, vide Act Amendment No. 1156(2) LXXIX-V-1-15-1(Ka), 24-2015 dated Sept 9, 2015 Uttar Pradesh Adhiniyam Sankhya 23 of 2000. Under the University Act, 'Technical Education' includes programmes of education, research and training in Engineering, Technology, Architecture, Town Planning, Pharmacy, Applied Arts & Crafts and such other programmes and areas that the central Government may in consultation with All India Council for Technical Education (AICTE) by notification in Gazette declare. The University is affiliating in nature and its jurisdiction spans the entire state of U.P. in affiliating B.Tech., M.B.A., M.C.A., B.Arch., B. Pharma., B.H.M.C.T., M.Tech. and Ph.D. programmes in 764 colleges/institutions imparting graduate, postgraduate and doctoral level training in all government and private institutions located all over U.P. in engineering, technology, architecture, pharmacy, hotel management and catering technology as well as M.B.A. and M.C.A. programmes. AKTU envisions facilitating and nurturing the quality of technical education and research in its own premises as well as all affiliating institutions. The total number of affiliated colleges was 49 in the year 2000 which has now gone up to 756 and the University is still growing. AKTU was reconstituted as "Gautam Buddha Technical University, Lucknow" and "Mahamaya Technical University, Noida" on 1st May 2010 through amendment of U.P. Govt. vide act no. 05 of 2010, Subsequently U.P. Government again combined the Gautam Buddha Technical University and Mahamaya Technical University with effect from 1st Nov. 2013 vide amendment act 21st of 2013 and reconstituted A.K.T.U. Lucknow.

The Institution of Engineers (India)

8 Gokhale Road, Kolkata, 700 020, India — Established 1920, incorporated by Royal Charter 1935

U.P. State Centre, Lucknow

Engineers Bhavan River Bank Colony, Lucknow-226018
Mob : 7839572369; Website : ieiup.org.in



The Institution of Engineers (India) or IEI is the largest multidisciplinary professional body that encompasses 15 engineering disciplines and gives engineers a global platform from which to share professional interest. IEI has membership strength of over 0.8 million. Established in 1920, with its headquarters at 8 Gokhale Road, Kolkata - 700020, IEI has served the engineering fraternity for over nine decades. In this period of time it has been inextricably linked with the history of modern-day engineering. In 1935, IEI was incorporated by Royal Charter and remains the only professional body in India to be accorded this honour. Today, its quest for professional excellence has given it a place of pride in almost every prestigious and relevant organization across the globe. IEI functions among professional engineers, academicians and research workers. It provides a vast array of technical, professional and supporting services to the Government, Industries, Academia and the Engineering fraternity, operating from 125 Centres located across the country. The Institution also provides grant-in-aid to its members to conduct research and development on engineering subjects. IEI has been recognized as Scientific and Industrial Research Organization (SIRO) by the Ministry of Science & Technology, Govt. of India and besides conducting its own research, provides Grant-in-Aid to UG/PG/ PhD students of Engineering Institutes & Universities. IEI holds the International Professional Engineers (IntPE) Register for India under the global International Professional Engineers Alliance (IntPEA). The Institution also awards the Professional Engineers (PE) Certification. For details, please visit www.ieindia.org

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The Institution of Engineers (India)
U.P. State Centre, Lucknow

INSTITUTION'S INNOVATION COUNCIL
(Ministry of HRD Initiative)

SMS School of Management Sciences
LUCKNOW
Accredited with A+ Grade by NAAC

Dr. A.P.J. Abdul Kalam Technical University
Uttar Pradesh, Lucknow

All India Seminar

on

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Post-Gosainganj, Lucknow-226501 (U.P.)
www.smslucknow.ac.in

Messages

आनंदीबेन पटेल
राज्यपाल, उत्तर प्रदेश



सत्यमेव जयते

जन भवन
लखनऊ - 226 027

16 जून, 2026

संदेश

मुझे यह जानकर प्रसन्नता हुई कि स्कूल ऑफ मैनेजमेंट साइंसेज (एस.एम.एस.), लखनऊ, द इंस्टीट्यूशन ऑफ इंजीनियर्स (इंडिया), उत्तर प्रदेश राज्य केन्द्र, लखनऊ तथा डॉ.ए.पी.जे. अब्दुल कलाम प्राविधिक विश्वविद्यालय, उत्तर प्रदेश, लखनऊ द्वारा संयुक्त रूप से 27 एवं 28 जून, 2026 को "सोर्सेज ऑफ प्लेनेट एनर्जी, एनवायरनमेंटल एंड डिजास्टर साइंस (SPEEDS-2026) : हिल्स इकोसिस्टम एंड ह्यूमन सर्वाइवल" विषय पर राष्ट्रीय सम्मेलन आयोजित किया जा रहा है।

जलवायु परिवर्तन, पर्यावरणीय असंतुलन, प्राकृतिक संसाधनों के क्षरण तथा बढ़ती प्राकृतिक आपदाओं के वर्तमान परिप्रेक्ष्य में यह सम्मेलन अत्यंत प्रासंगिक है। मुझे आशा है कि यह आयोजन शिक्षाविदों, वैज्ञानिकों, शोधकर्ताओं, नीति–निर्माताओं तथा विद्यार्थियों को विचार–विमर्श एवं नवाचारों के आदान–प्रदान हेतु एक मंच प्रदान करेगा।

मैं सम्मेलन के सफल आयोजन हेतु हार्दिक शुभकामनाएँ प्रेषित करती हूँ।

(आनंदीबेन पटेल)

दूरभाष : 0522-2236497 फैक्स : 0522-2239488 ईमेल : hgovup@gov.in वेबसाइट : www.upgovernor.gov.in

पत्रांक-530/सी.एम.यू.पी./25

योगी आदित्यनाथ



मुख्य मंत्री
उत्तर प्रदेश

लोक भवन,
लखनऊ -226001

दिनांक : 23.06.2026

संदेश

प्रकृति और मानव जीवन का संबंध परस्पर पूरक है। पर्यावरणीय संतुलन, प्राकृतिक संसाधनों का संरक्षण तथा आपदाओं के प्रति संवेदनशील और सक्षम समाज का निर्माण सतत विकास की आधारभूत आवश्यकता है। वर्तमान समय में जलवायु परिवर्तन, जैव विविधता के क्षरण, प्राकृतिक आपदाओं की बढ़ती चुनौतियों तथा ऊर्जा सुरक्षा से जुड़े प्रश्न वैश्विक चिंतन के प्रमुख विषय बन चुके हैं। ऐसे में इन मुद्दों पर गंभीर अकादमिक विमर्श और शोध की आवश्यकता पहले से अधिक बढ़ गई है।

मुझे यह जानकर प्रसन्नता है कि स्कूल ऑफ मैनेजमेंट साइंसेज (एसएमएस), लखनऊ द्वारा दिनांक 27-28 जून, 2026 को 'सोर्सेज ऑफ प्लेनेट एनर्जी, एनवायरनमेंटल एंड डिजास्टर साइंस (SPEEDS-2026): हिल्स इकोसिस्टम एंड ह्यूमन सर्वाइवल' विषय पर राष्ट्रीय सम्मेलन का आयोजन किया जा रहा है। 'द इंस्टीट्यूशन ऑफ इंजीनियर्स (इंडिया), उत्तर प्रदेश राज्य केन्द्र, लखनऊ' तथा 'डॉ. ए. पी. जे. अब्दुल कलाम प्राविधिक विश्वविद्यालय, उत्तर प्रदेश, लखनऊ' के सहयोग से आयोजित यह सम्मेलन समकालीन पर्यावरणीय चुनौतियों और उनके व्यावहारिक समाधानों पर विचार-विमर्श का एक महत्वपूर्ण मंच सिद्ध होगा।

पर्वतीय पारिस्थितिकी तंत्र का संरक्षण, नवीकरणीय ऊर्जा के स्रोतों का विस्तार, जल एवं प्राकृतिक संसाधनों का सतत प्रबंधन, आपदा जोखिम न्यूनीकरण तथा जलवायु अनुकूल विकास जैसे विषय मानव सभ्यता के सुरक्षित भविष्य से सीधे जुड़े हुए हैं। इन क्षेत्रों में वैज्ञानिक अनुसंधान, नवाचार और नीति आधारित दृष्टिकोण को प्रोत्साहित करना समय की मांग है। मुझे विश्वास है कि यह सम्मेलन इन महत्वपूर्ण विषयों पर सार्थक चर्चा को आगे बढ़ाते हुए ज्ञान और अनुभवों के आदान-प्रदान का अवसर प्रदान करेगा।

मैं राष्ट्रीय सम्मेलन SPEEDS-2026 के आयोजन के लिए आयोजकों को हार्दिक बधाई एवं शुभकामनाएं देता हूं। मेरी कामना है कि इस सम्मेलन से प्राप्त निष्कर्ष पर्यावरण संरक्षण, आपदा प्रबंधन, ऊर्जा सुरक्षा तथा सतत विकास के क्षेत्र में महत्वपूर्ण योगदान दें और मानवता के सुरक्षित एवं समृद्ध भविष्य के निर्माण में सहायक सिद्ध हों।

(योगी आदित्यनाथ)

दूरभाष : 0522-2289017 / 2289010 / 2289167 फैक्स - 0522-2239234 ईमेल - cmup@nic.in

प्रो0 जय प्रकाश पाण्डेय
कुलपति
Prof. Jai Prakash Pandey
Vice Chancellor

डॉ0 ए0पी0जे0 अब्दुल कलाम प्राविधिक विश्वविद्यालय
उत्तर प्रदेश, लखनऊ
Dr. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
Uttar Pradesh, Lucknow



Dated: 02.06.2026

MESSAGE

It is a matter of great pleasure and honor for me writing this message to be included in the souvenir to be brought out on the occasion of the National Conference on **"Sources on Planet Energy, Environmental & Disaster Science : Hills Ecosystem and Human Survival" (SPEEDS-2026).** The theme of the seminar is quite appropriate to the present day situation where sustainability of life on earth has become the main agenda item for all researchers, policy makers, regulators, industries and of course the society all over the world. Unless the environment and ecology are protected and preserved, the catastrophes and natural disasters will be unavoidable. Alternative resources of energy, preferably, the renewable resources would have to be searched and technologies will have to be developed to exploit them for ensuring sustainable development.

I am sure, all the essential aspects of energy, environment, ecology, sustainability etc. would be addressed by the eminent speakers in this seminar. The disaster management strategies and the use of technologies to avoid disasters will also, hopefully, be adequately covered.

The faculty and the students will certainly benefit from this seminar. The outcome of this seminar will hopefully, be setting the path forward for SMS School of Management Sciences to reinforce their efforts of building capability of research and innovation.

While complementing the management of SMS School of Management Sciences, I wish them success in their endeavours.

(Prof. Jai Prakash Pandey)
Vice-Chancellor

Sector-11, Jankipuram Extension, Lucknow - 226031 (U.P.) India, Website : www.aktu.ac.in
☎ (Office) : +91 522 2772189, 2772194 E-mail : vc@aktu.ac.in

प्रो० जय प्रकाश सैनी
कुलपति
Prof. Jai Prakash Saini
Vice-Chancellor

लखनऊ विश्वविद्यालय
लखनऊ-226007 (उ.प्र.) भारत
University of Lucknow
Lucknow-226007(U.P.)INDIA

Ref. No. .....
Date : .....



Message

I am pleased to extend my best wishes to the School of Management Sciences, Lucknow for organizing the National Conference "Sources of Planet Energy, Environmental & Disaster Science (SPEEDS-2026)" on 27–28 June 2026.

SMS Lucknow's A+ NAAC accreditation, ASSOCHAM recognition as "Best Engineering College in North India," and the impactful work of the C.V. Raman Centre for Research & Innovation reflect its commitment to academic and environmental excellence.

The theme "Hills Ecosystem and Human Survival" is urgent and vital. Climate change, biodiversity loss, and disaster risk in fragile hill regions demand integrated solutions. I am confident SPEEDS-2026 will foster meaningful dialogue among researchers, policymakers, and young scholars.

The University of Lucknow commends such feats that link knowledge with social responsibility. I commend SMS Lucknow's scholarly contributions through SAMRIDDHI and Adhyayan.

I wish the conference great success and hope its deliberations advance research, policy, and awareness for a sustainable future.

Dated : 10.06.2026

(Prof. Jai Prakash Saini)

Telephones : 0522-2740467 (O) 0522-2740462 (R) Fax : 0522-2740467 (O), 7991200500 (M), Email: vc@lkouniv.ac.in

बाबासाहेब भीमराव अम्बेडकर विश्वविद्यालय
(केन्द्रीय विश्वविद्यालय)
विद्या विहार, रायबरेली रोड
लखनऊ - 226 025, (उ.प्र.), भारत

आचार्य राज कुमार मित्तल
कुलपति

BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY
LUCKNOW
प्रज्ञा शील करुणा
ESTABLISHED 1996

Babasaheb Bhimrao Ambedkar University
(A Central University)
Vidya Vihar, Raebareli Road
Lucknow-226 025 (U.P.), India

Prof. Raj Kumar Mittal
Vice Chancellor

No. .....V.C.S./26.....

Date ....12.06.2026....

MESSAGE



It gives me immense pleasure to learn that the School of Management Sciences (SMS), Lucknow is organizing the National Conference on **"Sources of Planet Energy, Environmental & Disaster Science (SPEEDS-2026): Hills Ecosystem and Human Survival"** on 27-28 June 2026 in collaboration with **The Institution of Engineers (India), Uttar Pradesh State Centre, Lucknow, and Dr. A. P. J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow.**

The world today faces unprecedented challenges arising from climate ege, environmental degradation, depletion of natural resources, and increasing occurrences of natural disasters. In this context, the theme of SPEEDS-2026 is highly relevant and timely, as it focuses on critical issues concerning renewable and sustainable energy, environmental governance, hill ecosystem conservation, biodiversity protection, climate resilience, water security, disaster science, and sustainable community development.

I am confident that this conference will provide an excellent multidisciplinary platform for academicians, researchers, policymakers, industry experts, environmental practitioners, and students to engage in meaningful discussions, share research findings, and explore innovative solutions for ensuring ecological balance and sustainable human development. Such deliberations are essential for developing strategies that can effectively address the complex environmental and disaster-related challenges confronting society.

I congratulate the organizers for undertaking this important academic initiative and extend my best wishes for the grand success of **SPEEDS-2026.** I am confident that the conference deliberations will generate valuable insights and recommendations that will contribute to a sustainable, resilient, and environmentally responsible future.

I convey my best wishes to all participants for insightful discussions and successful outcomes.

राज कुमार मित्तल

(Raj Kumar Mittal)

Ph: 0522-2440820 (O), Email: vc@bbau.ac.in

ख़्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ
Khwaja Moinuddin Chishti Language University, Lucknow
(Uttar Pradesh State Government University)



Prof. Ajay Taneja
Vice Chancellor

Date: 08 June, 2026

MESSAGE

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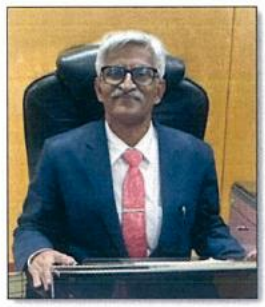
(Prof. Ajay Taneja)
Vice-Chancellor

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Contact:- +91-7007076124, Website:- https://kmclu.ac.in/ Email:- vc@kmclu.ac.in

प्रो0 अमर पाल सिंह
कुलपति
Prof. Amar Pal Singh
Vice Chancellor

धर्म संस्थापनार्थाय

डा0 राम मनोहर लोहिया राष्ट्रीय विधि विश्वविद्यालय,
लखनऊ – 226012 (उ.प्र.) भारत
Dr. Ram Manohar Lohiya National Law University, LUCKNOW - 226012 (U.P.) INDIA



MESSAGE

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Amar Pal Singh

(Prof. Amar Pal Singh)

एल.डी.ए., कानपुर रोड योजना, लखनऊ - 226 012
L.D.A., Kanpur Road Scheme, Lucknow - 226 012; www.rmlnlu.ac.in
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Dr. M.P. Singh
Executive Secretary
SMS Group of Institutions



Accredited 'A' Grade by NAAC
SMS VARANASI SCHOOL OF MANAGEMENT SCIENCES
An Autonomous College

Dated: 13th June, 2026

Message

I am delighted to extend my warm greetings and best wishes to all participants of the **International Conference on Sources of Planet Energy, Environmental and Disaster Science (SPEEDS-2026)** being organized on **27–28 June 2026** at the **School of Management Sciences, Lucknow**. The conference theme, **"Hills Ecosystem and Human Survival,"** is both timely and significant, reflecting the growing need to address environmental challenges through informed research and collective action.

Hill ecosystems are among the most dynamic and sensitive components of the natural environment. They play a crucial role in sustaining biodiversity, regulating water resources, maintaining ecological balance, and supporting the livelihoods of numerous communities. However, increasing environmental pressures, changing climatic conditions, and the rising frequency of natural hazards have heightened concerns regarding the long-term sustainability of these regions. Addressing such complex challenges requires a coordinated approach involving scientific innovation, policy support, and community participation.

The objective of SPEEDS-2026 aligns closely with the global commitment toward environmental sustainability and disaster resilience. By bringing together experts from academia, industry, government organizations, and research institutions, the conference provides an excellent forum for exchanging ideas, presenting innovative research, and discussing practical solutions that can contribute to sustainable development. Such interactions foster interdisciplinary learning and strengthen collaborative efforts to safeguard our natural resources and human well-being.

Educational institutions have a vital responsibility in promoting knowledge, innovation, and awareness concerning environmental stewardship. Through conferences such as SPEEDS-2026, researchers and practitioners are encouraged to explore emerging opportunities, share experiences, and develop strategies that can effectively address contemporary environmental and disaster-related concerns.

I am confident that the conference will generate meaningful discussions, inspire new research directions, and contribute valuable insights toward the protection of fragile ecosystems and the advancement of sustainable development goals. The knowledge shared during these deliberations will serve as a catalyst for future initiatives aimed at creating a safer, greener, and more resilient world.

I congratulate the organizers for their dedicated efforts in planning this important event and extend my sincere appreciation to all speakers, authors, delegates, and collaborators for their participation. I wish SPEEDS-2026 every success and hope that all participants benefit greatly from the academic and professional exchanges during the conference.

With best wishes for a highly successful conference.

Dr. M. P. Singh
Executive Secretary
School of Management Sciences, Varanasi

Sharad Singh
Secretary & CEO



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Approved by : AICTE, Ministry of HRD, Govt. of India &
Affiliated to Dr. A.P.J.A.K. Technical University, U.P., Lucknow

Dated: 13th June, 2026

Message

It is a matter of great pride and satisfaction for the School of Management Sciences, Lucknow, to host the **International Conference on Sources of Planet Energy, Environmental and Disaster Science (SPEEDS-2026)** on **27–28 June 2026**. The conference theme, **"Hills Ecosystem and Human Survival,"** addresses one of the most pressing concerns of our time—the sustainable coexistence of human societies with fragile natural ecosystems.

Mountain and hill regions serve as critical reservoirs of biodiversity, freshwater resources, and ecological services. They support the livelihoods of millions while contributing significantly to environmental stability. However, rapid urbanization, climate variability, land degradation, and increasing disaster risks are placing unprecedented pressure on these sensitive landscapes. The challenges before us demand innovative thinking, scientific collaboration, and responsible action at every level.

SPEEDS-2026 provides an excellent platform for bringing together scholars, researchers, practitioners, policymakers, and industry leaders to deliberate on emerging issues and explore practical solutions in the fields of renewable energy, environmental management, climate resilience, and disaster mitigation. Such multidisciplinary interactions are essential for generating knowledge that can support sustainable development and improve the quality of life for present and future generations.

At SMS Lucknow, we remain committed to promoting academic excellence, research-driven innovation, and meaningful engagement with societal challenges. We believe that higher educational institutions have a significant role to play in nurturing environmentally conscious leadership and fostering sustainable development practices. This conference reflects our continuing efforts to encourage intellectual exchange and collaborative research that contribute to national and global well-being.

I am confident that the deliberations and outcomes of SPEEDS-2026 will inspire new perspectives, strengthen professional networks, and pave the way for impactful research and policy initiatives. The exchange of ideas among experts from diverse disciplines will undoubtedly enrich our understanding of the complex relationship between ecosystems, energy resources, and human survival.

I extend my heartfelt appreciation to the organizing committee, speakers, researchers, delegates, and supporting organizations whose contributions have made this conference possible. I wish all participants a rewarding experience and a successful conference.

With my best wishes for the grand success of SPEEDS-2026.

Sharad Singh
Secretary & Chief Executive Officer
School of Management Sciences, Lucknow

The Institution of Engineers (India)

UTTAR PRADESH STATE CENTRE, ENGINEERS BHAWAN, RIVER BANK COLONY, LUCKNOW-226018

दि इन्स्टीट्यूशन ऑफ इंजीनियर्स (इण्डिया)

उत्तर प्रदेश स्टेट सेन्टर, इंजीनियर्स भवन, रिवर बैंक कालोनी, लखनऊ–226018

ER. VIJAYA PRATAP SINGH, FIE
CHAIRMAN

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(Established 1920, Incorporated by Royal Charter 1935)

"A Century of Service to the Nation"



MESSAGE

It gives me immense pleasure to learn that the School of Management Sciences (SMS), Lucknow is organizing the National Conference on "Sources of Planet Energy, Environmental & Disaster Science (SPEEDS-2026): Hills Ecosystem and Human Survival" on 27–28 June 2026 in collaboration with The Institution of Engineers (India), Uttar Pradesh State Centre, Lucknow, and Dr. A. P. J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow.

The world today faces unprecedented challenges arising from climate change, environmental degradation, depletion of natural resources, and increasing occurrences of natural disasters. In this context, the theme of SPEEDS-2026 is highly relevant and timely, as it focuses on critical issues concerning renewable and sustainable energy, environmental governance, hill ecosystem conservation, biodiversity protection, climate resilience, water security, disaster science, and sustainable community development.

I am confident that this conference will provide an excellent multidisciplinary platform for academicians, researchers, policymakers, industry experts, environmental practitioners, and students to engage in meaningful discussions, share research findings, and explore innovative solutions for ensuring ecological balance and sustainable human development. Such deliberations are essential for developing strategies that can effectively address the complex environmental and disaster-related challenges confronting society.

I congratulate the organizers and Dr Bharat Raj Singh, for passionately undertaking this important academic initiative and extend my best wishes for the grand success of SPEEDS-2026. I am confident that the conference deliberations will generate valuable insights and recommendations that will contribute to a sustainable, resilient, and environmentally responsible future.

(Er. Vijaya Pratap Singh, FIE)
Chairman

The Institution of Engineers (India)

UTTAR PRADESH STATE CENTRE

ENGINEERS' BHAWAN, RIVER BANK COLONY, LUCKNOW-226018

दि इन्स्टीट्यूशन ऑफ इंजीनियर्स (इण्डिया)

उत्तर प्रदेश स्टेट सेन्टर, इंजीनियर्स भवन, रिवर बैंक कालोनी, लखनऊ–226018

Er. NIRENDRA KUMAR NISHAD, FIE
Honorary Secretary

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NKnishad

(Er. Nirendra Kumar Nishad, FIE)
Honorary Secretary

Prof. (Dr.) Ashish Bhatnagar
Director



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Affiliated to Dr. A.P.J.A.K. Technical University, U.P., Lucknow

Dated: 13th June, 2026

Message

It gives me immense pleasure to welcome all distinguished delegates, academicians, researchers, industry experts, policymakers, and students to the **International Conference on Sources of Planet Energy, Environmental and Disaster Science (SPEEDS-2026)** on **27–28 June 2026** at the **School of Management Sciences, Lucknow**, organized in association with **Dr. A.P.J. Abdul Kalam Technical University (AKTU)** and **The Institution of Engineers (India), UP State Centre, Lucknow**.

The theme of the conference, **"Hills Ecosystem and Human Survival,"** highlights the critical relationship between ecological sustainability and human well-being. Hill ecosystem is an invaluable natural resource that supports biodiversity, regulates climate, conserves water resources, and sustains the livelihoods of millions of people. However, this fragile ecosystem is increasingly threatened by climate change, environmental degradation, rapid urbanization, and natural disasters. Addressing these challenges requires innovative research, informed policy interventions, and collaborative action among all stakeholders.

SPEEDS-2026 provides an excellent platform for exchange of ideas, research ndings, and technological innovations related to renewable energy, environmental management, disaster resilience, and sustainable development. The conference seeks to encourage interdisciplinary dialogue and foster partnerships that can contribute to practical solutions for emerging global environmental challenges.

At School of Management Sciences, Lucknow, we are committed to promoting academic excellence, innovation, and research that addresses societal needs. We believe that institutions of higher education play a vital role in developing responsible leaders and generating knowledge that supports sustainable progress. Conferences such as SPEEDS-2026 strengthen this commitment by creating opportunities for meaningful interaction among experts from diverse elds.

I congratulate the organizing committee for their dedicated efforts and express my sincere gratitude to all speakers, authors, delegates, and supporting organizations. I am con dent that the deliberations of SPEEDS-2026 will contribute signi cantly to advancing knowledge and inspiring collective action for a sustainable and resilient future.

Dr. Ashish Bhatnagar
Director
School of Management Sciences,
Lucknow

Prof. (Dr.) Bharat Raj Singh
Director General (Techanical)



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Affiliated to Dr. A.P.J.A.K. Technical University, U.P., Lucknow

Dated: 13th June, 2026

Message

It gives me immense pleasure to welcome distinguished academicians, researchers, scientists, policymakers, industry experts, environmentalists, and students to the **International Conference on Sources of Planet Energy, Environmental and Disaster Science (SPEEDS-2026): Hills Ecosystem and Human Survival**, being organized on **27–28 June 2026** at the **School of Management Sciences, Lucknow in association with AKTU and IEI, UP State Centre, Lucknow**.

The hill ecosystems of our planet are among the most valuable natural assets, providing essential ecological services, biodiversity conservation, water security, climate regulation, and livelihood support to millions of people. However, these fragile ecosystems are increasingly facing challenges arising from climate change, environmental degradation, unsustainable resource utilization, natural disasters, and anthropogenic pressures. The need for scientific understanding, innovative technologies, sustainable policies, and collective action has therefore become more urgent than ever before.

SPEEDS-2026 aims to provide a multidisciplinary platform for meaningful dialogue and knowledge exchange on emerging issues related to renewable energy, environmental sustainability, disaster risk reduction, ecosystem conservation, and human resilience. The conference seeks to bring together experts from diverse disciplines to share research findings, innovative practices, and transformative solutions that can contribute to a sustainable and secure future for humanity.

The theme, **"Hills Ecosystem and Human Survival,"** highlights the intricate relationship between ecological stability and societal well-being. Sustainable management of mountain and hill regions is not only vital for local communities but also for maintaining environmental balance at regional and global levels. Through scientific deliberations and collaborative discussions, the conference endeavors to promote innovative approaches that support environmental stewardship, disaster preparedness, and sustainable development.

I am confident that the technical sessions, keynote addresses, panel discussions, and interactions among participants will generate valuable insights and foster future collaborations. The outcomes of this conference will contribute significantly to advancing research, policy formulation, and practical implementation in the fields of energy, environment, and disaster science.

I extend my sincere appreciation to all speakers, authors, delegates, organizing committee members, sponsors, and partners for their valuable contributions and support. I wish SPEEDS-2026 great success and hope that all participants find the conference intellectually enriching, professionally rewarding, and inspiring.

With best wishes for a productive and memorable conference.

Prof. Bharat Raj Singh, FIE
Co-Chair, SPEEDS-2026
Director General (Technical)
School of Management Sciences, Lucknow

Prof. (Dr.) Dharmendra Singh
Associate Director



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Dated: 15th June, 2026

Message

It is a matter of great pleasure to welcome all participants to the **National Conference on Sources of Planet Energy, Environmental & Disaster Science (SPEEDS): Hills Ecosystem and Human Survival, being organized on 27–28 June, 2026.**

The conservation of hill ecosystems has emerged as a critical global concern due to the increasing challenges posed by climate change, environmental degradation, biodiversity loss, and natural disasters. Hills and mountainous regions serve as vital ecological assets, supporting water resources, energy generation, and the livelihoods of millions of people. Ensuring their sustainability is essential for maintaining ecological balance and securing the well-being of future generations.

This conference provides an excellent platform for academicians, researchers, scientists, policymakers, industry professionals, and students to exchange knowledge, present innovative research, and discuss practical solutions related to energy resources, environmental protection, disaster management, and sustainable development. The interdisciplinary nature of the conference will encourage meaningful dialogue and collaboration among stakeholders working towards a resilient and sustainable future.

I am confident that the deliberations, technical sessions, keynote addresses, and research presentations will generate valuable insights and recommendations that contribute to scientific advancement and informed policy-making. Such initiatives are instrumental in promoting awareness, innovation, and collective action for addressing the environmental and developmental challenges faced by hill ecosystems.

I extend my sincere appreciation to all distinguished speakers, delegates, authors, reviewers, and members of the organizing committee for their valuable contributions and support in making this conference a success. I wish all participants a fruitful, enriching, and memorable experience.

With best wishes for the grand success of SPEEDS-2026.

Dr. Dharmendra Singh
Associate Director
SMS, Lucknow

Prof.(Dr.) Pramod Kumar Singh
Dean Student-Welfare



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Affiliated to Dr. A.P.J.A.K. Technical University, U.P., Lucknow

Dated: 23rd June, 2026

Message

It gives me immense pleasure to present the Souvenir of Sources of Planet Energy, Environmental & Disaster Science (SPEEDS): Hills Ecosystem and Human Survival.

SPEEDS-2026 serves as a unique interdisciplinary platform dedicated to addressing some of the most pressing challenges confronting our planet today. The conference highlights the intricate linkages between sustainable energy systems, environmental conservation, disaster resilience, and human well-being, with special emphasis on the fragile and ecologically significant hill and mountain ecosystems.

Mountain regions are vital to global environmental stability, acting as reservoirs of biodiversity, freshwater resources, and climate regulation. However, these regions are increasingly threatened by climate change, unsustainable development practices, resource degradation, and recurring natural hazards. The discussions and contributions to be presented at this conference would underscore the urgency of adopting integrated, science-based, and community-centered approaches to ensure ecological sustainability and disaster preparedness.

The conference brings together researchers, academicians, engineers, environmentalists, policymakers, and practitioners from diverse disciplines to exchange innovative ideas, share research findings, and explore practical solutions. By fostering collaboration and integrating modern scientific advancements with traditional ecological knowledge, SPEEDS-2026 aims to contribute meaningfully toward building resilient communities and sustainable mountain environments.

I extend my sincere appreciation to all authors, speakers, delegates, reviewers, sponsors, and organizing committee members whose dedication and contributions are essential to make the conference a success. I am confident that the knowledge shared through this event and documented in this souvenir will inspire further research, innovation, and policy initiatives for a safer, greener, and more resilient future.

I wish all participants a fruitful and enriching experience at SPEEDS-2026.

Dr. Pramod Kumar Singh
Co-coordinator SPEEDS-2026

Dr. Arunesh Kumar Srivastava
Manager SIEF



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Affiliated to Dr. A.P.J.A.K. Technical University, U.P., Lucknow

Dated: 23th June, 2026

From the Desk of Convenor.....

Dear Delegates,

It is my privilege and pleasure to welcome you to the National Conference on "Sources of Planet Energy, Environmental & Disaster Science (SPEEDS-2026): Hills Ecosystem and Human Survival," being organized by the School of Management Sciences, Lucknow, in collaboration with Dr. A.P.J. Abdul Kalam Technical University, Uttar Pradesh, Lucknow &The Institution of Engineers (India), UP State Centre, Lucknow, Uttar Pradesh, on 27–28 June 2026.

The Himalayas and other hill, ecosystems are among the most ecologically significant regions of the world. They serve as vital sources of freshwater, biodiversity, renewable energy potential, and environmental stability. However, these fragile ecosystems are increasingly threatened by climate change, glacier retreat, biodiversity loss, unsustainable development practices, and disaster risks. Recent events in mountainous regions have underscored the urgent need for scientific intervention, sustainable planning, and collective action to safeguard these natural treasures.

The theme of SPEEDS-2026 reflects the growing global concern regarding the sustainability of hill ecosystems and their direct linkage with human survival. The conference aims to provide a vibrant platform for academicians, scientists, researchers, engineers, policymakers, environmentalists, industry experts, and students to share their knowledge, research findings, and innovative solutions for addressing contemporary environmental and disaster-related challenges.

Through technical sessions, keynote addresses, panel discussions, and research presentations, we seek to foster interdisciplinary dialogue and encourage meaningful collaborations that can contribute to sustainable development and environmental resilience. We firmly believe that scientific research, technological innovation, and informed policymaking must work together to preserve the ecological balance of our hill regions while ensuring socio-economic progress.

I express my sincere gratitude to our distinguished speakers, session chairs, authors, delegates, sponsoring organizations, and organizing committee members for their invaluable support and contributions. Your participation is instrumental in making this conference a meaningful and impactful academic event. I am confident that SPEEDS-2026 will provide enriching experiences, stimulate intellectual exchange, and generate actionable insights for protecting our planet's energy resources, environment, and fragile hill ecosystems. I wish all participants a productive, engaging, and memorable conference. With warm regards,

Dr. Arunesh Kumar Srivastava
Convener, SPEEDS-2026

All Indian Seminar

on

Sources of Planet Energy, Environmental & Disaster Science : Hills Ecosystem and Human Survival (SPEEDS-2026)

on

27th & 28th June, 2026

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Programme Schedule

SPEEDS-2026

27th & 28th June, 2026

-2026

Programme Schedule

Day-1; 27 June, 2026 (Saturday)

Venue : M.P. Hall

Inaugural Session

09:30 A.M. Registration

10:30 A.M. Tea

11:00 A.M. Lighting of the Ceremonial Lamp & Goddess Saraswati Vandana.

11:10 A.M. Welcome Address by Prof. (Dr.) Ashish Bhatnagar, Conference Chair & Director, SMS, Lucknow.

11:20 A.M. Welcome Address by Er. Vijaya Pratap Singh, FIE, Chairman, The Institution of Engineers (India) UP State Centre, Lucknow

11:30 A.M. About the Theme of Conference by Dr. P.K. Singh, Conference Co-cordinator.

11:35 A.M. Address by Guest of Honour Shri Sushil Kumar Aggarwal, Gobind Industries, Barabanki, Lucknow

11:50 A.M. Address by Guest of Honour Prof. Onkar Singh, HBTU, Kanpur

12:05 P.M. Address by Chief Guest Dr. Rajendra Singh, Waterman of India

12:25 P.M. Unveiling of Book Aravali, Souvenir & Presentation of Mementos

12:35 P.M. Vote of Thanks by Dr. Arunesh Kumar Srivastava, Manager SIEF, & Convener, SPEEDS-2026

12:39 P.M. National Anthem.

Plenary Session

(12:40 PM. - 1:40 PM)

1. Dr. P.K. Bharti, Head of Mechanical Department, Integral University, Lucknow
2. Dr. Prashant Singh, Scientist (E), Central Pollution Control Board, Ministry of Environment, Forest & Climate Change Govt. of India
3. Prof. Jyotsna Singh, Director, Research and Director of the Institute of New and Renewable Energy, University of Lucknow

01:40-02:30 P.M. - Lunch

02:30-04:30 P.M. - Technical Sessions

Day-2; 28 June, 2026 (Sunday)

Venue : M.P. Hall

10:30-1:30 P.M. Technical Sessions

01:30-2:30 P.M. Lunch

Valedictory Session

(June 28, 2026)

02:30 P.M. Welcome address by Prof. (Dr.) Ashish Bhatnagar, Conference Chair and Director, SMS Lucknow

02:40 P.M. Welcome Address by Er. Vijaya Pratap Singh, FIE, Chairman, The Institution of Engineers (India) UP State Centre, Lucknow

02:50 P.M. Address & Seminar Concluding Remarks by Prof. (Dr.) Bharat Raj Singh, Conference Co-Chair and DG (Tech.), SMS, Lucknow

03:00 P.M. Address by Guest of Honour Dr. Rana Pratap Singh, Director (Hon) Centre for Sustainable Agriculture and Environment (CSAE)

03:20 P.M. Address by Chief Guest Dr. Harikesh Bahadur Singh, Advisor, UP Pollution Control Board, Lucknow

03:40 P.M. Presentation of Mementos & Distribution of Certificates.

04:10 P.M. Vote of Thanks by Dr. Dharmendra Singh, Associate Director & Coordinator, SPEEDS-2026

04:15 P.M. National Anthem.

04:16 P.M. High Tea

PRESENTATION SCHEDULE SPEEDS-2026

(Day 1:27/06/2026)

Technical Sessions

Multipurpose Hall, Conference Hall& LT – 1

(A) Technical Session - I (Multipurpose Hall)
Technical Session - II (Conference Hall, Ganga Block)
Technical Session-III (Lecture Theatre- 1)

Time: 2:30 pm to 4:30 pm	Technical Session-I	Session Chair –	Technical Session-II	Session Chair –	Technical Session-III	Session Chair –
		Dr. Premshankar Yadav		**Dr. Upendra**		**Dr. Pooja Srivastava**
		Multipurpose Hall		Conference Hall, Ganga Block		Lecture Theatre - 1
1. Sustainable & Renewable Energy in Mountain Terrains: / 2. Hill Ecology, Biodiversity Conservation, and Water Security:	**T 1.1**	Capacity Building For Disaster Preparedness: Strengthening Communities, Institutions, And Systems For Resilient Futures	**T 1.2**	Sustainable & Renewable Energy in Mountain Terrains of India	**T 1.3**	Development of Pilgrim corridor and Slope instability in Kedarnath Himalaya: An exploratory analysis of 2013 disaster
		Dr. Niharika Singh		**Dr. Amarjeet Singh**		**Dr. Pushpanjali Singh**
	T 1.4	Machine Learning-Based Flood Forecasting And Community-Centric Early Warning Systems for Sustainable Mountain Regions	**T 1.5**	Role of Local Communities in Biodiversity Conservation of Mountain Ecosystems	**T 1.6**	Artificial Intelligence-Driven Sustainable and Renewable Energy Systems for Mountain Terrains: Enhancing Energy Accessibility, Efficiency, and Climate Resilience
		Anshika Singh		**Abdul Nadeem khan**		**Prof. Gyanendra Kumar Gupta, Dr. Dinesh Kumar Pandey**
	T 1.7	Stabilization of Expansive Soils in Hill Regions Using Industrial By-Products: A Sustainable Approach for Road Subgrade and Slope Protection	**T 1.8**	Biopolymer-Based Soil Stabilization for Erosion Control and Slope Protection in Hill Ecosystems: An Eco-Friendly Geotechnical Intervention	**T 1.9**	Sustainable Tourism in Hill Ecosystems: Strategies for Human Survival and Environmental Conservation
		Ashish Puri, Dr. Asha Kulshrestha, Shiva Prajapati		**Dr. Asha Kulshrestha, Ashish Puri, Shiva Prajapati**		**Medha Singh**
	T 1.10	Teleconnection Impacts on Temperature and Rainfall in Kashmir (1982–2024)	**T 1.11**	Harnessing Small-Scale Wind Energy in Hilly Terrains: A Sustainable Strategy for Disaster-Resilient Power and Ecosystem Conservation	**T 1.12**	Design of Extensions of Solar Plates for Maximum Utilization of Energy in hills area through means of Mechanical mechanism
		Preeti		**Vivek Mishra**		**Mr. Himanshu Minotra**
	T 1.13	Climate-Responsive Renewable Energy Strategies to Reduce Ecological Vulnerability in Mountain Terrains	**T 1.14**	Sustainable Solar Integration for Hilly Ecosystems: A Green Engineering Approach for Minimal Ecological Impact and Disaster Resilience	**T 1.15**	Sustainable Biomass Energy Conversion: A Strategy for Waste Management and Energy Security in Hilly Ecosystems
		Varun Singh		**Puskar Mishra, Vivek Mishra, Pappu Kushwaha**		**Abhishek kumar,Puskar Mishra**
	T 1.16	Urbanization in Hill Areas: Environmental Stress and Policy Solutions	**T 1.17**	Solar Photovoltaic Systems for Sustainable Energy Generation in Himalayan Hill Terrains: Challenges, Innovations, and Future Prospects	**T 1.18**	Adverse Environmental Effects of Hill Mining: Stability Analysis, Parameter Estimation, and Numerical Simulation
		Harshvardhan Chauhan		**Ankita Kulshrestha, Kuwar Mausam ,Rishabh Chaturvedi**		**Dr. Ajai Singh Yadav**

	T 1.19	Impact of climate change on water security and renewable energy potential in hill ecosystems assessment **Atul Kumar**	**T 1.20**	Integrating Sustainable and Renewable Energy Solutions for Enhancing Biodiversity Conservation in Mountain Terrains **Pankaj Kumar Yadav**	**T 1.21**	Importance of the Aravalli Hills and their Environmental & Global Significance **Guaravkumar Ojha**
	T 1.22	The Role of Renewable Energy in Climate Change Mitigation **Manmohan Singh Chauhan Ved Kumar Ranjeeta Bhati**	**T 1.23**	Rooftop Solar Power: A Lifeline for Himalayan Homes **Preeti Kulshrestha**	**T 1.24**	Solar Paint: The Future of Ecofriendly and Economically Renewable energy **VedKumar ,Bharat Raj Singh, Pramod Kumar Singh**
	T 1.25	Renewable Energy – Powering a Safer and Prosperous Future **Dr. Manoj Kumar Singh, Prof. Bharat Raj Singh**	**T 1.26**	Circular Economy the Technology for Environmental Sustenance in Hills **Ms. Sujata Sinha**	**T 1.27**	Application Of Climate Resilience Technology in Agriculture System Enhance Soil Carbon Sequestration And Mitigate The Climate Changes **Shalini G Pratap**
	T 1.28	Impact of Hilly Terrain on Solar Energy Generation and Techno-Economic Optimization of Hybrid Renewable Energy Systems in Jhansi, India **Garima Singh**	**T 1.29**	Towards sustainable heal Ecosystem: renewable energy, environmental protection, & disaster Resilience **Durgesh Kumar Tripathi**	**T 1.30**	Performance optimization of Solar TV Systems through intelligent control and Monitor **Abhishek Srivastava**
	T 1.31	Decision support framework for Pine needle mycoremediation and Disaster mitigation in the himalayas **Utkarsh Katiyar, Dr, Manmohan Singh**	**T 2.1**	Sustainable Ecosystem Restoration Strategies in the Aravalli Hills-Hill Ecology, Biodiversity Conservation, and Water Security **Prof. Bharat Raj Singh, Dr. Asha Kulshreshtha**	**T 2.2**	Green Supply Chain Management in Hills Ecosystem: A Study of Sustainable Logistics and Environmental Development **Utkarsh Singh**
	T 2.3	Development and Mechanical Performance of Hemp–Water Hyacinth Reinforced Hybrid Composites for Hill Ecosystem Applications **Mr Ravi Shukla, Amarpreet kaur, Harshit upadhyay, Diksha patel, Nitish yadav**	**T 2.4**	Hill Ecosystem and Human Survival: Environmental Challenges, Disaster Risks, and Sustainable Development Approaches **Dr. Arunesh Kumar Srivastava**	**T 2.5**	Water Conservation and Security in Indian States: Challenges, Governance, and Pathways to 2047 **Dr. Roli Raghuvanshi**
	T 2.6	Zero-Waste Natural Fibre Geotextile System: For Erosion Control, Slope Stability, Watershed Conservation, and Water Security in Himalayan Hill Slopes **Aman Singh**	**T 2.7**	Conserving Hill Ecology for Sustainable Biodiversity and Water Resource Management **Akansha Srivastava**	**T 2.8**	Effect of Thermal Pollution on Hills **Anoop Kumar Singh, Dr. Arvind Singh**
	T 2.9	Computing Resilience: Safeguarding Hill Ecosystems and Human Lives **Ms. Ayushi Patel, Ms. Divya Mishra**	**T 2.10**	Enhancing Human Resilience Through Sustainable Management of Hill Ecosystems **Kuldeep Kumar Katiyar**	**T 2.11**	Mathematical Modeling of Socio-Environmental Collapse due to Hill Mining in Bundelkhand: A Quantitative Sustainability Analysis **Dr. Seema Singh, Dr. Sachin Upadhya**

Day 2: (28/06/2026)
Technical Sessions
Multipurpose Hall, Conference Hall, LT – 1 & LT – 2

(B) Technical Session – IV(Multipurpose Hall)
Technical Session - V(Conference Hall, Ganga Block)
Technical Session-VI(Lecture Theatre-1)
Technical Session - VII(Lecture Theatre-2)

Time: 10:30 am to 1:00 pm	Technical Session-IV	Session Chair – Dr. Shailendra Kumar Yadav, Multipurpose Hall	Technical Session-V	Session Chair- Dr. Sarvesh Rai, Conference Hall, Ganga Block	Technical Session-VI	Session Chair – Dr. P.K. Singh, Lecture Theatre-1	Technical Session-VII	Session Chair – Dr. Alok Kumar, Lecture Theatre-2
3. Climate Change Impacts, Landslides, Floods, and Earthquakes: / 4. Environmental Governance, Community Resilience, and Livelihoods:/ 5. Science Policy Integration for Disaster Preparedness and Mitigation: / 6. Other Emerging Area of Science, Technology and Management (Connected with Theme)	T 3.1	Integrated Multi-Hazard Risk Assessment of Climate Change, Earthquakes, Landslides, and Flash Floods	T 3.2	Assessing the Environmental Consequences of Road Expansion in Mountainous Ecosystems	T 3.3	GIS-Based Landslide Susceptibility Mapping for Sustainable Infrastructure Development in Hill Regions	T 3.4	Big Data Analytics and Machine Learning for Climate Change Impact Assessment in Global Hills and Mountain Ecosystems
		Renu, Anamika Kumari		**Harshit Shukla, Bhanu Pratap Gupta**		**Bhanu Pratap Gupta, Harshit Shukla**		**Anamika, Savita Gautam**
	T 3.5	Review of Landslide Risk Reduction Strategies in the Himalayan Belt	T 3.6	Climate-Smart Development: Linking Carbon Neutrality with Resilience Building	T 3.7	Landslide Susceptibility and Risk Assessment in Hilly Regions under Changing Climatic and Land Use Conditions	T 3.8	Himalaya Hills Are Collapsing: Reasons, Impacts, and Mitigation Strategies
		Sanjeev Kumar Pandey		**Dr. Anod Kumar Singh**		**Rahul Singh**		**Dr. Dharmendra Singh, Prof. Bharat Raj Singh**
	T 3.9	Climate Change due to Rising Temperatures and its Causes and Effects	T 3.10	Himalayan Glacier Melting in a Changing Climate: Challenges for Human Systems and Sustainable Development	T 3.11	Foothill Residential Infrastructure for Climate-Resilient Himalayan Development: A Sustainable Framework for Disaster Risk Reduction in Uttarakhand	T 3.12	Artificial Intelligence-Based Flood Prediction in Mountain Regions: A Review of Opportunities and Challenges
		Swati Agrawal, Ved Kumar, Ajai Singh Yadav, Sudhaker Dixit		**V.D Tripathi, Ved Kumar, Pramod Kumar Singh, Guarav Ojha**		**Dr. Pramod Kumar Singh, Prof. Bharat Raj Singh**		**Krishna Agrawal**
	T 3.13	Morphological and Physiological Responses of UV-B Stress in Plants of Hill Ecosystems: Mechanisms, Adaptations, and Future Perspectives	T 3.14	Data Driven Decision Making for Climate & Disaster Resilience: Frameworks, Models, &Evidence	T 4.1	AI-Driven Environmental Risk Management and Sustainability Analytics Using Machine Learning, IoT, Blockchain, and Predictive Data Intelligence	T 4.2	Geo-Energy and Environmental Sustainability: Exploring Renewable Planetary Resources for Mitigating Natural Disasters and Climate Change
		Vineet Kumar Awasthi		**Sanjay Kumar Singh**		**Shashank Gaur**		**Yogendra Kumar Verma, Rahul Chaturvedi, Pappu Kushwaha**

T 4.3	Environmental Justice and Ecocentrism: With Special Reference to The Hungry Tide	T 4.4	An Assessment of India's Sustainable Energy Policies for Promoting Green Infrastructure	T 4.5	Waste-to-Wealth Models in Hill Ecosystems: An Economic Evaluation for Environmental Sustainability and Human Survival	T 5.1	Harnessing Sustainable Planetary Energy Sources for Climate Resilience: An Integrated Framework for Environmental Conservation and Disaster Risk Reduction
	Dr. Shobhana Singh		**Syed Shuja Askari**		**Dr. Ashok Sengupta**		**Rahul Chaturvedi, Yogendra Verma, Pappu Kushwaha**
T 5.2	Leveraging Minitab and Regression Analysis for Environmental Sustainability and Disaster Resilience: A Statistical Modelling Framework	T 6.1	Flood Risk Prediction in Hill-Adjacent Communities Using Deep Neural Networks and Environmental Vulnerability Indicators	T 6.2	Landslide Risk Prediction Using Convolutional Neural Networks Integrated with Digital Elevation Model and Rainfall Data	T 6.3	Satellite Image Analysis for Monitoring Environmental Changes in Hill Regions
	Utkarsh Kumar Sharma		**Sunit Kumar Mishra, Umesh Pratap Singh**		**Dr. Niyati Gaur, Sunit Kumar Mishra**		**Divya Mishra and Dr. Niyati Gaur**
T 6.4	Artificial Intelligence for Environmental Monitoring and Disaster Prediction: Datasets, Models, and an Integrated Framework	T 6.5	Human Survival in Hill Ecosystems: A Deep Learning and Geospatial Analytics Framework for Climate-Induced Flood and Landslide Risk Assessment and Prediction	T 6.6	Electric Vehicle-Driven Planetary Energy Solutions: A Multidisciplinary Approach Combining Green Technologies and Environmental Monitoring	T 6.7	Towards Sustainable Generative AI: A Systematic Literature Review of Environmental Challenges, Green AI Techniques, and Future Directions
	Savita Gautam, Renu		**Rahul Yadav**		**Pappu Kushwaha, Rahul Chaturvedi, Yogendra Kumar Verma, Dr. Kamlesh Singh**		**Alka**
T 6.8	Human Survival Vulnerability Index for Hill Regions Using Explainable XGBoost: A Case Study of the Hindu Kush Himalayan Region	T 6.9	Terrain-Aware Wheeled–Legged Robot for Autonomous Robotics Operations in Hill and Mountain Terrains	T 6.10	AI-Enabled Energy-Efficient Cloud Data Centers: A Pathway to Sustainable Computing	T 6.11	Favourable transformation in the properties of Liquid Crystal by Gamma Radiation
	Umesh Pratap Singh		**Dr. Kamlesh Singh**		**Dr. Hemant Kumar Singh, Dr. Saima Aleem**		**Sudhaker Dixit, Avneesh Kumar Singh, Ved Kumar**

KEYNOTE SPEAKERS/ SESSION CHAIR

1. Rejuvenation of River Ganga (Preserving our life line and securing our future)
2. Energy Transition in the 21st Century: Renewable Energy, Climate Change, and Human Survival
3. Application of Climate Resilience Technology In Agriculture System Enhance Soil Carbon Sequestration And Mitigate The Climate Changes
4. Role of Artificial Intelligence in Planet Energy, Environment and Disaster Science
5. Ecological Risk of Pesticide Industry Waste Leachate: Insights from Earthworm Bioassays
6. Prototype-Guided Risk Ranking for Hill Ecosystem Monitoring and Human Survival under Environmental Domain Shift

Rejuvenation of River Ganga
(Preserving our life line and securing our future)

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ABSTRACT

The presentation outlines the Governments initiative to clean R. Ganga. Government is playing a key role in over-all task of clean R. Ganga through strengthening of common waste treatment facilities, strict monitoring of Industrial units and drains carrying sewage and other waste that is cause of pollution. It highlights ancient cultural values with modern scientific tools and significant structural achievements, including the operationalisation of more number of sewage treatment plants (STPs) and real-time monitoring system for polluting industries. The roadmap addresses challenges like industrial effluent and reduced flows through targeted ecological conservation, active community engagement, and a future framework powered by AI and IoT data tracking. Over all water quality is improving, number of Ganga Dolphins are increasing in number and Biological Water Quality (BWQ) is in Good to moderate range.

Keywords : sewage treatment plants (STPs), Ganga River, Industrial Effluent.

Energy Transition in the 21st Century: Renewable Energy, Climate Change, and Human Survival

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ABSTRACT

The global energy system is experiencing a fundamental transformation driven by the intertwined challenges of climate change, energy security, environmental sustainability, and economic development. As nations seek to balance growing energy demands with the imperative of reducing carbon emissions, the transition from fossil-fuel-based energy systems to cleaner and more sustainable alternatives has emerged as one of the defining priorities of the twenty-first century. This transition is not merely a technological shift; it represents a broader reconfiguration of the relationship between energy, society, the economy, and the environment.

This keynote lecture explores the evolving energy landscape and examines how advances in renewable energy technologies, including solar and wind power, green hydrogen, energy storage systems, and smart-grid infrastructure, are reshaping pathways to sustainable development. The lecture also considers the growing importance of international cooperation in accelerating this transition through initiatives such as the Paris Agreement, the Sustainable Development Goals (SDGs), Mission Innovation, and the International Solar Alliance, which have strengthened global commitments toward a low-carbon future.

Particular attention is devoted to India's emerging role in the global energy transition. Through initiatives such as the National Solar Mission, PM-KUSUM, PM Surya Ghar Yojana, the National Green Hydrogen Mission, the FAME programme, the National Smart Grid Mission, and energy-efficiency measures under the Perform, Achieve and Trade (PAT) scheme, India is pursuing a comprehensive strategy that integrates renewable energy expansion, sustainable mobility, energy efficiency, and industrial decarbonization. These efforts reflect the growing recognition that energy transitions must be technologically viable, economically inclusive, and environmentally sustainable.

The lecture argues that the success of future energy systems cannot be assessed solely through measures of generation capacity, efficiency, or economic returns. Equally important are their contributions to climate resilience, environmental stewardship, social equity, and human well-being. The convergence of renewable energy technologies, digital innovation, artificial intelligence, and resilient infrastructure offers new opportunities for creating energy systems that are cleaner, smarter, and more adaptive to emerging societal needs.

Ultimately, the energy transition represents a unique opportunity to address climate change while promoting sustainable development and improving quality of life. Its success will depend on our collective ability to align scientific innovation, policy frameworks, and societal aspirations in pursuit of a resilient, equitable, and sustainable future.

Keywords: Renewable Energy Technologies, energy storage system, International Solar Alliance, Industrial de-carbonization

Application of Climate Resilience Technology In Agriculture System Enhance Soil Carbon Sequestration And Mitigate The Climate Changes

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ABSTRACT

Hill ecosystems represent some of the most ecologically sensitive and resource-constrained environments on Earth. Traditional linear economic models—extracting, consuming, and discarding — have accelerated soil degradation, deforestation, and water scarcity across mountainous regions. The circular economy offers a transformative paradigm, wherein waste is minimized, resources are cyclically regenerated, and ecological integrity is preserved through purposeful technological intervention. This paper examines how circular economy principles, enabled by emerging and appropriate technologies, can ensure environmental sustenance in hill communities. Key technologies explored include biomass-to-energy conversion systems that repurpose agricultural and forest residues, closed-loop water harvesting and grey-water recycling infrastructure suited to terrain-specific hydrology, and precision agro-forestry platforms leveraging IoT sensors and remote sensing to optimize land use without compromising biodiversity. Additionally, community-based composting and bio-digesters are assessed as tools for converting organic waste into soil amendments, restoring degraded hill slopes. The paper further highlights digital traceability systems that enable local circular supply chains for artisanal and forest-based products, reducing resource leakage from hill economies. Social co-design and indigenous knowledge integration are identified as critical enablers; ensuring technological solutions remain contextually appropriate and community-owned.

Findings suggest that a technology-mediated circular economy framework, when aligned with local ecological knowledge and governance structures, can significantly reduce environmental pressure in hill regions while generating livelihood resilience. This study contributes to the growing discourse on sustainable mountain development and advocates for policy frameworks that incentivize circular transitions in fragile highland ecosystems.

Keywords: Circular Economy, Hill Ecosystems, Environmental Sustenance, Sustainable Technology, Mountain Development, Resource Regeneration

Role of Artificial Intelligence in Planet Energy, Environment and Disaster Science

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ABSTRACT

Artificial intelligence (AI) has become a game-changing tool for tackling important worldwide issues like disaster management, environmental preservation, and energy sustainability. Opportunities for AI-driven solutions that improve forecasting, monitoring, and decision-making processes have been made possible by the quick expansion of data from satellites, sensors, weather stations, and smart devices. AI improves efficiency, lowers operating costs, and lowers carbon emissions in the energy sector by supporting smart grid management, predicting renewable energy, energy demand prediction, and predictive maintenance. AI-enabled systems contribute to sustainable energy development by making it easier to incorporate renewable energy sources like solar and wind power into contemporary electrical networks.

In environmental research, AI plays a significant role in climate change modelling, air and water quality monitoring, biodiversity conservation, and natural resource management. Large-scale environmental datasets are analyzed by machine learning and deep learning algorithms to find trends, forecast changes in the environment, and assist in making evidence-based policy decisions. Additionally, AI uses remote sensing and image processing methods to monitor ecosystem health, wildlife populations, and deforestation.

By offering precise early warning systems for floods, earthquakes, wildfires, cyclones, and landslides, artificial intelligence (AI) improves preparedness, response, and recovery efforts in disaster research. AI assists in risk assessment, emergency response strategy optimization, and disaster event prediction by evaluating real-time meteorological, hydrological, and geological data. The usefulness of AI in fostering resilience and sustainability is illustrated by case studies like Google DeepMind's energy optimization and AI-based flood forecasting systems. All things considered, AI is a potent instrument for creating a sustainable future by enhancing environmental responsibility, energy efficiency, and disaster risk reduction while promoting global sustainable development goals.

Keywords : Artificial Intelligence, Machine Learning, Renewable Energy, Environmental Monitoring, Disaster Prediction, Remote Sensing, Climate Change, Sustainable Development, Geospatial Analytics, Early Warning Systems

Ecological Risk of Pesticide Industry Waste Leachate: Insights from Earthworm Bioassays

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ABSTRACT

A laboratory-based study was conducted to evaluate the acute toxicity of pesticide waste leachate using the earthworm *Eisenia fetida* as a test organism. Both lethal (mortality) and sublethal (behavioural and reproductive) endpoints were assessed to determine the ecotoxicological impact. The test media included direct leachate exposure as well as leachate-spiked compost (LSC) and leachate-spiked artificial soil (LSAS).

The median lethal concentration (LC_{50}) for direct leachate exposure was determined to be 12.4%. Sublethal effects were pronounced, with the median effective concentration (EC_{50}) for locomotion after 96 h exposure estimated at 50% in LSC and 10% in LSAS, indicating higher sensitivity in artificial soil. In LSAS, earthworms were unable to burrow at 50% concentration after 96 h and at 100% concentration after 48 h of exposure. Locomotory activity ceased completely beyond 72 h at 50% concentration and beyond 48 h at 100% concentration in LSAS. The reduction in locomotion and burrowing behaviour was more severe in LSAS compared to LSC.

Reproductive toxicity was also evident, as no cocoon production was observed at 100% leachate concentration after 96 h of exposure. The EC_{50} values for reproduction were calculated as 21.5% for LSC and 16% for LSAS. Overall, the results demonstrate that pesticide waste leachate exerts significant acute and sublethal toxic effects on *E. fetida*, with greater toxicity observed in artificial soil conditions. These findings highlight the potential ecological risks associated with improper disposal of pesticide wastes and underscore the importance of ecotoxicological evaluation in waste management practices.

Keywords - Pesticide leachate, Eisenia fetida, Acute and sublethal toxicity, Ecotoxicology, LC_{50} and EC_{50}, Soil contamination, Environmental risk assessment

Prototype-Guided Risk Ranking for Hill Ecosystem Monitoring and Human Survival under Environmental Domain Shift

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ABSTRACT

Hill ecosystems are highly sensitive to environmental variations, land-use changes, slope instability, soil erosion, vegetation loss, and extreme weather conditions. These changes directly affect human survival in hilly regions by increasing the risk of landslides, road blockage, settlement damage, water scarcity, and disruption of essential services. Manual monitoring of such regions is difficult due to complex terrain, seasonal variations, and limited accessibility. To address this challenge, this paper proposes a prototype-guided risk ranking framework for image-based hill ecosystem monitoring and human survival assessment under environmental domain shift. The proposed approach retrieves visually and semantically similar environmental risk patterns from a reference image database and ranks them according to their potential severity. Source-guided ecological prototypes are used to represent key risk categories such as stable slopes, minor erosion, severe erosion, landslide-prone regions, damaged hill roads, vegetation degradation, and vulnerable human settlements. A ranking-aware learning strategy is further introduced to prioritize critical risk images over normal or low-risk scenes. The framework is designed to handle variations caused by weather, illumination, season, altitude, terrain texture, and image acquisition conditions. By combining prototype-guided semantic alignment with risk-aware retrieval optimization, the proposed method improves discrimination between safe and unsafe hill ecosystem conditions. Experimental results show that the proposed framework performs better than existing state-of-the-art image retrieval and visual risk assessment methods in terms of retrieval accuracy, ranking consistency, and critical-risk prioritization. The proposed system can support early warning, preventive planning, and decision-making for sustainable hill ecosystem management and human safety.

Keywords: Hill ecosystem monitoring . image retrieval . environmental domain shift . risk ranking . prototype-guided learning . landslide risk . ecological vulnerability and disaster prevention.

ABSTRACT

1. Sustainable & Renewable Energy in Mountain Terrains
2. Hill Ecology, Biodiversity Conservation, and Water Security
3. Climate Change Impacts, Landslides, Floods, and Earthquakes
4. Environmental Governance, Community Resilience, and Livelihoods
5. Science–Policy Integration for Disaster Preparedness and Mitigation
6. Other Emerging area of Science Technology & Management (Connected with Theme)

1 SUSTAINABLE & RENEWABLE ENERGY IN MOUNTAIN TERRAINS

- Capacity Building For Disaster Preparedness: Strengthening Communities, Institutions, and Systems for Resilient Futures
- Sustainable & Renewable Energy in Mountain Terrains of India
- Machine Learning-Based Flood for E-casting and Community-Centric Early Warning Systems for Sustainable Mountain Regions
- Role of Local Communities in Biodiversity Conservation of Mountain Ecosystems
- Development of Pilgrim corridor and Slope instability in Kedarnath Himalaya: An exploratory analysis of 2013 disaster
- Solar Photovoltaic Systems for Sustainable Energy Generation in Himalayan Hill Terrains: Challenges, Innovations, and Future Prospects
- Artificial Intelligence-Driven Sustainable and Renewable Energy Systems for Mountain Terrains: Enhancing Energy Accessibility, Efficiency, and Climate Resilience
- Sustainable Tourism in Hill Ecosystems: Strategies for Human Survival and Environmental Conservation
- Stabilization of Expansive Soils in Hill Regions Using Industrial By-Products: A Sustainable Approach for Road Subgrade and Slope Protection
- Urbanization in Hill Areas: Environmental Stress and Policy Solutions
- Biopolymer-Based Soil Stabilization for Erosion Control and Slope Protection in Hill Ecosystems: An Eco-Friendly Geotechnical Intervention
- Harnessing Small-Scale Wind Energy in Hilly Terrains: A Sustainable Strategy for Disaster-Resilient Power and Ecosystem Conservation
- Towards Sustainable Hill Ecosystems: Renewable Energy, Environmental Protection, and Disaster Resilience
- Sustainable Solar Integration for Hilly Ecosystems: A Green Engineering Approach for Minimal Ecological Impact and Disaster Resilience

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- Climate-Responsive Renewable Energy Strategies to Reduce Ecological Vulnerability in Mountain Terrains
- Sustainable Biomass Energy Conversion: A Strategy for Waste Management and Energy Security in Hilly Ecosystems
- Adverse Environmental Effects of Hill Mining: Stability Analysis, Parameter Estimation, and Numerical Simulation
- Tele Connection Impacts on Temperature and Rainfall in Kashmir (1982–2024)
- Integrating Sustainable and Renewable Energy Solutions for Enhancing Biodiversity Conservation in Mountain Terrains
- Impact of Climate Change on Water Security and Renewable Energy Potential in Hill Ecosystems Assessment
- Importance of the Aravalli Hills and their Environmental & Global Significance
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- Renewable Energy – Powering a Safer and Prosperous Future
- Solar Paint: The Future of Ecofriendly and Economically Renewable Energy
- Design of Extensions of Solar Plates for Maximum Utilization of Energy in Hills Area through Means of Mechanical Mechanism
- Circular Economy the Technology for Environmental Sustenance in Hills
- Impact of Hilly Terrain on Solar Energy Generation and Techno-Economic Optimization of Hybrid Renewable Energy Systems in Jhansi, India
- Performance Optimization of Solar PV Systems Through Intelligent Control and Monitoring

Capacity Building For Disaster Preparedness: Strengthening Communities, Institutions, and Systems for Resilient Futures

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ABSTRACT

Natural and man-made disasters continue to cause catastrophic damage to people, the economy, and the environment worldwide. Building capacity is a key component of initiatives to lower disaster risk and increase resilience, according to the Sendai Framework for Disaster Risk Reduction (2015–2030). However, despite increasing awareness of its importance, disaster preparedness capacity building is still dispersed throughout communities, organizations, and systems. Using sources from UNDRR, WHO, FEMA, IFRC, UNDP, and scholarly publications, this review study synthesizes secondary data from peer-reviewed literature, international policy documents, grey literature, and organizational reports published between 2000 and 2025.

Three interrelated aspects of disaster preparedness capacity are identified by the review: systemic frameworks, institutional preparedness, and community-level resilience. Important conclusions show that investments in infrastructure and technology, inclusive governance, community-based early warning systems, interagency collaboration, and localized training are all essential components of resilience. Progress is nevertheless hampered by enduring gaps, such as underfunding, unequal resource distribution, knowledge silos, and the marginalization of vulnerable groups. To contextualize global patterns, the study uses case studies from South Asia, Sub-Saharan Africa, Southeast Asia, and the Americas. In order to create resilient futures in a time of growing geophysical and climate-related risks, it ends with a set of evidence-based policy suggestions for multi-stakeholder action.

Keywords: Disaster Preparedness, Capacity Building, Disaster Risk Reduction (DRR), Early Warning Systems (EWS), Vulnerability Assessment

Sustainable & Renewable Energy in Mountain Terrains of India

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ABSTRACT

Renewable energy in mountainous terrain involves utilizing sources such as hydropower, solar power, biomass and wind energy. These rugged, high-altitude areas provide rich natural resources for energy generation but they also pose considerable engineering and environmental challenges, particularly within ecologically fragile environments. Characterized by extreme environmental heterogeneity, mountain terrains feature distinct climates, rugged topographies, and rich biodiversity. These unique attributes leave both the ecosystems and their local populations disproportionately vulnerable to climate disruptions and energy poverty—the inability to access or afford critical energy services. This paper evaluates the regional impacts of climate change and addresses the socioeconomic pressures of energy poverty. Furthermore, the paper analyzes the respective advantages and disadvantages of various renewable resources, including solar, wind, hydropower, and biomass, within the context of mountainous terrains unique environmental and socioeconomic conditions. Ultimately, this highlights the critical role that boosts the reliability and efficiency of renewable energy networks across complex mountainous terrains.

Keywords: Renewable Energy, Mountain Terrains, Environmental Challenges, Sustainable Development, Photovoltaic (PV) Cells, Wind Energy, Hydropower, Biomass Energy.

Machine Learning-Based Flood for E-casting and Community-Centric Early Warning Systems for Sustainable Mountain Regions

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ABSTRACT

Mountain regions are increasingly vulnerable to flash floods, glacial lake outburst floods, and extreme rainfall events intensified by climate change. Traditional flood forecasting approaches often struggle to provide timely and localized warnings due to complex terrain, sparse monitoring infrastructure, and rapidly changing environmental conditions. This study proposes an integrated framework that combines machine learning-based flood forecasting with community-centric early warning systems to enhance disaster preparedness and resilience in sustainable mountain regions.

The proposed approach utilizes historical hydrological, meteorological, topographical, and satellite-derived data sets to develop predictive models capable of identifying flood risks with improved accuracy and lead time. Advanced machine learning techniques can detect hidden patterns and nonlinear relationships within environmental data, enabling more reliable forecasts than conventional methods. Beyond technological innovation, the framework emphasizes active community participation through locally accessible warning mechanisms, mobile-based alerts, and awareness-driven response strategies. By bridging artificial intelligence with grass roots engagement, the proposed model aims to reduce disaster losses, strengthen climate resilience, and support sustainable development goals in mountain communities. The study highlights how data-driven decision-making, when combined with inclusive community involvement, can transform disaster risk reduction from a reactive process into a proactive and adaptive system. This research contributes to the growing field of intelligent environmental management and offers a scalable pathway for protecting vulnerable populations in mountainous regions worldwide.

Keywords: Machine Learning, Flood Forecasting, Disaster Risk Reduction (DRR), Early Warning Systems (EWS), Climate Change Resilience, Glacial Lake Outburst Floods (GLOF), Sustainable Mountain Development, Community-Centric Engagement, Predictive Analytics, Remote Sensing.

Role of Local Communities in Biodiversity Conservation of Mountain Ecosystems

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ABSTRACT

Mountain ecosystems are among the most biologically diverse and environmentally sensitive regions of the world. They provide essential ecosystem services, including freshwater resources, climate regulation, soil conservation, and habitat for numerous plant and animal species. However, these ecosystems are increasingly threatened by climate change, deforestation, habitat fragmentation, unsustainable tourism, overgrazing, and rapid urbanization. Local communities residing in mountain regions have historically played a vital role in conserving biodiversity through traditional ecological knowledge, sustainable resource management practices, and community-based conservation initiatives. This study examines the contribution of local communities to biodiversity conservation in mountain ecosystems, with special reference to the Himalayan region. The study highlights traditional conservation practices, community forestry programs, participatory management approaches, and indigenous knowledge systems that support ecological sustainability. It also discusses the challenges faced by mountain communities and proposes strategies for strengthening community participation in conservation efforts. The findings suggest that integrating local knowledge with scientific management approaches can significantly enhance biodiversity conservation and promote sustainable development in mountain ecosystems.

Keywords: Biodiversity Conservation, Mountain Ecosystems, Local Communities, Indigenous Knowledge, Sustainable Development, Himalayan Region, Community Participation.

Development of Pilgrim corridor and Slope instability in Kedarnath Himalaya: An exploratory analysis of 2013 disaster

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ABSTRACT

The Himalayan region has witnessed a substantial increase in pilgrimage-induced infrastructure development over the past two decades. In the Kedarnath Himalaya, the expansion of pilgrim corridors, transportation networks, lodging facilities, and commercial premises has considerably improved accessibility to one of India's most important religious destinations. Although these developments have also metamorphosed the landforms of an environmentally fragile mountain ecosystem. The devastating event of June 2013, which consequences in the widespread landslides, floods, and massive loss of life and infrastructure.

This study examines the connections between pilgrim corridor development and slope instability in the Kedarnath region through an exploratory analysis of the 2013 disaster. The findings unveil that extreme rainfall and hydrometeorological conditions stimulated the 2013 disaster, human driven modifications intensified the extent of destruction. More than 1,000 landslides were recorded across the Mandakini catchment, over than 6,000 people lost their lives. Rapid expansion of pilgrimage infrastructure, combined with environmental degradation and climate-related changes such as glacier retreat and increasing extreme rainfall events, contributed to the destabilization of mountain slopes and heightened disaster risk. The study underlines the need to integrate geological suitability assessments, carrying-capacity evaluation, ecological conservation, and climate-resilient planning into future pilgrimage corridor development. Sustainable management of mountain infrastructure is essential to reduce disaster risk and ensure the long-term environmental stability of the Kedarnath Himalaya and other pilgrimage destinations within the Himalayan region.

Keywords: Kedarnath Himalaya, Pilgrim Corridor Development, Slope Instability, Disaster Risk, Landslides, Climate Change, Sustainable Tourism etc.

Solar Photovoltaic Systems for Sustainable Energy Generation in Himalayan Hill Terrains: Challenges, Innovations, and Future Prospects

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ABSTRACT

Hill and mountain ecosystems of India, particularly the Himalayan region, possess enormous solar energy potential owing to high solar irradiance, reduced atmospheric interference, and extended sunshine hours at elevated altitudes. Solar photovoltaic (PV) technology offers a viable and sustainable pathway for decentralized energy access in these geographically isolated and ecologically sensitive terrains. However, the deployment of solar PV systems in mountain regions is challenged by extreme temperature variations, snow accumulation, terrain complexity, seismic vulnerability, limited infrastructure, and supply chain constraints. This paper presents a comprehensive review of solar PV technologies adapted for Himalayan hill regions, analyses site-specific performance parameters, and proposes a framework integrating bifacial PV modules, Maximum Power Point Tracking (MPPT) controllers, and hybrid energy storage systems. Field performance data from existing installations are critically assessed. The study recommends a community-centric deployment model aligned with India's National Solar Mission and the SDG-7 goal of affordable clean energy. The paper contributes to SPEEDS-2026's thematic focus on sustainable energy in mountain terrains and hills ecosystem resilience.

Keywords: Solar photovoltaic; Himalayan energy; hill terrain; bifacial modules; MPPT; hybrid storage; decentralized energy; renewable energy India.

Artificial Intelligence-Driven Sustainable and Renewable Energy Systems for Mountain Terrains: Enhancing Energy Accessibility, Efficiency, and Climate Resilience

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ABSTRACT

The attainment of reliable energy access for mountain areas throughout the world is hindered by challenging geographical features, unfavorable climatic conditions, sparse population, and lack of proper infrastructure. In addressing these challenges, renewable energy options, such as solar energy, wind energy, micro-hydro power, and biomass, can provide an effective approach in terms of ensuring energy access while mitigating carbon emissions. Nonetheless, the unpredictability of renewable energy sources and the nature of mountain terrain necessitate the adoption of sophisticated management methods.

This paper seeks to explore the revolutionary application of Artificial Intelligence (AI) in boosting the effectiveness of renewable energy in mountain areas. Various AI applications, like machine learning, analytics, digital twin technologies, and intelligent energy management systems, can help optimize energy production, consumption, and forecasting, storage, and distribution networks in a mountain environment. Moreover, the paper evaluates ways through which the use of AI technologies can enhance energy generation capacity in the mountain terrain through improved resource analysis, weather forecasting, fault detection, and maintenance. Additionally, the integration of smart microgrids and hybrid renewable energy sources in rural areas is considered. The research paper proposes that renewable energy systems powered by AI technology provide an attractive future option for ensuring sustainable development, climate resiliency, and energy access within mountain regions. The focus of future research areas is on regional specific approaches based on AI technology and energy systems to ensure maximum sustainability and resiliency.

Keywords: Sustainable Energy, Renewable Energy, Artificial Intelligence, Mountain Terrains, Smart Microgrids, Energy Optimization, Climate Resiliency, Machine Learning, Rural Electrification, Hybrid Energy Systems.

Sustainable Tourism in Hill Ecosystems: Strategies for Human Survival and Environmental Conservation

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ABSTRACT

Hill ecosystems are among the most fragile and ecologically sensitive regions of the world. Increasing tourism activities in mountainous regions have contributed significantly to environmental degradation, biodiversity loss, waste accumulation, water scarcity, and socio-cultural disturbances. Unregulated tourism development threatens both ecological balance and the livelihoods of local communities. This research paper examines sustainable tourism strategies in hill ecosystems with special emphasis on limiting tourist carrying capacity, implementing effective waste management systems, establishing plastic-free tourism zones, promoting eco-friendly hotels, and encouraging local culture and products. The study highlights how sustainable tourism can contribute to environmental conservation, economic development, and human survival in mountainous regions. The paper also discusses challenges, policy recommendations, and case studies from different hill regions.

Keywords: Sustainable tourism, hill ecosystem, carrying capacity, waste management, eco-friendly tourism, plastic-free tourism, local culture, environmental conservation.

Stabilization of Expansive Soils in Hill Regions Using Industrial By-Products: A Sustainable Approach for Road Subgrade and Slope Protection

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ABSTRACT

Expansive soils, characterized by significant volumetric changes in response to moisture fluctuations, pose severe geotechnical challenges in hill and mountainous terrains where seasonal rainfall patterns are highly variable and unpredictable. The swelling and shrinkage behaviour of such soils frequently leads to pavement distress, slope instability, retaining wall failures, and foundation damage — threats that are further amplified by the intensifying effects of climate change. Conventional chemical stabilization using lime and cement, while effective, raises environmental and economic concerns in ecologically sensitive hill zones. This study investigates the effectiveness of industrial by-products — Ground Granulated Blast Furnace Slag (GGBS), Fly Ash (Class F), and Rice Husk Ash (RHA) — as sustainable stabilizing agents for expansive black cotton soil collected from hill-fringe areas. Laboratory investigations following IS code provisions encompassed Proctor Compaction Tests, California Bearing Ratio (CBR), Unconfined Compressive Strength (UCS), Free Swell Index (FSI), and Atterberg Limits at varying additive proportions (5%, 10%, 15%, and 20% by dry weight). Results demonstrate that a binary blend of GGBS (15%) and RHA (10%) achieves a 62% reduction in Free Swell Index, a 2.8-fold increase in UCS, and a CBR improvement of approximately 74% over untreated soil at 7-day curing. Microstructural analysis using Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) confirmed formation of cementitious compounds (C-S-H and C-A-H gels) responsible for strength gain and swell suppression. Environmental impact assessment validates that the proposed approach reduces carbon footprint by approximately 45% compared to conventional cement-based treatment.

Keywords : Expansive soil stabilization; GGBS; Fly Ash; Rice Husk Ash; CBR; UCS; Hill terrain; Sustainable geotechnics.

Urbanization in Hill Areas: Environmental Stress and Policy Solutions

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ABSTRACT

Urbanization in hill areas has increased rapidly in recent decades due to tourism growth, migration, infrastructure expansion, and economic opportunities. While urban development brings improved livelihoods and services, it also creates severe environmental stress in fragile hill ecosystems. These include deforestation, soil erosion, water scarcity, biodiversity loss, and increased disaster risks such as landslides. This paper examines the environmental impacts of urbanization in hill regions and evaluates policy measures aimed at achieving sustainable development. It argues that integrated planning, ecological zoning, community participation, and climate-sensitive infrastructure are essential for balancing human survival and environmental protection in hill ecosystems.

Keywords: Urbanization, Hill Ecosystems, Environmental Stress, Sustainable Development, Soil Erosion, Deforestation, Landslides, Water Scarcity, Biodiversity Loss, Climate Change, Mountain Regions, Disaster Risk Reduction, Ecological Zoning, Sustainable Tourism, Human–Environment Interaction.

Biopolymer-Based Soil Stabilization for Erosion Control and Slope Protection in Hill Ecosystems: An Eco-Friendly Geotechnical Intervention

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ABSTRACT

Soil erosion and shallow slope failures in hill ecosystems represent critical environmental and geotechnical hazards threatening biodiversity, water quality, and human settlements. Traditional chemical stabilizers such as cement and synthetic polymers, while mechanically effective, introduce ecological risks including soil pH alteration, groundwater contamination, and disruption of native microbial communities — of paramount importance in environmentally sensitive mountain terrains. This study evaluates the geotechnical performance of two biopolymers — Xanthan Gum (XG) and Guar Gum (GG) — for stabilizing silty hill soil collected from landslide-prone Sub-Himalayan slopes. Laboratory experiments were conducted at dosages of 0.5%, 1.0%, 1.5%, and 2.0% by dry weight, with curing periods of 7, 14, and 28 days. Geotechnical tests including Unconfined Compressive Strength (UCS), Direct Shear Test, Permeability Test, and Erosion Resistance Index were performed under dry and wet curing conditions. Xanthan Gum at 1.5% dosage with 28-day curing achieves a 3.4-fold increase in UCS, a 58% reduction in hydraulic conductivity, and an 81% improvement in erosion resistance over untreated soil. Guar Gum demonstrated superior performance under immediate application conditions, suitable for emergency slope stabilization. Microstructural analysis through SEM revealed biopolymer chains filling inter-particle voids, creating bio-cementation bonds enhancing mechanical strength and water repellency. Soil pH and microbial activity tests confirmed negligible environmental impact of both biopolymers, validating their ecological compatibility with sensitive hill ecosystems.

Keywords: Biopolymer stabilization; Xanthan Gum; Guar Gum; Slope erosion control; Hill ecosystem; Eco-friendly geotechnics; Landslide mitigation; Sub-Himalayan soil.

Harnessing Small-Scale Wind Energy in Hilly Terrains: A Sustainable Strategy for Disaster-Resilient Power and Ecosystem Conservation

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ABSTRACT

Hilly ecosystems possess unique wind flow characteristics, such as valley and mountain breezes, which offer significant potential for decentralized wind energy harvesting. Unlike large-scale wind farms that require massive land clearing and intrusive infrastructure, this paper focuses on small-scale, vertical-axis wind turbine (VAWT) technology, which is highly suitable for complex, rugged mountainous topographies. The research explores how these low-impact turbines can provide a reliable power source for remote human settlements without compromising the delicate ecological balance of the region.

The paper addresses the technical challenges of integrating small-scale wind power into isolated micro-grids, focusing on turbine blade design that minimizes avian impact and reduces noise pollution—factors crucial for preserving mountain biodiversity. Furthermore, it examines the use of robust, lightweight materials that facilitate installation without heavy machinery, thereby preventing soil erosion and large-scale habitat disturbance. By evaluating the integration of wind-solar hybrid systems, the study demonstrates that decentralized wind energy can significantly enhance disaster resilience, providing stable electricity during periods of limited solar irradiance or extreme weather events. This approach not only addresses the energy requirements for human survival in challenging terrains but also promotes a non-invasive, sustainable engineering model that respects the integrity of the hilly ecosystem.

Keywords: Small-scale Wind Energy, Hilly Ecosystems, Vertical-Axis Wind Turbines (VAWT), Decentralized Micro-grids, Environmental Conservation, Disaster Resilience, Sustainable Power.

Towards Sustainable Hill Ecosystems: Renewable Energy, Environmental Protection, and Disaster Resilience

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ABSTRACT

Hill ecosystems are among the most ecologically fragile and environmentally significant landscapes, providing essential ecosystem services such as freshwater resources, biodiversity conservation, climate regulation, and livelihood support for millions of people. However, these regions are increasingly threatened by climate change, deforestation, unsustainable land use, excessive dependence on fossil fuels, and natural disasters including landslides, floods, and soil erosion. Addressing these challenges requires an integrated approach that combines renewable energy development with environmental conservation and disaster risk reduction. This paper explores the potential of sustainable energy sources, including biomass, solar, micro-hydropower, and wind energy, to promote resilient and low-carbon development in hill regions. The study emphasizes biomass-based bioenergy as a promising solution for converting agricultural and forest residues into clean energy while minimizing waste, reducing greenhouse gas emissions, and supporting circular economy principles. In addition, the application of Life Cycle Assessment (LCA) and carbon footprint analysis is discussed as an effective framework for evaluating the environmental performance and sustainability of renewable energy systems. The paper further highlights the importance of ecosystem-based planning, community participation, and decentralized energy infrastructure in enhancing disaster preparedness and strengthening the adaptive capacity of vulnerable mountain communities. The integration of clean energy technologies with sustainable resource management can reduce environmental degradation, improve energy accessibility, and contribute to long-term ecological stability and human well-being. The proposed framework supports global climate action initiatives and aligns with the United Nations Sustainable Development Goals by promoting affordable clean energy, resilient infrastructure, environmental sustainability, and sustainable livelihoods for present and future generations living in hill ecosystems.

Keywords: Hill Ecosystems; Renewable Energy; Environmental Sustainability; Disaster Resilience; Life Cycle Assessment; Climate Change.

Sustainable Solar Integration for Hilly Ecosystems: A Green Engineering Approach for Minimal Ecological Impact and Disaster Resilience

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ABSTRACT

The deployment of solar energy infrastructure in hilly regions offers a promising pathway for sustainable development, yet it requires a delicate balance between engineering efficiency and ecological preservation. Conventional solar installations often involve extensive land clearing, which poses threats to the fragile mountain biodiversity, triggers soil erosion, and disrupts local water tables. This paper proposes a "Low-Impact Green Engineering" framework for Solar Photovoltaic (PV) deployment in hilly ecosystems, emphasizing techniques that harmonize energy generation with environmental safety.

The study evaluates the use of elevated, non-invasive mounting structures that minimize ground disruption and prevent the degradation of topsoil. Furthermore, it explores the technical feasibility of integrating solar energy into existing built environments—such as rooftops and natural cliff-side slopes—to avoid deforestation and land-use conflicts. By leveraging advanced power electronics, the paper discusses decentralized micro-grid systems that reduce the need for long, environmentally destructive transmission lines through pristine forest areas. Special attention is given to disaster-resilient designs that can withstand high winds and seismic activity, ensuring power availability during landslides or extreme weather events. Through this approach, the research demonstrates that robust solar infrastructure can effectively support human survival in hilly areas while maintaining the integrity and ecological health of the mountainous landscape.

Keywords: Ecological Preservation, Hilly Ecosystems, Low-Impact Engineering, Renewable Energy, Sustainable Infrastructure, Disaster Resilience, Environmental Protection..

Climate-Responsive Renewable Energy Strategies to Reduce Ecological Vulnerability in Mountain Terrains

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ABSTRACT

Mountain terrains are among the most ecologically sensitive and climate-vulnerable regions, where fragile ecosystems, steep topography, and limited infrastructure intensify the impacts of climate change. Increasing temperature variability, erratic precipitation, glacial retreat, and extreme weather events are significantly affecting ecological stability and energy access in these regions. In this context, climate-responsive renewable energy strategies offer a sustainable pathway to reduce ecological vulnerability while ensuring energy security. This study explores adaptive renewable energy planning approaches tailored for mountain environments, focusing on the integration of localized climate data with energy system design. The research examines the suitability of decentralized renewable energy systems such as micro-hydropower, solar photovoltaic systems, wind microgrids, and hybrid energy configurations under varying climatic conditions. It further evaluates how climate-resilient energy infrastructure can minimize environmental degradation, reduce dependence on fossil fuels, and enhance community resilience. The analysis highlights that adaptive energy systems designed with consideration of seasonal variability, terrain constraints, and resource availability can significantly improve energy reliability while preserving ecological balance. The findings emphasize the importance of combining climate modeling, geospatial assessment, and community-based planning to optimize renewable energy deployment in mountain regions. Additionally, policy frameworks supporting decentralized energy governance and climate adaptation are identified as critical enablers for sustainable implementation. The study concludes that climate-responsive renewable energy strategies not only mitigate ecological vulnerability but also promote sustainable development, energy equity, and long-term resilience in mountainous terrains facing accelerating climate risks.

Keywords: Climate-Responsive Energy; Mountain Ecosystems; Renewable Energy Systems; Ecological Vulnerability; Microgrids; Climate Adaptation.

Sustainable Biomass Energy Conversion: A Strategy for Waste Management and Energy Security in Hilly Ecosystems

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ABSTRACT

Hilly regions often face significant challenges in managing organic and solid waste due to limited land availability and difficult geographical terrain. Improper disposal of waste in environmentally sensitive ecosystems contaminates water resources and accelerates ecological degradation. This study proposes decentralized biomass-based Waste-to-Energy (WtE) conversion systems as an effective solution for waste management and energy generation in mountain communities. The research investigates the feasibility of small-scale anaerobic digesters and biomass gasification units optimized for high-altitude environments. By converting agricultural residues, forest biomass, and organic waste into biogas, heat, and electricity, these systems support a circular energy economy while minimizing environmental impacts. The study further examines the role of automated monitoring and control systems in ensuring operational efficiency, environmental compliance, and safety. The findings demonstrate that biomass energy conversion can reduce greenhouse gas emissions, enhance local energy independence, improve resilience, and contribute to long-term sustainable development and energy security in hilly ecosystems.

Keywords: Biomass Energy; Waste-to-Energy; Hilly Ecosystems; Circular Economy; Sustainable Infrastructure; Localized Micro-grids; Environmental Safety.

Adverse Environmental Effects of Hill Mining: Stability Analysis, Parameter Estimation, and Numerical Simulation

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ABSTRACT

Hill mining significantly alters fragile mountain ecosystems through deforestation, accelerated soil erosion, hydrological disruption, biodiversity loss, and environmental pollution. This paper develops a coupled nonlinear mathematical model describing interactions among forest cover, soil quality, water quality, biodiversity, and mining intensity. Equilibrium solutions, local stability conditions, and sensitivity analyses are derived. Parameters are estimated using environmental indicators reported in mining regions worldwide. Numerical simulations demonstrate that increasing mining intensity drives the system toward ecological degradation, whereas reclamation and afforestation programs improve long-term sustainability. An Environmental Sustainability Index (ESI) is proposed to quantify ecosystem health and evaluate management **strategies.**

Keywords: Hill mining, ecological degradation, mathematical ecology, stability analysis, environmental modeling, sustainability index.

Tele Connection Impacts on Temperature and Rainfall in Kashmir (1982–2024)

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ABSTRACT

This study investigates the influence of the North Atlantic Oscillation (NAO) on local climate variability across four stations in the Kashmir region—Gulmarg, Jammu, Qazigund, and Srinagar—using monthly and annual datasets spanning 1982–2024.Wavelet coherence analysis combined with Kendall tau correlations was applied to maximum temperature, minimum temperature, rainfall, and Srinagar mean sea level pressure (MSLP) to assess both strength and phase relationships with NAO(Northern Atlantic Oscillation)which strongly affects western Himalayan climate, especially during winters. Results reveal that NAO's dominance is concentrated at the annual cycle (12-month period) within the monthly data, where phase arrows consistently cluster.Across all stations, the prevailing phase relationship is ↓ (Variable leads NAO), indicating that local climate variables tend to precede NAO signals by approximately 90°.Anti-phase (←) relationships are the second most frequent, while in-phase (→) and NAO-leading (↑) occurrences are rare.

Gulmarg and Srinagar rainfall show the clearest lagged dominance, while Jammu and Srinagar temperatures exhibit strong lead relationships. Srinagar MSLP further confirms this lead tendency, reinforcing the view that local pressure anomalies anticipate NAO variability. Annual-scale correlations are weak, confirming that NAO's signal is smoothed out when aggregated yearly.Overall, the findings highlight that NAO's influence in Kashmir is most visible in monthly data at the annual cycle frequency, but the local climate often anticipates NAO variability rather than responding synchronously. This suggests a complex lagged coupling between regional climate processes and large-scale atmospheric circulation, with implications for seasonal forecasting and climate impact assessments in the western Himalayas.

Keywords: Northern Atlantic Oscillation; Rainfall; Kashmir.

Integrating Sustainable and Renewable Energy Solutions for Enhancing Biodiversity Conservation in Mountain Terrains

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ABSTRACT

Mountain terrains represent some of Earth's most ecologically sensitive and biodiversity-rich zones, yet they remain disproportionately vulnerable to the compounding pressures of climate change, habitat degradation, and unsustainable energy practices. This paper examines the synergistic potential of integrating sustainable and renewable energy solutions—including solar photovoltaic microgrids, micro-hydropower systems, and wind energy installations—within mountain conservation frameworks to simultaneously reduce carbon footprints and strengthen biodiversity outcomes. Drawing on case studies from high-altitude ecosystems across the Himalayas, Andes, and Alpine regions, the study evaluates how decentralized clean energy infrastructure can replace fossil fuel dependency in remote communities while minimizing ecological disruption to sensitive habitats. The research employs a mixed-methods approach combining geospatial analysis, ecological impact assessments, and stakeholder consultation to identify optimal energy deployment zones that avoid critical wildlife corridors and nesting grounds. Findings indicate that carefully planned renewable energy systems, when co-designed with local communities and conservation bodies, can reduce habitat fragmentation, lower anthropogenic pressure on forest resources, and support the long-term viability of endemic and migratory species. The paper further proposes a policy framework that aligns renewable energy targets with biodiversity conservation goals through adaptive land-use planning and environmental safeguards. This research contributes to the growing discourse on nature-positive energy transitions and offers replicable models for mountain nations pursuing dual mandates of sustainable development and ecological preservation.

Keywords: Renewable Energy Integration, Biodiversity Conservation, Mountain Ecosystems, Decentralized Energy Systems, Habitat Fragmentation, Sustainable Development.

Impact of Climate Change on Water Security and Renewable Energy Potential in Hill Ecosystems Assessment

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ABSTRACT

Hill ecosystems are very vulnerable to climate variability and responsible for maintaining water resources and generation of renewable energy. The water security and energy sustainability of mountainous regions are also facing challenges due to climate change, which includes the rise in temperature, changes in precipitation and more frequent and extreme weather events. The present study evaluates the effect of climate change on water availability and renewable energy potential in hill ecosystems by integrating the hydrological and climatic parameters. The study focuses on rainfall distribution, stream flow patterns, glacier and snow melt contribution and groundwater recharge, which directly affect water security for domestic, agricultural, and ecological purposes. Moreover, the study assesses the impact of these changes on renewable energy sources, such as hydropower, solar and wind energy systems, which are increasingly being used in mountainous regions. The results suggest that the impact of climate change on hydrological cycles can impact the availability of water resources and the capacity to produce hydropower, and that shifts in climate can impact the efficiency and productivity of technologies such as solar and wind energy. The results emphasize the importance of adaptive water resource management, climate-resilient infrastructure, and diversified renewable energy strategies for sustainable development in hill areas. The study helps to deepen the understanding of the complex inter linkages between climate change, water security and renewable energy development, and thus offers valuable insights for policy makers, planners and decision makers engaged in sustainable mountain development and climate adaptation projects.

Keywords: Climate Change, Water Security, Hill Ecosystems, Renewable Energy, Hydropower, Sustainable Development.

Importance of the Aravalli Hills and their Environmental & Global Significance

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ABSTRACT

The Aravalli Range is part of an ecologically and geologically valuable and vital strategic asset of global significance as one of the oldest fold mountain range in the world with high environmental, scientific and socio-economic values. The Aravalli region has significant scientific importance for its Precambrian geological features, mineral resources, ecosystem dynamics, climate adaptation and sustainable land management. The hills are rich in minerals and other natural resources, which play an important role in the production of industries, infrastructure and the economic development of the region. Intertwined with this, however, has been rapid urbanization, illegal mining, deforestation, land-use and land-cover (LULC) changes and escalating anthropogenic pressures in recent years which have led to serious ecological degradation. Deforestation and habitat fragmentation have contributed to desertification, to the loss of carbon storage capacity and have led to higher levels of particulate matter in the atmosphere, impacting both environmental quality and public health. In terms of the global consequences, the degradation of the ecosystem of the Aravallis would indirectly be linked to climate change in the form of reduction in carbon sequestration potential and increase in the Green House Gases emitted due to land degradation. In addition, regional and global markets are affected by the agricultural, water, supply chain, mineral-based industries, and sustainable economic development, which can be influenced by environmental instability within the region.Modern scientific tools such as Geographic Information Systems (GIS), Remote Sensing (RS), Environmental Impact Assessment (EIA), and climate modeling have highlighted the urgent need for ecological restoration and sustainable resource management. Therefore, integrated conservation strategies, afforestation programs, biodiversity protection, and strict environmental governance are essential to restore ecosystem functionality and strengthen climate resilience. Protecting the Aravalli Hills is crucial not only for regional environmental sustainability but also for supporting global climate goals, ecological security, and long-term economic stability.

Keywords: Aravalli Hills, Ecosystem Services, Carbon Sequestration, Climate Change, Desertification, Biodiversity Conservation, Land Use Land Cover (LULC), Remote Sensing, GIS, Ecological Restoration, Environmental Sustainability, Global Market Impact.

Rooftop Solar Power: A Lifeline for Himalayan Homes

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ABSTRACT

The Himalayan region presents a challenging reality for mountain communities, rather than the peaceful, environmentally pure existence often imagined. A serious problem is access to reliable energy because of frequent power outages, a difficult transport system, and harsh climate conditions. In many far-flung Himalayan villages homes experience power cuts for hours on a daily basis. The high price and unpredictable supply of LPG cylinders mean that a large percentage of families continue to use firewood for cooking and heating. Poor ventilation in homes produces smoke, leading to severe indoor air pollution, resulting in respiratory and eye-related diseases, particularly among women and children.

In natural disasters such as floods, landslides, earthquakes, avalanches, and heavy snowfall, the situation becomes more critical. These disasters often take out electricity transmission systems, leaving entire regions without power for extended periods. The recent events in Kedarnath, Joshimath, and Lahaul proved that homes with rooftop solar systems can maintain essential electricity services during emergencies. This study looks at rooftop solar power as a sustainable, health-conscious, and disaster-resilient option for the Himalayan communities. The paper also reviews the existing government initiatives and supplies policy recommendations for the regions to improve the adoption of solar energy in the mountains.

Keywords: Rooftop Solar Energy, Himalayan Villages, Disaster Resilience, Indoor Air Pollution, Renewable Energy, PM-Surya Ghar Yojana.

A Decision-Support Framework for Pine Needle Mycoremediation and Disaster Mitigation in the Himalayas

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ABSTRACT

The forests of the Indian Himalayan Region are caught in a destructive cycle. Each year, a thick layer of lignin rich Chir pine needles accumulates on the forest floor. Decomposing slowly but burning readily, these needles cause annual forest fires leaving behind bare hydrophobic soils, incapable of absorbing the upcoming monsoon rainfall, producing intense surface runoff and landslides that damage terraced farmland. Although research has demonstrated the use of native white-rot fungi to break down pine needle lignin efficiently, translation of this knowledge on ground remains very limited. The problem is logistical: transporting bulky, low-density biomass across steep slopes to a centralized processing facility remains costly and impractical for scattered mountain settlements. What the Himalayas require are decentralized, Nature-Based Solutions (NbS).

This paper proposes a locally adaptable DSF that enables rural forest managers to route collected pine needles into one of two valorization pathways based on specific conditions of their site. The framework directs needles into low-oxygen trench kilns to produce biochar on slopes with active erosion. When applied along terrace margins, this biochar enhances shear soil strength and improves moisture retention. In communities facing winter energy shortage, the framework routes needles through a fungal pre-treatment using local white-rot species, followed by pressing into dense bio-briquettes for off-grid cooking and heating. The DSF turns a chronic wildlife hazard into a locally managed resource, linking lab validated mycoremediation with real constraints of Himalayan agroecosystems.

Keywords: Pine Needle Valorization, Translational Gap, Decision Support Framework, Mycoremediation, Biochar, Disaster Risk Reduction.

The Role of Renewable Energy in Climate Change Mitigation

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ABSTRACT

Biodiesel production has received considerable attention in the recent past as biodegradable and non-polluting fuel. Substituting petro-diesel with biodiesel may reduce air emission, increase the domestic supply of fuel, and create new market for agriculture. An alternative approach would be one focus on multi-purpose; short-duration annual crops that can either simultaneously yield fuel along with food/fodder or can be cultivated in rotation with food crops, so that there are a lot of opportunities for small formers. The central policy of biodiesel concerns for creation and protection of environment. The economic benefits include support to the agriculture sector tremendous employment opportunities in plantation and processing. Biodiesel fuel plays an important role for the replacement of petro-diesel to eco-friendly fuel. Various studies showed that pollutants like CO, CO_2, SO_X, HC, PAH, PM etc., can be reduced by using blended and pure biodiesel. NO_X emissions are increased by using biodiesel. Biodiesel is an environment friendly biofuel since it provides a means to recycle of CO_2, biodiesel does not contribute global warming. Biodiesel is produced from various plant oils like Jatropha oil, Cottonseed oil, Pongania oil, Palm oils, Rapeseed oil, Castor oil and sorghum oil converted to biodiesel through the process of transesterification. This study is initiated to investigate the potential of jatropha oil as source of biodiesel. This review paper describes the production of biofuel, its properties, agricultural benefits, eco-friendly, recycle of $CO_2$and reduce greenhouse gases future potential of biodiesel.

Keywords: Renewable Energy, Agriculture benefit, Jatropha, Transesterification, Eco-friendly.

Renewable Energy – Powering a Safer and Prosperous Future

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ABSTRACT

Energy production and consumption are closely linked to global climate change, as the majority of greenhouse gas emissions originate from the combustion of fossil fuels for electricity generation, transportation, industrial operations, and heating requirements. The energy sector continues to be one of the most significant contributors to atmospheric carbon emissions, intensifying global warming and environmental degradation. In recent years, increasing carbon emissions in mountain and hill ecosystems have emerged as an additional concern. Expanding infrastructure, deforestation, tourism-related activities, and the growing use of fossil-fuel-based transportation in hilly regions are accelerating environmental degradation and disrupting fragile mountain climates. These changes contribute to altered precipitation patterns, glacier retreat, biodiversity loss, and increased vulnerability to natural hazards. Scientific assessments indicate that substantial reductions in greenhouse gas emissions are necessary to limit the adverse impacts of climate change. To achieve international climate targets, global emissions must decline significantly by 2030 and reach net-zero levels by the middle of the century. The transition from conventional fossil-fuel-based energy systems to renewable and sustainable alternatives has therefore become a global priority.

Renewable energy resources such as solar radiation, wind power, hydropower, biomass, and geothermal energy are naturally replenished and generate minimal environmental pollution during operation. These resources offer a viable pathway toward reducing carbon footprints while ensuring long-term energy security and economic sustainability. Recent developments demonstrate remarkable growth in renewable energy deployment worldwide, driven by technological advancements, supportive policies, and increasing environmental awareness. This study emphasizes the crucial role of renewable energy in mitigating climate change, reducing carbon emissions in both urban and mountain environments, and supporting sustainable development. Accelerating investments in clean energy infrastructure and innovation is essential for creating a resilient, low-carbon future that benefits present and future generations while preserving ecological balance and environmental stability

Keywords: Renewable Energy, Carbon Emissions, Mountain Ecosystems, Climate Change, Sustainable Development, Clean Energy Transition, Environmental Sustainability, Energy Security, Low-Carbon Economy,

Solar Paint: The Future of Ecofriendly and Economically Renewable Energy

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ABSTRACT

Solar paint also referred to as photovoltaic or photoactive paint is an emerging technology engineered to efficiently convert sunlight into electricity. Utilizing advanced nanomaterial, semiconductors, and conductive polymers, solar paint solution provides a low-cost, flexible, and highly scalable method for energy generation. These innovative coatings can be applied to various surfaces, transforming walls, roofs, and even vehicles into active power-generating systems. While the solar paint technology demonstrates immense potential due to its adaptability and economic manufacturing profile, improving its power conversion efficiency remains a critical challenge, requiring further research into optimal material compositions. This study explores the fundamental principles of solar energy conversion, examines the roles of nanomaterial and photoactive layers, and evaluates methods for fabricating and assessing the performance of solar paints. The primary objective of this research is to identify and develop optimal paint materials capable of delivering higher electrical and thermal conductivities alongside improved overall efficiency.

Keyword: Solar Paint, Nanomaterial, Semiconductor, Ecofriendly, Economically.

Design of Extensions of Solar Plates for Maximum Utilization of Energy in Hills Area through Means of Mechanical Mechanism

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ABSTRACT

Solar panel is a device for conversion of sun's radiant energy into electric energy by the help of photovoltaic cells. As it is easy in plane area because a single solar roof plate requires four poles which is quite easy. But in hilly area's or where there is shortages of plane space this design of extensions of solar plates for maximum Utilization of Energy in hills area through means of Mechanical mechanism is fruitful because solar panel is based on only two pole and the solar plates (can be 2to 4)can be extended in trolley form one over another at same two poles .this will be done by the help of slider-crank mechanism where crank will revolve with the help of stepper motor in long span of time in both clockwise and anticlock wise direction and solar plates are attached to a fixed solar plate at the bottom through trolley and top most solar plate is connected to slider which will move in forward direction causing extension of solar plates and backward direction motion of solar plate will cause contraction of all plates to the same position as that of fixed solar plate . All this arrangement will be tiled at 450 angle to the reference plane in order to avail maximum sun's radiation on the solar plates. solar plates will convert sun's energy into electricity which will be received by lead acid battery through AC-DC Converter. Thus we can use maximum electrify at mountain or hilly area's also with the help of this design.

Key words: Solar Plates, Slider-crank Mechanism, stepper motor, Battery, Inverter, lead-caid battery, AC-DC converter.

Circular Economy the Technology for Environmental Sustenance in Hills

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ABSTRACT

Hill ecosystems represent some of the most ecologically sensitive and resource-constrained environments on Earth. Traditional linear economic models—extracting, consuming, and discarding — have accelerated soil degradation, deforestation, and water scarcity across mountainous regions. The circular economy offers a transformative paradigm, wherein waste is minimized, resources are cyclically regenerated, and ecological integrity is preserved through purposeful technological intervention. This paper examines how circular economy principles, enabled by emerging and appropriate technologies, can ensure environmental sustenance in hill communities. Key technologies explored include biomass-to-energy conversion systems that repurpose agricultural and forest residues, closed-loop water harvesting and grey-water recycling infrastructure suited to terrain-specific hydrology, and precision agro-forestry platforms leveraging IoT sensors and remote sensing to optimize land use without compromising biodiversity. Additionally, community-based composting and bio-digesters are assessed as tools for converting organic waste into soil amendments, restoring degraded hill slopes. The paper further highlights digital traceability systems that enable local circular supply chains for artisanal and forest-based products, reducing resource leakage from hill economies. Social co-design and indigenous knowledge integration are identified as critical enablers; ensuring technological solutions remain contextually appropriate and community-owned.

Findings suggest that a technology-mediated circular economy framework, when aligned with local ecological knowledge and governance structures, can significantly reduce environmental pressure in hill regions while generating livelihood resilience. This study contributes to the growing discourse on sustainable mountain development and advocates for policy frameworks that incentivize circular transitions in fragile highland ecosystems.

Keywords: Circular Economy, Hill Ecosystems, Environmental Sustenance, Sustainable Technology, Mountain Development, Resource Regeneration

Impact of Hilly Terrain on Solar Energy Generation and Techno-Economic Optimization of Hybrid Renewable Energy Systems in Jhansi, India

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ABSTRACT

Rapid growth in electricity demand and increasing environmental concerns has accelerated the adoption of renewable energy technologies across India. The Bundelkhand region, particularly the hilly and undulating terrain surrounding Jhansi, presents both opportunities and operational challenges for solar energy utilization. Variations in elevation, slope orientation, seasonal shading, dust accumulation, and micro-climatic conditions significantly influence photovoltaic (PV) power output and overall system performance. Therefore, the development of an optimized hybrid renewable energy system becomes essential for ensuring reliable and sustainable electricity supply in such geographically complex areas. The present investigation evaluates the techno-economic feasibility and performance optimization of hybrid solar-based energy systems for the hilly regions of Jhansi using the Hybrid Optimization Model for Electric Renewables (HOMER) software platform. Several configurations comprising solar photovoltaic arrays, wind turbines, biomass generators, battery storage systems, and grid connectivity were assessed under varying load and climatic conditions. The analysis aimed to identify the most cost-effective and energy-efficient systems capable of maintaining supply reliability while reducing dependence on conventional fossil-fuel-based generation.

Simulation results indicate that hybrid combinations, particularly PV–Biomass and PV–Wind integrated systems, exhibit superior performance compared with standalone solar installations. The inclusion of complementary renewable resources compensates for fluctuations caused by terrain-induced shading and seasonal solar variability. Furthermore, the optimized systems demonstrate reduced carbon emissions, improved energy security, lower lifecycle operating costs, and enhanced resilience against climatic uncertainties. The study also reveals that careful consideration of hill slope characteristics and solar resource distribution can substantially improve annual energy generation. The outcomes of this research provide valuable guidance for planners, researchers, and policy makers seeking sustainable electrification solutions in topographically challenging regions. The findings highlight the critical role of hybrid renewable energy systems in supporting climate-change mitigation, rural development, and long-term energy sustainability in Jhansi and similar hilly landscapes throughout India.

Keywords: Hybrid Renewable Energy System, Solar Photovoltaic, Hilly Terrain, HOMER Optimization, Wind Energy.

Performance Optimization of Solar PV Systems Through Intelligent Control and Monitoring

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ABSTRACT

Solar energy is one of the most promising renewable energy sources for meeting the growing global energy demand. However, the efficiency of solar photovoltaic (PV) panels is significantly affected by environmental factors such as solar irradiance, temperature variations, dust accumulation, and load fluctuations. This study focuses on improving solar panel efficiency through the implementation of an intelligent control panel system. The proposed control panel continuously monitors key operating parameters, including voltage, current, power output, battery status, and environmental conditions. Based on real-time data, the system optimizes power extraction and distribution using advanced control techniques such as Maximum Power Point Tracking (MPPT) and automated load management. The control panel also provides protection against overvoltage, over current, and system faults, thereby enhancing reliability and operational safety. Experimental observations indicate that the integration of a smart control panel can increase overall energy harvesting efficiency, reduce power losses, and improve system performance under varying environmental conditions. The proposed approach offers a cost-effective and sustainable solution for maximizing solar energy utilization in residential, commercial, and industrial applications.

Keywords: Solar PV, Solar Panel Efficiency, Intelligent Control Panel, MPPT, Energy Management, Power Optimization, Renewable Energy, Real-Time Monitoring.

2 HILL ECOLOGY, BIODIVERSITY CONSERVATION, AND WATER SECURITY

- Sustainable Ecosystem Restoration Strategies in the Aravalli Hills- Hill Ecology, Biodiversity Conservation, and Water Security
- Water Conservation and Security in Indian States: Challenges, Governance, and Pathways to 2047
- Development and Mechanical Performance of Hemp–Water Hyacinth Reinforced Hybrid Composites for Hill Ecosystem Applications
- Enhancing Human Resilience Through Sustainable Management of Hill Ecosystems
- Hill Ecosystem and Human Survival: Environmental Challenges, Disaster Risks, and Sustainable Development Approaches
- Zero-Waste Natural Fibre Geotextile System: For Erosion Control, Slope Stability, Watershed Conservation, and Water Security in Himalayan Hill Slopes
- "Effect of Thermal Pollution on Hills"
- Conserving Hill Ecology for Sustainable Biodiversity and Water Resource Management
- Computing Resilience: Safeguarding Hill Ecosystems and Human Lives
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- Mathematical Modeling of Socio-Environmental Collapse due to Hill
- The Himalayan Exodus: Climate Change and the Fragile Future of Uttarakhand's Hill Regions

Sustainable Ecosystem Restoration Strategies in the Aravalli Hills- Hill Ecology, Biodiversity Conservation, and Water Security

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ABSTRACT

The Aravalli Hills represent one of the oldest mountain systems in the world and play a significant role in maintaining ecological balance, biodiversity conservation, and water security in northwestern India. The Aravalli region functions as a natural ecological barrier against desert expansion, supports diverse flora and fauna, regulates local climate, and contributes substantially to groundwater recharge and watershed sustainability. However, rapid urbanization, illegal mining, deforestation, overgrazing, land degradation, and climate change have severely affected the ecological stability of the region. These environmental pressures have resulted in biodiversity loss, soil erosion, depletion of water resources, habitat fragmentation, and declining ecosystem resilience. This study highlights the importance of integrated ecosystem restoration and sustainable environmental management for conserving the fragile ecology of the Aravalli Hills. The paper examines the relationship between biodiversity conservation, watershed protection, and water security while emphasizing the need for ecological restoration through afforestation, revival of traditional water harvesting systems, soil conservation, and sustainable land-use planning. The study also discusses the role of local communities, policy interventions, scientific monitoring, and climate-resilient development strategies in restoring ecological balance.

The research emphasizes that conservation of the Aravalli ecosystem is essential not only for protecting biodiversity but also for ensuring long-term water security, climate adaptation, and sustainable socio-economic development. Strengthening ecological governance and adopting integrated watershed management practices can significantly improve environmental sustainability and resilience in the Aravalli region. The study concludes that coordinated conservation efforts, supported by scientific planning and community participation, are necessary to restore the ecological integrity and hydrological stability of the Aravalli Hills for future generations.

Keywords: Aravalli Hills, ecological balance, biodiversity conservation, biodiversity conservation, climate-resilient, sustainable environmental, hydrological stability.

Water Conservation and Security in Indian States: Challenges, Governance, and Pathways to 2047

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ABSTRACT

India holds 18% of global population but only 4% of freshwater resources, making water security a critical constraint for SDG 6 and national development. Groundwater depletion, river pollution, and climate variability threaten 600 million Indians facing high-to-extreme water stress. This paper reviews literature 2005-2024 on water governance in Indian states, analyzes NITI Aayog Composite Water Management Index data, and examines central + state policy interventions. Findings show Gujarat, MP, and Andhra Pradesh lead in water governance, while Punjab, Haryana, and Rajasthan face severe groundwater crisis. Central schemes like Jal Jeevan Mission JJM + state programs like Jalyukt Shivar Maharashtra and Mukhyamantri Jal Swavlamban Rajasthan have improved outcomes, but implementation gaps persist. Future prospects depend on demand management, watershed restoration, water-energy-food nexus, and climate adaptation. The paper argues for shifting from "supply augmentation" to "water accounting + decentralized governance".

Keywords: Water Security, Water Conservation, Indian States, Groundwater, Jal Jeevan Mission, NITI Aayog.

Development and Mechanical Performance of Hemp–Water Hyacinth Reinforced Hybrid Composites for Hill Ecosystem Applications

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ABSTRACT

The growing awareness of environmental issues related to synthetic composite materials has led to a demand for sustainable and biodegradable alternatives. This study focuses on developing and characterizing hemp and water hyacinth reinforced hybrid composites for use in fragile hill and Himalayan ecosystems. Hemp fiber is a strong and stiff material, while water hyacinth, an invasive aquatic plant, offers lightweight reinforcement and benefits the environment by reducing waste. These hill ecosystems have unique challenges, including significant seasonal temperature changes, high humidity, difficult terrain, and ecological sensitivity. This situation requires eco-friendly and durable structural solutions. Additionally, using local biomass and removing invasive species can help decrease environmental damage and promote the circular economy in remote mountain communities with limited transportation and resources. Hybrid composite laminates were made with epoxy resin as the matrix using the hand lay-up compression molding technique. We evaluated the physical and mechanical performance of the composites through water absorption and impact tests based on ASTM standards. The results showed that the hybrid combination of hemp and water hyacinth fibers performed better than single-fiber composites. Composites with more hemp showed improved impact resistance and energy absorption, while water hyacinth helped reduce weight, manage moisture, and support sustainability.

The hybrid natural fiber composites show strong resistance to humidity, temperature changes, and sudden loads. This makes them ideal for rural housing, interior panels, furniture, and insulation in sensitive hill and Himalayan regions. Their lightweight design and effective thermal insulation help keep indoor spaces comfortable in cold mountainous climates by shielding against harsh weather. Using natural fibers and invasive plants lowers the carbon footprint of construction. It also supports environmental protection and sustainable resource use in hill communities. These composites offer durability, eco-friendliness, and solid performance, showing great promise as sustainable materials for infrastructure and housing in fragile ecosystems. The study emphasizes how fiber hybrid composites can aid environmental protection, resource sustainability, and better living conditions in mountainous areas using renewable and locally sourced materials.

Keywords: Natural Fiber Composite, Hemp Fiber, Water Hyacinth Fiber, Hybrid Composite, Mechanical Characterization, Sustainable Materials, Hill Ecosystem, Himalayan Region.

Enhancing Human Resilience Through Sustainable Management of Hill Ecosystems

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ABSTRACT

Hill ecosystems are critical components of the global environment, providing essential ecosystem services that support human well-being and resilience. These ecosystems regulate water resources, conserve biodiversity, maintain soil fertility, sequester carbon, and sustain the livelihoods of millions of people living in both upland and downstream regions. However, increasing pressures from climate change, deforestation, land-use change, unplanned urbanization, unsustainable agricultural practices, and expanding tourism have accelerated the degradation of hill ecosystems, thereby increasing the vulnerability of local communities to environmental and socio-economic risks.

Keywords: Hill Ecosystems; Ecosystem Services; Human Resilience, Artificial Intelligence, Internet of Things (IoT), Geographic Information Systems (GIS), Remote Sensing, Disaster Risk Reduction, Environmental Monitoring, Climate Change Adaptation, Sustainable Development.

Hill Ecosystem and Human Survival: Environmental Challenges, Disaster Risks, and Sustainable Development Approaches

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ABSTRACT

Hill ecosystems are among the most fragile and ecologically significant ecosystems on Earth. They support biodiversity, regulate climate, conserve water resources, and provide livelihoods to millions of people. The Hill ecosystem, often called the "Third Pole," is one of the most important mountain ecosystems globally because it contains extensive glacier reserves and supports major river systems of South Asia. However, rapid deforestation, climate change, biodiversity loss, unplanned urbanization, and increasing natural disasters are threatening both ecological balance and human survival in hill regions.

This research explores the ecological significance of hill ecosystems, and analyzes major environmental challenges affecting these regions. The research also highlights disaster risks such as landslides, flash floods, glacier lake outburst floods, and earthquakes. Human dependence on hill ecosystems for agriculture, tourism, hydropower, forest resources, and freshwater is explored in detail. The research further points out sustainable development strategies including afforestation, eco-tourism, renewable energy, disaster preparedness, climate adaptation, biodiversity conservation, and community participation. The study concludes that sustainable and scientifically planned development is essential for protecting hill ecosystems and ensuring long-term human survival.

Keywords: Hill ecosystem, climate change, biodiversity, sustainable development, disaster management, human survival, eco-tourism, renewable energy.

Zero-Waste Natural Fibre Geotextile System: For Erosion Control, Slope Stability, Watershed Conservation, and Water Security in Himalayan Hill Slopes

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ABSTRACT

Hill and mountain regions function as the ecological backbone of the planet, regulating climate, conserving biodiversity, sustaining water resources, and supporting millions of livelihoods. However, these fragile ecosystems face escalating pressures from climate change, unplanned development, and recurring natural hazards. This review paper proposes a zero-waste natural fibre geotextile system that integrates circular economy principles with traditional Himalayan water conservation practices to address soil erosion, water scarcity, and ecosystem degradation simultaneously. The framework synthesizes existing literature on natural fibre geotextiles (jute, hemp, coir, bamboo), biochar amendment, mycorrhizal fungi, and traditional water harvesting systems (jihads, kuhls, terrace farming) into a unified, community-driven approach. Unlike previous studies that address erosion control and water conservation separately, the proposed framework integrates biodegradable geotextiles with traditional Himalayan watershed management systems to create a synergistic and sustainable solution. This paper identifies a critical research gap: existing studies focus either on natural fiber geotextiles or on traditional watershed management, with limited literature on integrating circular-economy-based waste fiber geotextiles with traditional Himalayan water conservation systems. The proposed framework bridges this gap through a closed-loop, nature-based system in which waste natural fibres are upcycled into geotextile mats that enhance slope stability, improve water retention, enrich soil fertility, promote vegetation growth, and support spring recharge. The system aligns with six United Nations Sustainable Development Goals (SDG_s 1, 6, 11, 12, 13, 15) and offers a scalable, low-cost, community-centric solution for Himalayan hill ecosystems. Future research should focus on field-scale validation and advanced monitoring approaches to evaluate long-term environmental and hydrological benefits.

Keywords: Natural fiber geotextiles, circular economy, Himalayan watershed management, erosion control, biochar, mycorrhizal fungi, traditional water harvesting systems, spring recharge, sustainable mountain development.

"Effect of Thermal Pollution on Hills"

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ABSTRACT

Hill ecosystems are among the most fragile and ecologically significant ecosystems on Earth. They support biodiversity, regulate climate, conserve water resources, and provide livelihoods to millions of people. The Hill ecosystem, often called the "Third Pole," is one of the most important mountain ecosystems globally because it contains extensive glacier reserves and supports major river systems of South Asia. However, rapid deforestation, climate change, biodiversity loss, unplanned urbanization, and increasing natural disasters are threatening both ecological balance and human survival in hill regions.

This research explores the ecological significance of hill ecosystems, and analyzes major environmental challenges affecting these regions. The research also highlights disaster risks such as landslides, flash floods, glacier lake outburst floods, and earthquakes. Human dependence on hill ecosystems for agriculture, tourism, hydropower, forest resources, and freshwater is explored in detail. The research further points out sustainable development strategies including afforestation, eco-tourism, renewable energy, disaster preparedness, climate adaptation, biodiversity conservation, and community participation. The study concludes that sustainable and scientifically planned development is essential for protecting hill ecosystems and ensuring long-term human survival.

Keywords: Hill ecosystem, climate change, biodiversity, sustainable development, disaster management, human survival, eco-tourism, renewable energy.

Conserving Hill Ecology for Sustainable Biodiversity and Water Resource Management

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ABSTRACT

Hill ecosystems are among the most valuable natural landscapes, providing critical ecological services that support biodiversity conservation, climate regulation, and freshwater availability. These regions serve as important reservoirs of biological diversity and act as natural water towers, supplying water to millions of people living in both upland and downstream areas. However, rapid population growth, deforestation, infrastructure development, unsustainable agricultural practices, and the growing impacts of climate change have placed immense pressure on hill environments. Such disturbances have resulted in habitat fragmentation, loss of native species, increased soil erosion, reduced groundwater recharge, and declining water quality and quantity. This paper explores the intricate relationship between hill ecology, biodiversity conservation, and water security, highlighting their collective significance in achieving environmental sustainability and socio-economic resilience. The study examines how healthy hill ecosystems contribute to watershed protection, maintenance of hydrological cycles, carbon sequestration, and the conservation of diverse plant and animal species. It further investigates the consequences of ecological degradation on water resources and the livelihoods of communities that depend on these ecosystems for agriculture, domestic use, and economic activities.

The paper emphasizes the need for integrated and adaptive management approaches that combine ecological restoration, biodiversity conservation, sustainable land-use planning, afforestation, and community participation. It also discusses the role of policy frameworks, scientific research, and traditional ecological knowledge in addressing emerging environmental challenges. By strengthening ecosystem resilience and promoting sustainable resource management, biodiversity conservation can significantly enhance long-term water security in hill regions. The study concludes that a holistic and interdisciplinary approach is essential for protecting hill ecosystems, conserving biodiversity, and ensuring reliable water resources for present and future generations. Such efforts are fundamental to achieving sustainable development goals and fostering ecological stability in mountain and hill landscapes worldwide.

Keywords: Hill Ecology, Biodiversity Conservation, Water Security, Watershed Management, Climate Change, Sustainable Development, Ecosystem Restoration.

Computing Resilience: Safeguarding Hill Ecosystems and Human Lives

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ABSTRACT

Hill ecosystems are among the most environmentally sensitive regions, facing increasing threats from climate change, deforestation, landslides, soil erosion, biodiversity loss, and unplanned urban development. These challenges not only degrade ecological balance but also endanger the livelihoods and safety of communities residing in mountainous areas. Recent advancements in computing technologies provide transformative opportunities to strengthen the resilience of these vulnerable landscapes through intelligent monitoring, predictive analysis, and data-driven decision-making. This study explores the integration of artificial intelligence, the Internet of Things (IoT), remote sensing, geographic information systems (GIS), cloud computing, and big data analytics to develop a comprehensive framework for safeguarding hill ecosystems and human lives. We want to analyze techniques thatemphasizes real-time environmental monitoring, early warning systems for natural hazards, sustainable resource management, and community-centric disaster preparedness. Machine learning models can analyze multi-source environmental data to predict landslides, flash floods, and forest degradation with improved accuracy, while edge and cloud computing infrastructures enable rapid processing and dissemination of critical information to authorities and local populations. Furthermore, the framework supports biodiversity conservation, sustainable tourism planning, and climate adaptation strategies by facilitating evidence-based policy formulation. By combining ecological intelligence with modern computational techniques, the study demonstrates how digital technologies can enhance environmental resilience while reducing disaster risks and promoting sustainable development in hill regions. The findings highlight the importance of interdisciplinary collaboration among environmental scientists, computer engineers, policymakers, and local communities to build adaptive, resilient, and technologically empowered mountain ecosystems capable of addressing present and future environmental challenges.

Keywords: Computing Resilience, Hill Ecosystems, Artificial Intelligence, Internet of Things (IoT), Geographic Information Systems (GIS), Remote Sensing, Disaster Risk Reduction, Environmental Monitoring, Climate Change Adaptation, Sustainable Development.

Green Supply Chain Management In Hills Ecosystem: A Study Of Sustainable Logistics And Environmental Development

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ABSTRACT

Green Supply Chain Management (GSCM) has become an important approach for achieving sustainable development in environmentally sensitive regions. Hill ecosystems face unique challenges such as poor transportation networks, deforestation, climate vulnerability, waste accumulation, and high logistics costs. This research paper examines the role of green supply chain management in promoting sustainable logistics and environmental conservation in hill regions. The study focuses on eco-friendly transportation, renewable energy integration, sustainable packaging, waste management, and local sourcing systems. Secondary data from journals, government reports, and previous research studies have been used for analysis. Case studies from Sikkim, Himachal Pradesh, and Uttarakhand are discussed to understand practical implementation of green logistics in mountainous areas. The findings indicate that green supply chains help reduce carbon emissions, improve rural livelihoods, minimize environmental degradation, and increase supply chain efficiency. However, challenges such as poor infrastructure, high implementation costs, and lack of awareness continue to hinder adoption. The paper concludes that government support, technological innovation, and community participation are essential for building sustainable green supply chain systems in hill ecosystems.

Keywords: Green Supply Chain Management, Hill Ecosystem, Sustainable Logistics, Renewable Energy, Eco-Friendly Transportation, Waste Management.

Mathematical Modeling of Socio-Environmental Collapse due to Hill

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ABSTRACT

Hill mining in the Bundelkhand region has emerged as a critical driver of economic activity, yet it simultaneously accelerates environmental degradation and social distress. This study presents a **quantitative and mathematical analysis** of mining impacts using real-world data and dynamic models. Air pollution levels in mining zones exceed safe limits, with Suspended Particulate Matter (SPM) reaching up to 541 $\mu g/m^3$, while nearly 68% of workers suffer from respiratory diseases, indicating severe public health consequences.

Mathematical formulations based on **exponential growth models** demonstrate that pollution levels increase rapidly with mining intensity, while **differential equations** reveal continuous depletion of groundwater resources. A **non-linear cost-benefit model** highlights that although economic gains initially rise, social and environmental costs grow at a faster rate, leading to a decline in overall societal welfare beyond an optimal mining threshold.

The study establishes that environmental quality decreases non-linearly, and health risks are directly proportional to pollution levels. These findings confirm that unregulated mining leads to a **mathematically unsustainable system**, where long-term losses outweigh short-term benefits. The paper concludes by recommending controlled mining strategies, rehabilitation functions, and policy interventions to achieve sustainable development in Bundelkhand.

Keyword : Extreme air pollution, Exponential growth model, Differential equations, Diminishing, Optimal mining level.

The Himalayan Exodus: Climate Change and the Fragile Future of Uttarakhand's Hill Regions

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ABSTRACT

The Indian Himalayan Region is warming at rates significantly higher than the global average. In Uttarakhand, this elevation-dependent warming is no longer a distant environmental projection; it is an active humanitarian crisis. Driven by a compounding cycle of glacial retreat, drying aquifers, and agricultural collapse, the state's mountain districts are witnessing an unprecedented demographic shift. This article examines the intersection of climate change and anthropogenic stress in Uttarakhand, exploring how ecological destabilisation is driving a massive demographic exodus, leaving behind hundreds of abandoned "ghost villages".

Keywords: Himalayan, Climate Change, Fragile, Uttarakhand.

3 CLIMATE CHANGE IMPACTS, LANDSLIDES, FLOODS, AND EARTHQUAKES

- Integrated Multi-Hazard Risk Assessment of Climate Change, Earthquakes, Landslides, and Flash Floods
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- Data-Driven Decision Making for Climate and Disaster Resilience: Frameworks, Models, and Evidence

Integrated Multi-Hazard Risk Assessment of Climate Change, Earthquakes, Landslides, and Flash Floods

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ABSTRACT

Mountain environments, especially those situated in the Himalayas, may be referred to as one of the environments, which is highly vulnerable to natural hazards occurrence. For instance, consequences of climate change have begun to show up in the last decades because of the temperature rise, the changes in the rainfalls, glaciers melting, and other weather conditions. Nevertheless, due to some peculiarities of the geological structure, the above-mentioned mountain range is highly vulnerable to earthquakes. Some kinds of natural hazards like climate change and earthquakes may provoke landslides and flash floods and thereby create problems for the sustainable development of the ecosystem in question.

This assignment is aimed at considering the connections between various types of natural hazards that can occur in a mountain environment. As it was indicated above, natural hazards do not appear on their own but affect one another in the result of which the population living in such environments becomes highly vulnerable. Besides landslides and flash floods, the impacts of natural hazard interdependence include, but are not limited to, the destruction of transport facilities, losses of human lives and livelihoods, pollution of natural resources and many more. In addition, one must take into account the requirement for applying a holistic approach when addressing the potential dangers of the aforementioned incidents. Furthermore, when speaking of disaster prevention strategies, one must mention that efficient governance and the adoption of evidence-based policies supported by scientific research may play an important role.

Keywords: Multi-Hazard Risk Assessment, Climate Change, Earthquakes, Landslides, Flash Floods, Community Resilience, Disaster Risk Reduction, Himalayan Ecosystems.

Himalayan Glacier Melting in a Changing Climate: Challenges for Human Systems and Sustainable Development

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ABSTRACT

The Himalayan region, known as the "Third Pole" is home to one of the largest freshwater reserves in the world outside of the Polar Regions. As global temperatures rise, glaciers in the Himalayas are retreating at an ever faster rate, with profound environmental, social and economic consequences. Glacier melt impacts water availability, agriculture productivity, hydropower generation, biodiversity, and disaster vulnerability in downstream areas. This paper reviews the link of climate change with the retreat of Himalayan glaciers and its implications for human systems and sustainable development. The study emphasizes major challenges including water insecurity; more frequent glacial lake outburst floods (GLOFs) and threats to livelihoods. Furthermore, it discusses adaptation and mitigation strategies that can enhance resilience and support sustainable development in the Himalayan region.

Keywords: Climate Change, Himalayan Glaciers, Glacier Retreat, Sustainable Development, Water Security

Big Data Analytics and Machine Learning for Climate Change Impact Assessment in Global Hills and Mountain Ecosystems

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ABSTRACT

Mountain and hill ecosystems are among the most climatically sensitive environments on Earth, yet they remain critically underrepresented in climate impact assessments due to their topographic complexity and sparse ground-based monitoring networks. This paper presents a comprehensive framework integrating Big Data Analytics and Machine Learning (ML) to assess climate change impacts across global mountain and hill ecosystems. Using multi-source heterogeneous datasets including satellite remote sensing (MODIS, Landsat), climate reanalysis products (ERA5), digital elevation models (SRTM), and IoTbased sensor networks, we apply an ensemble of ML algorithmsincluding Long Short-Term Memory (LSTM) networks, Random Forest, Convolutional Neural Networks (CNN), XGBoost, and Generative Adversarial Networks (GANs)to detect trends, predict hazards, and project future scenarios. Our results reveal significant warming trends (+1.8°C since 1980), accelerating glacial retreat (–24% areal coverage), increased frequency of extreme precipitation events (+38%), and expanding landslide susceptibility zones across the Hindu KushHimalaya, Andes, Alps, and Rocky Mountain ranges. The proposed framework achieves predictive accuracies of 87–96% across different hazard models. The paper argues for data-driven, ML-augmented climate governance frameworks that can enable community-resilient and policy-integrated disaster preparedness for vulnerable mountain populations globally.

Keywords: Big Data Analytics, Machine Learning, Climate Change, Mountain Ecosystems, Predictive Modeling, Remote Sensing, Disaster Preparedness, Random Forest

GIS-Based Landslide Susceptibility Mapping for Sustainable Infrastructure Development in Hill Regions

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ABSTRACT

Hill regions are highly vulnerable to landslides due to steep slopes, intense rainfall, seismic activities, and anthropogenic interventions such as road construction and deforestation. Landslides pose significant threats to infrastructure, human lives, and sustainable development in mountainous areas. Geographic Information Systems (GIS) have emerged as powerful tools for landslide susceptibility mapping (LSM), enabling the identification of hazard-prone zones through the integration of topographical, geological, hydrological, and land-use factors. This paper reviews GIS-based approaches for landslide susceptibility assessment and highlights their significance in sustainable infrastructure planning. The study discusses commonly used conditioning factors, mapping techniques, and applications in hill-region infrastructure development. The findings indicate that GIS-based susceptibility mapping can significantly enhance disaster preparedness, reduce economic losses, and support resilient infrastructure development in mountainous ecosystems.

Keywords: Landslide susceptibility mapping, GIS, Hill ecosystems, Sustainable infrastructure, Disaster risk reduction, Remote sensing.

Climate-Smart Development: Linking Carbon Neutrality with Resilience Building

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ABSTRACT

Climate change has emerged as one of the most critical environmental challenges of the twenty-first century, primarily driven by the increasing concentration of greenhouse gases (GHGs) in the atmosphere. Anthropogenic activities such as fossil fuel combustion, industrialization, deforestation, transportation, and intensive agricultural practices have significantly elevated atmospheric levels of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), resulting in global warming and associated environmental consequences. Rising temperatures, extreme weather events, sea-level rise, biodiversity loss, and ecosystem degradation have highlighted the urgent need for sustainable climate action. Carbon neutrality has gained global importance as a strategic approach to balance carbon emissions through emission reduction, renewable energy adoption, afforestation, carbon capture technologies, and sustainable land-use practices. Simultaneously, climate resilience focuses on enhancing the adaptive capacity of communities, ecosystems, and infrastructure to withstand, respond to, and recover from climate-related disturbances. This study explores the interrelationship between carbon neutrality and climate resilience, emphasizing their combined role in achieving environmental sustainability and climate security. The paper evaluates major sources of greenhouse gas emissions, examines their environmental and socio-economic impacts, and discusses mitigation and adaptation strategies for sustainable development. The findings suggest that integrating carbon-neutral policies with climate-resilient planning can significantly reduce climate risks, strengthen ecological stability, and support long-term sustainable development goals at local, national, and global scales.

Keywords: Carbon neutrality, climate resilience, greenhouse gases, sustainable development, carbon sequestration, renewable energy.

Review of Landslide Risk Reduction Strategies in the Himalayan Belt

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ABSTRACT

The Himalayan region is one of the most geologically active and environmentally sensitive mountain systems in the world. Frequent landslides caused by heavy rainfall, earthquakes, slope instability, deforestation, road construction, and unplanned urban growth pose significant risks to human life, infrastructure, biodiversity, and economic development. Recent changes in precipitation patterns due to climate change have further increased the frequency and severity of landslide events across the Himalayan belt. This review paper looks at existing landslide risk reduction strategies used in the Himalayan region, assesses their effectiveness, and identifies gaps in current methods. The study gathers findings from scientific literature, government reports, and disaster management frameworks. Key strategies examined include structural measures, bioengineering techniques, land-use planning, early warning systems, remote sensing and GIS applications, community-based disaster risk management, and policy interventions. The review emphasizes the need to combine scientific knowledge with community involvement and governance for effective landslide risk reduction. The paper concludes with suggestions for creating a complete and sustainable framework for managing landslides in the Himalayan region.

Keywords: Landslides, Himalayas, Disaster Risk Reduction, Climate Change, Slope Stabilization, Early Warning Systems, Community Resilience.

Landslide Susceptibility and Risk Assessment in Hilly Regions under Changing Climatic and Land Use Conditions

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ABSTRACT

Landslides are a significant geological hazard in hilly and mountainous regions, posing substantial risks to human life, infrastructure, and the environment. This research paper investigates the multifaceted causes and consequences of landslides in these areas, focusing on both natural and anthropogenic factors. Geological instability, heavy rainfall, seismic activity, and human activities such as deforestation, urbanization, and improper land use practices contribute to the prevalence of landslides. The study employs a combination of field surveys, remote sensing techniques, and statistical analyses to assess the frequency, triggers, and impacts of landslides in selected hilly regions.

Our findings reveal that climate change is exacerbating the frequency and intensity of rainfall events, leading to increased landslide susceptibility. Additionally, we highlight the role of land management practices in either mitigating or exacerbating landslide risks. The paper emphasizes the need for comprehensive risk assessment frameworks that incorporate geological, hydrological, and socio-economic factors to develop effective landslide mitigation strategies. By promoting sustainable land use practices and enhancing community awareness and preparedness, this research aims to contribute to the development of resilient hilly ecosystems. Ultimately, this study underscores the urgent need for integrated approaches to address the challenges posed by landslides in hilly regions, ensuring both human safety and environmental sustainability.

Keywords: Landslides, Hilly and Mountainous Regions, Climate Change, Remote Sensing, Risk Assessment, Sustainable Land Use.

Climate Change due to Rising Temperatures and its Causes and Effects

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ABSTRACT

Climate change has become one of the major environmental concerns of the present time, mainly due to the continuous rise in global temperatures. Human activities such as industrialization, fossil fuel burning, deforestation, urbanization, and pollution have increased the concentration of greenhouse gases in the atmosphere. These gases trap heat and contribute to global warming, which affects natural systems across the world. One of the visible impacts of rising temperatures is the melting and retreat of glaciers. Glaciers are important sources of freshwater, and changes in their size and stability can affect river flow, water availability, ecosystems, agriculture, and human settlements. In mountain regions, glacier melting may also increase the risk of hazards such as flooding and the formation of unstable glacial lakes. This review paper discusses the major human causes of climate change and explains how increasing greenhouse gas emissions contribute to rising temperatures. It also highlights the environmental and social effects of climate change, with special attention to glacier melting, water resource stress, ecosystem disturbance, and disaster-related risks. The study emphasizes the need for monitoring, mitigation, awareness, and sustainable practices to reduce the harmful effects of climate change.

Keywords: Human activities, Industrialization, Temperature, Ecosystem, Pollution.

Himalaya Hills Are Collapsing: Reasons, Impacts, and Mitigation Strategies

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ABSTRACT

The Himalayan mountain region, often called the "Third Pole" of the Earth, is facing serious environmental and geological challenges. Rising global temperatures, unusual local weather patterns, and unplanned human activities are damaging this fragile ecosystem at an alarming rate. This paper provides a detailed and evidence-based review of the major weaknesses affecting the Himalayan region. It also highlights the author's early warnings and research findings published from 2012 onwards in books such as Global Warming and Climate Change (2012) and Climate Change – Realities, Impacts Over Ice Cap, Sea Level and Risks (2014).

The study examines major disasters, including the 2013 Kedarnath tragedy and the 2023 Joshimath land subsidence incident, to explain how tectonic instability, extreme weather events, and excessive infrastructure development together increase disaster risks. The paper further proposes practical solutions suggested by the authors over the years. These include developing planned residential settlements in foothill areas such as Dehradun, Haridwar, Kathgodam, and Amroha, along with village-level vulnerability assessments. Seasonal relocation of people from high-risk zones and strict environmental regulations are recommended as effective measures to protect lives and maintain ecological balance in the Himalayan region.

Keywords: Himalayan Degradation, Glacial Retreat, Land Subsidence, Anthropogenic Pressure, Foothill Relocation, Climate Adaptation.

Foothill Residential Infrastructure for Climate-Resilient Himalayan Development: A Sustainable Framework for Disaster Risk Reduction in Uttarakhand

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ABSTRACT

The Himalayan mountain system is facing unprecedented pressure from accelerating climate change, fragile geological conditions, and unregulated developmental activities. Increasing occurrences of landslides, flash floods, glacial hazards, and land instability have exposed the vulnerability of settlements located in high-altitude regions. Major incidents such as the Kedarnath tragedy in 2013, the Chamoli disaster in 2021, the ground sinking crisis in Joshimath during 2022–2023, and the Dharali event of 2025 have demonstrated that existing patterns of habitation and infrastructure expansion are no longer suitable for ensuring long-term safety and sustainability in the Himalayas. These events call for a transformative planning strategy that balances human needs with environmental protection.

This paper introduces the concept of Foothill Residential Infrastructure (FRI) as an alternative development model for Himalayan regions. The framework encourages the systematic establishment of residential clusters, public facilities, and supporting infrastructure within relatively stable foothill areas while minimizing intensive construction in ecologically sensitive mountain zones. The study evaluates the proposed approach through a qualitative examination of terrain characteristics, disaster susceptibility, climatic influences, environmental impacts, and socio-economic requirements. The assessment indicates that FRI has the potential to lower disaster risk, improve the durability of infrastructure systems, and enhance access to essential services. Simultaneously, it can contribute to ecological conservation by reducing human-induced stress on vulnerable mountain landscapes. The study recommends integrating FRI into regional planning policies, climate adaptation initiatives, and disaster management programs to support resilient and sustainable development across the Himalayan region.

Keywords: Foothill Residential Infrastructure, Himalayas, Climate Change, Disaster Risk Reduction, Sustainable Development, Uttarakhand.

Morphological and Physiological Responses of UV-B Stress in Plants of Hill Ecosystems: Mechanisms, Adaptations, and Future Perspectives

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ABSTRACT

Ultraviolet-B (UV-B) radiation is a critical environmental factor influencing plant growth and development, particularly in mountainous ecosystems where radiation intensity increases with altitude. Plants inhabiting hill regions, including the Himalayas, experience prolonged exposure to elevated UV-B levels due to reduced atmospheric shielding. Excessive UV-B radiation can alter plant morphology, impair physiological functions, and reduce productivity through oxidative stress and metabolic disruption. Nevertheless, hill plants have evolved diverse adaptive mechanisms, including structural modifications, antioxidant defense systems, and UV-screening compounds that enhance survival under high-radiation conditions. This review synthesizes current knowledge regarding the morphological and physiological responses of plants to UV-B stress in mountain ecosystems. Particular emphasis is placed on Himalayan vegetation, adaptive mechanisms, ecological significance, and future research opportunities related to climate change and sustainable agriculture.

Keywords: UV-B radiation, Himalayan plants, mountain ecosystems, oxidative stress, antioxidant defense, climate change, plant adaptation.

Assessing the Environmental Consequences of Road Expansion in Mountainous Ecosystems

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ABSTRACT

Road infrastructure is a crucial component of socio-economic development, particularly in mountainous and remote regions where accessibility remains a challenge. However, the rapid and often unplanned expansion of road networks in hilly areas has emerged as a major environmental concern. Excessive road construction destabilizes slopes, accelerates deforestation, increases landslide occurrences, disrupts hydrological systems, and threatens biodiversity. The ecological fragility of mountainous landscapes makes them particularly vulnerable to anthropogenic disturbances. This paper examines the environmental consequences of excessive road construction in hilly regions, highlighting its effects on soil stability, water resources, biodiversity, climate resilience, and local communities. Through a synthesis of existing studies and environmental observations from mountainous regions worldwide, the paper demonstrates that while road development contributes to economic growth, unsustainable practices can significantly damage environmental balance. Recommendations are proposed for environmentally sustainable road planning and construction.

Keywords: Road construction, hilly regions, environmental degradation, landslides, biodiversity loss, sustainable infrastructure.

Artificial Intelligence-Based Flood Prediction in Mountain Regions: A Review of Opportunities and Challenges

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ABSTRACT

Floods are among the most destructive natural disasters affecting mountain regions. Climate change, extreme rainfall, and environmental degradation have increased flood frequency and severity. Artificial Intelligence (AI) provides advanced techniques for analyzing hydrological and meteorological data to improve flood forecasting accuracy. This paper reviews AI-based flood prediction approaches, their benefits, challenges, and future scope in disaster management.

Keywords: Artificial Intelligence, Flood Prediction, Machine Learning, Disaster Management, Climate Change.

Data-Driven Decision Making for Climate and Disaster Resilience: Frameworks, Models, and Evidence

(A Review and Methodological Study)

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ABSTRACT

As climate change intensifies the frequency and severity of natural disasters, the decisions that determine how societies prepare, respond, and adapt are increasingly made under deep uncertainty and severe time pressure. Data-driven decision making (DDDM) offers a disciplined alternative to intuition-led planning by grounding choices in integrated evidence drawn from climate records, hazard and exposure data, socio-economic indicators, and real-time sensors. This paper examines how DDDM strengthens climate and disaster resilience. We propose a five-stage framework that converts heterogeneous data into prioritised action through analytics, risk insight, and cost-benefit evaluation, supported by a continuous monitoring-and-learning loop. Using illustrative experiments, we show that machine-learning models classify disaster risk with up to 0.91 accuracy, that composite indices reveal the uneven spatial distribution of vulnerability, and that cost-benefit analysis of adaptation options yields benefit-cost ratios ranging from roughly four to ten. We conclude that the value of DDDM depends not on predictive accuracy alone but on the integration of transparent models, calibrated uncertainty, and equitable governance, so that the communities most exposed to climate risk are also the ones empowered to act.

Keywords: data-driven decision making; climate resilience; disaster risk reduction; vulnerability assessment; machine learning; cost-benefit analysis; adaptation; risk analytics.

4 ENVIRONMENTAL GOVERNANCE, COMMUNITY RESILIENCE, AND LIVELIHOODS

- AI-Driven Environmental Risk Management and Sustainability Analytics Using Machine Learning, IoT, Blockchain, and Predictive Data Intelligence
- Environmental Justice and Ecocentrism: With Special Reference to The Hungry Tide
- Geo-Energy and Environmental Sustainability: Exploring Renewable Planetary Resources for Mitigating Natural Disasters and Climate Change
- Waste-to-Wealth Models in Hill Ecosystems: An Economic Evaluation for Environmental Sustainability and Human Survival
- An Assessment of India's Sustainable Energy Policies for Promoting Green Infrastructure

AI-Driven Environmental Risk Management and Sustainability Analytics Using Machine Learning, IoT, Blockchain, and Predictive Data Intelligence

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ABSTRACT

Environmental sustainability and climate resilience have become major global priorities due to increasing ecological degradation, pollution, and climate-related disasters. Traditional environmental risk management systems often lack real-time monitoring and predictive capabilities. This research paper presents an AI-driven environmental risk management framework integrating Machine Learning (ML), Internet of Things (IoT), Blockchain Technology, and Predictive Data Intelligence for sustainable environmental governance. Machine learning algorithms are utilized for environmental forecasting, flood prediction, pollution analysis, and climate modelling, while IoT sensors enable real-time environmental monitoring. Blockchain technology enhances data transparency, traceability, and security within sustainability ecosystems. The study also explores the role of cloud computing, GIS, and predictive analytics in improving environmental decision-making and resource optimization. The findings demonstrate that AI-driven sustainability systems significantly improve predictive accuracy, operational efficiency, environmental resilience, and governance transparency, thereby supporting Sustainable Development Goals (SDGs) and intelligent environmental management practices.

Keywords: Environmental Risk Management, Sustainability Analytics, Artificial Intelligence, Machine Learning, Internet of Things, Blockchain, Predictive Analytics, Climate Change, Environmental Monitoring, Big Data Analytics, Smart Governance.

Environmental Justice and Ecocentrism: With Special Reference to The Hungry Tide

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ABSTRACT

Environmental concerns in contemporary literature increasingly focus on the relationship between ecological conservation, social equity, and sustainable development. Amitav Ghosh's The Hungry Tide (2004) presents a compelling exploration of environmental justice and ecocentrism through its portrayal of the Sundarbans, a fragile mangrove ecosystem inhabited by diverse human and non-human communities. This paper examines how the novel foregrounds the tension between environmental conservation and human survival, particularly through the historical narrative of the Morichjhapi refugees and the ecological significance of the Sundarbans. Employing an ecocritical framework, the study analyzes Ghosh's representation of nature as an active and autonomous force rather than a passive backdrop. The novel advocates an ecocentric perspective by emphasizing the intrinsic value of all living beings, including endangered species such as the Royal Bengal Tiger and the Irrawaddy dolphin. Simultaneously, it raises concerns about environmental justice by highlighting the marginalization of local communities and refugees whose livelihoods are threatened by conservation policies. Through characters such as Piya, Fokir, and Kusum, Ghosh illustrates the need to reconcile ecological preservation with social responsibility. The paper argues that The Hungry Tide challenges anthropocentric approaches to environmental management and promotes a more inclusive model that integrates ecological sustainability with human rights. Ultimately, the novel serves as a powerful critique of environmental policies that overlook vulnerable populations while advocating a balanced coexistence between humans and nature.

Keywords: Environmental Justice, Ecocentrism, Ecocriticism, Amitav Ghosh, The Hungry Tide, Sundarbans, Conservation, Human Rights, Ecology.

Geo-Energy and Environmental Sustainability: Exploring Renewable Planetary Resources for Mitigating Natural Disasters and Climate Change

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ABSTRACT

The increasing frequency and intensity of climate change-induced natural disasters, coupled with the depletion of conventional fossil fuel reserves, have necessitated the exploration of sustainable geo-energy resources for achieving long-term environmental resilience. This study investigates the potential of renewable planetary energy sources, including geothermal energy, solar radiation, wind systems, tidal forces, and subsurface thermal reservoirs, as strategic solutions for promoting environmental sustainability while mitigating the impacts of natural disasters and global climate change. The research examines the integration of advanced geospatial technologies, remote sensing, artificial intelligence, and environmental monitoring systems to identify, assess, and optimize renewable geo-energy resources across diverse ecological regions. Furthermore, the study analyzes the role of sustainable energy infrastructures in reducing greenhouse gas emissions, enhancing disaster preparedness, improving ecosystem stability, and supporting climate adaptation strategies. A multidisciplinary framework combining geological sciences, environmental engineering, renewable energy technologies, and disaster risk management is proposed to evaluate resource availability, environmental impacts, economic feasibility, and policy implications. The findings suggest that effective utilization of renewable planetary resources can significantly contribute to carbon neutrality goals, strengthen energy security, minimize ecological degradation, and enhance the resilience of vulnerable communities against extreme environmental events. The study provides valuable insights for policymakers, researchers, and sustainable development practitioners by establishing a comprehensive roadmap for integrating geo-energy systems into future climate mitigation and disaster management strategies. Ultimately, the research highlights that the transition toward renewable planetary energy resources is not merely an alternative energy pathway but a fundamental requirement for achieving global environmental sustainability and resilient socio-economic development.

Keywords: Geo-Energy, Environmental Sustainability, Renewable Planetary Resources, Climate Change Mitigation, Natural Disaster Management, Geothermal Energy, Renewable Energy Systems, Greenhouse Gas Reduction, Disaster Resilience, Sustainable Development, Geospatial Technologies, Environmental Monitoring, Artificial Intelligence, Energy Security, Climate Adaptation.

Waste-to-Wealth Models in Hill Ecosystems: An Economic Evaluation for Environmental Sustainability and Human Survival

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ABSTRACT

Hill ecosystems are environmentally sensitive regions that provide essential services such as water conservation, biodiversity protection, and livelihood support. However, increasing waste generation due to population growth, tourism, and poor waste management practices has created significant environmental challenges. The Waste-to-Wealth approach offers a sustainable solution by converting waste into valuable resources while reducing ecological degradation.

This study examines Waste-to-Wealth initiatives in selected hill regions of India, focusing on community-based waste management, composting, recycling, and resource recovery practices. Using a case study approach and secondary data sources, the research evaluates their contribution to environmental conservation, livelihood generation, and community resilience.

The findings reveal that Waste-to-Wealth models help reduce pollution, promote resource recovery, create employment opportunities, and support sustainable development in mountain areas. The study concludes that integrating circular economy principles and community participation into waste management can strengthen ecological sustainability and improve the quality of life in hill ecosystems. These insights offer valuable policy directions for sustainable mountain development and environmental governance.

Keywords: Waste-to-Wealth, Hill Ecosystems, Human Survival, Environmental Economics, Circular Economy, Sustainable Development, Resource Recovery, Mountain Communities, Ecological Sustainability.

An Assessment of India's Sustainable Energy Policies for Promoting Green Infrastructure

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ABSTRACT

India's rapid economic growth and urban development have been factors in the rising demand for energy and infrastructure. The situation has posed serious environmental and sustainability challenges. The government, in turn, has implemented a variety of sustainable energy policies directed at the promotion of green infrastructure and the reduction of fossil fuel dependence. This paper provides an overview of the main sustainable energy policies of India and analyzes them as to their part in increasing green infrastructure in the areas of power, industry, buildings, transport and urban systems. Qualitative policy analysis is the principal method of the study with government policy documents, official reports and existing research literature as the sources. National Action Plan on Climate Change, National Electricity Policy, renewable energy targets, Energy Conservation Act, Smart Cities Mission and National Infrastructure Pipeline are some of the key policies evaluated in this paper. The analysis also highlights how the setting of clear targets, the overhauling of the policy framework, and the implementation of market-based mechanisms have enabled India to reach a substantial increase in renewable energy and to improve energy efficiency measures. Infrastructure for low carbon producers and energy efficient ones are positively demonstrated by initiatives such as solar parks, The Perform, Achieve, and Trade scheme, and smart city projects. Yet, there are still obstacles to overcome regarding finance, grid integration, coordination among different institutions, and the limited capacity of state and local governments. The author concludes that India's sustainable energy policies have indeed provided a strong inducement for the development of green infrastructures, but the long-term sustainability goal can only be achieved through better policy integration, improved financing mechanisms, and strengthened local capacity.

Keywords: Sustainable Energy Policies; Green Infrastructure; Renewable Energy; Energy Efficiency; Smart Cities; Low-Carbon Development; Clean Energy Transition; Sustainable Development.

5 SCIENCE POLICY INTEGRATION FOR DISASTER PREPAREDNESS AND MITIGATION

- Harnessing Sustainable Planetary Energy Sources for Climate Resilience: An Integrated Framework for Environmental Conservation and Disaster Risk Reduction
- Leveraging Minitab and Regression Analysis for Environmental Sustainability and Disaster Resilience: A Statistical Modelling Framework

Harnessing Sustainable Planetary Energy Sources for Climate Resilience: An Integrated Framework for Environmental Conservation and Disaster Risk Reduction

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ABSTRACT

The escalating impacts of climate change, environmental degradation, and the increasing frequency of natural disasters have intensified the global demand for sustainable energy solutions that simultaneously promote ecological preservation and societal resilience. Harnessing sustainable planetary energy sources—including solar, wind, geothermal, tidal, hydrokinetic, and biomass energy—offers a transformative pathway toward achieving climate resilience while reducing dependence on fossil fuels and minimizing greenhouse gas emissions. This study proposes an integrated framework that combines renewable energy technologies, environmental conservation strategies, and disaster risk reduction mechanisms to create adaptive and sustainable energy ecosystems. The framework emphasizes the synergistic interaction between clean energy generation, ecosystem restoration, smart energy management systems, and climate-resilient infrastructure supported by advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Geographic Information Systems (GIS), remote sensing, and predictive analytics. Furthermore, the study examines how decentralized renewable energy systems can enhance community preparedness, ensure energy security during extreme events, and facilitate rapid post-disaster recovery. The proposed approach aligns with global sustainability initiatives, including carbon neutrality objectives and the United Nations Sustainable Development Goals (SDGs), by integrating environmental stewardship with technological innovation and policy-driven governance. The research highlights that sustainable planetary energy utilization not only mitigates climate change but also strengthens ecological balance, socio-economic development, and disaster resilience through interdisciplinary collaboration and intelligent resource management. The findings provide policymakers, researchers, and industry stakeholders with a comprehensive framework for designing resilient and environmentally sustainable energy systems capable of addressing future climate and disaster challenges.

Keywords: Sustainable Planetary Energy, Renewable Energy Sources, Climate Resilience, Environmental Conservation, Disaster Risk Reduction, Clean Energy Systems, Artificial Intelligence, Internet of Things, Geographic Information Systems, Smart Grids, Carbon Neutrality, Sustainable Development Goals, Energy Security, Ecosystem Restoration, Climate Change Mitigation.

Leveraging Minitab and Regression Analysis for Environmental Sustainability and Disaster Resilience: A Statistical Modelling Framework

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ABSTRACT

As climate volatility intensifies, quantifying environmental degradation and community vulnerability has become paramount for sustainable development and risk mitigation, yet translating complex, multi-variable ecological datasets into actionable policy remains a critical challenge. This paper demonstrates the practical application of Analysis of Variance (ANOVA) and various regression modelling techniques within Minitab software to evaluate sustainability metrics and disaster recovery trajectories. For environmental sustainability, one-way and general linear model (GLM) ANOVA frameworks are utilised to compare ecological impacts across disparate sectors, while multiple linear regression is applied to isolate significant predictors of urban carbon footprints. For disaster resilience, binary logistic regression is deployed to model structural and community survival probabilities against natural hazards, supplemented by time-series trend analysis to project post-disaster economic recovery timelines. The integration of these statistical tools allows researchers to validate assumptions, identify non-linear interactions, and utilise factorial and contour visualisation tools to map risk zones and optimal sustainability thresholds. Ultimately, this software-driven workflow bridges the gap between raw empirical data and strategic decision-making, providing environmental scientists, structural engineers, and urban planners with the precise, statistically validated insights necessary to optimise resource allocation, enhance infrastructure durability, and foster long-term climate resilience.

Keywords: Minitab, ANOVA, Multiple Linear Regression; Environmental Sustainability; Disaster Resilience, Predictive Modelling; Climate Change Adaptation.

6 OTHER EMERGING AREA OF SCIENCE TECHNOLOGY & MANAGEMENT (CONNECTED WITH THEME)

- Flood Risk Prediction in Hill-Adjacent Communities Using Deep Neural Networks and Environmental Vulnerability Indicators
- Towards Sustainable Generative AI: A Systematic Literature Review of Environmental Challenges, Green AI Techniques, and Future Directions
- Landslide Risk Prediction Using Convolutional Neural Networks Integrated with Digital Elevation Model and Rainfall Data
- Artificial Intelligence for Environmental Monitoring and Disaster Prediction: Datasets, Models, and an Integrated Framework
- AI-Enabled Energy-Efficient Cloud Data Centers : A Pathway to Sustainable Computing
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- Satellite Image Analysis for Monitoring Environmental Changes in Hill Regions
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Flood Risk Prediction in Hill-Adjacent Communities Using Deep Neural Networks and Environmental Vulnerability Indicators

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ABSTRACT

Hill-adjacent communities face disproportionate flood risks driven by steep terrain, accelerated deforestation, and intensifying monsoon precipitation amplified by climate change. Conventional hydrological models often fail to capture the non-linear interdependencies among environmental vulnerability indicators that govern flood occurrence in these ecologically sensitive regions. This study presents a Deep Neural Network (DNN)-based predictive framework trained on 21 environmental and socio-physical features from the publicly available Kaggle Flood Prediction Dataset (50,000 records). The proposed multi-layer DNN architecture employs batch normalization and dropout regularization for robust generalization. It is benchmarked against Logistic Regression, Support Vector Machine (SVM), and Random Forest. The DNN achieves the highest predictive performance: Accuracy 91.8%, $R^2 = 0.93$, and RMSE = 0.098. Permutation-based feature importance analysis identifies Monsoon Intensity, Topographic Drainage, and Deforestation as the dominant flood-triggering factors, directly linking hill ecosystem degradation to human survival risk. Results advocate for integrating AI-driven flood prediction into disaster resilience frameworks for sustainable hill ecosystem management.

Keywords: Deep Neural Network, Flood Risk Prediction, Hill Ecosystem, Environmental Vulnerability, Disaster Early Warning, Monsoon Intensity, Human Survival.

Towards Sustainable Generative AI: A Systematic Literature Review of Environmental Challenges, Green AI Techniques, and Future Directions

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ABSTRACT

The rapid advancement of Generative Artificial Intelligence (GenAI), particularly Large Language Models (LLMs) and foundation models, has transformed various sectors, including education, healthcare, software engineering, and scientific research. However, the increasing computational requirements of these models have raised significant concerns regarding their environmental sustainability. Training and deployment of large-scale Generative AI systems require substantial energy resources, contribute to carbon emissions, consume large quantities of water for data center cooling, and generate indirect environmental impacts through hardware manufacturing and electronic waste. As a result, sustainable AI development has emerged as a critical research area in recent years.

This paper presents a systematic literature review of research published between 2019 and 2026 on the environmental implications of Generative AI. The review aims to identify major environmental challenges associated with Generative AI systems, examine Green AI techniques proposed to reduce resource consumption, and analyze emerging research trends in sustainable AI development. The selected studies are categorized into environmental impact assessment, energy-efficient model design, carbon-aware computing, model optimization techniques, and sustainability governance frameworks. Furthermore, the paper proposes a taxonomy that organizes existing research according to environmental challenges, mitigation strategies, and future sustainability directions. A comparative analysis of Green AI techniques, including model pruning, quantization, knowledge distillation, and efficient architectures, is also presented. Finally, key research gaps and future directions are identified to support the development of environmentally responsible Generative AI systems. The findings of this review provide a comprehensive overview of the current state of Sustainable Generative AI research and highlight potential pathways for balancing technological advancement with environmental responsibility.

Keywords: Generative Artificial Intelligence, Sustainable AI, Green AI, Carbon Footprint, Energy-Efficient Computing, Environmental Sustainability, Large Language Models, Systematic Literature Review

Landslide Risk Prediction Using Convolutional Neural Networks Integrated with Digital Elevation Model and Rainfall Data

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ABSTRACT

Landslides represent one of the most devastating ecological hazards worldwide, causing significant casualties, infrastructure damage, and environmental degradation. This research presents a novel deep learning approach combining Convolutional Neural Networks (CNN) with Digital Elevation Model (DEM) and rainfall data for accurate landslide risk prediction. The proposed model achieves 92% accuracy, surpassing traditional machine learning methods including Support Vector Machines (78%), Random Forest (84%), and Artificial Neural Networks (81%). A comprehensive dataset comprising 10,000+ spatial samples from landslide-prone regions in Kerala, India was utilized, incorporating seven conditioning factors: slope, elevation, aspect, rainfall, curvature, NDVI, and distance to river. Feature importance analysis reveals slope (28%) and rainfall (18%) as the most critical predictors. The CNN architecture employs two convolutional layers (32 and 64 filters), max pooling, and fully connected output layers. Training convergence was achieved within 50 epochs with validation accuracy stabilizing at 89%. This study demonstrates that integrating topographic and meteorological data through deep learning significantly enhances landslide susceptibility mapping, providing valuable insights for disaster mitigation and ecological planning.

Keywords: Landslide risk, Convolutional Neural Network, DEM, Rainfall data, Machine learning, Susceptibility mapping, Deep learning.

Artificial Intelligence for Environmental Monitoring and Disaster Prediction: Datasets, Models, and an Integrated Framework

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ABSTRACT

Environmental degradation and the rising frequency of natural disasters have intensified the need for monitoring and early-warning systems that are fast, accurate, and scalable. Artificial intelligence (AI), and machine learning in particular, has emerged as a powerful means of extracting actionable signals from the vast and heterogeneous data generated by satellites, sensor networks, and physical models. This paper reviews how AI supports environmental monitoring and disaster prediction across hazards including floods, wildfires, earthquakes, and air-quality episodes. We characterize the principal data sources, propose a five-stage architecture that links sensing to emergency response, and survey the spectrum of models from classical classifiers to deep convolutional and recurrent networks. A comparative experiment on a multi-hazard detection benchmark shows that deep models substantially outperform classical baselines, with a CNN-LSTM reaching 0.94 accuracy and an area under the receiver-operating-characteristic curve of 0.96, while an illustrative flood-forecasting case demonstrates a useful early-warning lead time. We conclude that AI offers transformative capability for disaster risk reduction, but that interpretability, data quality, and equitable deployment remain decisive challenges, and that physically informed, human-in-the-loop systems are the most trustworthy path forward.

Keywords: artificial intelligence; machine learning; environmental monitoring; disaster prediction; early warning; remote sensing; deep learning; flood forecasting.

AI-Enabled Energy-Efficient Cloud Data Centers : A Pathway to Sustainable Computing

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ABSTRACT

Cloud computing has emerged as a transformative technology that plays a vital role in shaping a sustainable digital future. As organizations increasingly adopt cloud-based solutions, their potential contribution to sustainable development has become more evident. This paper examines the impact of cloud computing from environmental, economic and social perspectives.

From an environmental standpoint, cloud computing supports sustainability by optimizing resource utilization, lowering energy consumption, reducing greenhouse gas emissions and encouraging the development of energy-efficient data centers. Economically, cloud services help organizations reduce capital and operational expenses, enhance flexibility and scalability, adoptive innovation and improve overall business performance and competitiveness. Socially, cloud technology promotes greater digital inclusion by expanding access to information and services, facilitating remote work and collaboration and enhancing the delivery of essential services in sectors such as education, healthcare, and public administration. The study demonstrates that cloud computing serves as a significant enabler of sustainable development by creating a balance between environmental stewardship, economic progress and social advancement. The paper concludes that the long-term benefits of cloud computing can be maximized through responsible adoption practices, continuous technological innovation, and supportive policy frameworks that encourage sustainable digital transformation.

Keywords: Cloud Computing, Sustainable Development, Environmental Sustainability, Digital Transformation, Green Computing.

Human Survival in Hill Ecosystems: A Deep Learning and Geospatial Analytics Framework for Climate-Induced Flood and Landslide Risk Assessment and Prediction

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ABSTRACT

Hill ecosystems are increasingly affected by climate change, leading to a rising frequency of floods and landslides driven by variations in rainfall intensity, temperature patterns, land-use change, and vegetation loss. These processes significantly threaten human life, infrastructure, and ecosystem stability in mountainous regions. Accurate identification of hazard-prone areas is essential for effective disaster risk reduction; however, conventional methods not succeed to capture the complex and nonlinear interactions among climatic, topographic, and land-cover variables.

This work introduces an integrated framework for fslood and landslide risk assessment in mountainous ecosystems leveraging remote sensing data, geospatial analytics, and deep learning techniques. The framework integrates satellite imagery, climatic variables, and terrain information to represent both spatial heterogeneity and temporal dynamics of hazard occurrence. A hybrid deep learning architecture combining Convolutional Neural Networks (CNN), U-Net, and Long Short-Term Memory (LSTM) networks is employed for spatial feature extraction, vulnerability mapping, and temporal risk modelling. The proposed approach enables accurate susceptibility mapping, improved risk prediction, and early warning support for disaster management in mountainous regions. The results highlight the potential of deep learning–based geospatial analysis in enhancing disaster preparedness and resilience in climate-sensitive hill environments.

Keywords: Flood risk assessment, landslide susceptibility, hill ecosystems, remote sensing, geospatial analytics, deep learning, CNN, U-Net, LSTM, disaster management, climate change.

Electric Vehicle-Driven Planetary Energy Solutions: A Multidisciplinary Approach Combining Green Technologies and Environmental Monitoring

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ABSTRACT

The accelerating impacts of climate change, environmental degradation, and the depletion of fossil fuel resources have intensified the need for sustainable and intelligent energy systems. Electric Vehicles (EVs) have emerged as a transformative technology capable of reducing greenhouse gas emissions while serving as integral components of future smart energy ecosystems. This study presents a multidisciplinary framework that integrates electric vehicle technologies with renewable energy resources, green technologies, and advanced environmental monitoring systems to develop comprehensive planetary energy solutions. The proposed approach emphasizes the synergistic interaction between EV charging infrastructure, solar and wind energy generation, smart grids, Internet of Things (IoT)-based environmental sensors, artificial intelligence (AI)-driven analytics, and energy storage systems. Furthermore, the framework explores vehicle-to-grid (V2G) and vehicle-to-everything (V2X) technologies for enhancing grid stability, demand-side management, and renewable energy utilization. Environmental monitoring through real-time data acquisition enables continuous assessment of air quality, carbon emissions, and ecological indicators, thereby facilitating adaptive energy management and informed policymaking. The study also examines the economic, environmental, and social dimensions of EV-driven energy transitions, highlighting their potential to support carbon neutrality, sustainable urban development, and resilient infrastructure. By combining advances in green technologies with intelligent monitoring and data-driven decision-making, the proposed multidisciplinary approach contributes to achieving global sustainability goals and fostering a cleaner, more efficient, and environmentally responsible planetary energy system. The findings provide valuable insights for researchers, policymakers, and industry stakeholders seeking integrated strategies for future energy and environmental management.

Keywords: Electric Vehicles (Evs); Green Technologies; Renewable Energy; Environmental Monitoring; Smart Grid; Vehicle-to-Grid (V2G); Internet of Things (IoT); Artificial Intelligence (AI); Sustainable Energy Systems; Carbon Neutrality; Energy Storage; Climate Change Mitigation.

Satellite Image Analysis for Monitoring Environmental Changes in Hill Regions

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ABSTRACT

Hill and mountain regions are among the most ecologically sensitive yet poorly monitored landscapes on Earth, where steep relief, persistent cloud cover and rapid land-use transitions complicate field observation. This study presents a multi-temporal satellite image analysis framework for detecting and quantifying environmental change across a representative Himalayan hill watershed over the period 2000–2025. Landsat 5 TM, Landsat 8 OLI and Sentinel-2 MSI imagery were integrated with an SRTM digital elevation model and corrected for atmospheric and topographic effects. Spectral indices (NDVI, NDWI, NDBI) together with terrain derivatives were used as inputs to five classifiers ranging from maximum-likelihood to a U-Net deep-learning segmentation model. The U-Net achieved the highest overall accuracy of 94.3% (Kappa = 0.92), outperforming Random Forest by 4.6 percentage points. Change analysis revealed a 7.7% net loss of dense forest, a near three-fold expansion of built-up area and a measurable decline in watershed-mean NDVI of approximately 0.05 over 25 years. The results demonstrate that combining open multi-sensor archives with deep learning offers an accurate, transferable and low-cost approach for monitoring environmental change in data-scarce mountain regions.

Keywords: remote sensing; hill regions; NDVI; land-use/land-cover change; deep learning; U-Net; change detection; Himalaya.

Human Survival Vulnerability Index for Hill Regions Using Explainable XGBoost: A Case Study of the Hindu Kush Himalayan Region

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ABSTRACT

The Hindu Kush Himalayan (HKH) region, widely regarded as the "Third Pole," constitutes one of the most critical freshwater repositories on Earth, sustaining the livelihoods of nearly two billion people through snow and glacier melt-fed river systems. Accelerating glacier retreat, rising temperature anomalies, extreme precipitation variability, and compounding disaster risks are converging to threaten water security, agricultural productivity, critical infrastructure, and human survival in mountain communities across eight riparian nations. This study proposes and operationalises a novel Human Survival Vulnerability Index (HSVI)—a composite measure that integrates glacier loss dynamics, elevation gradients, temperature anomalies, precipitation variability, population exposure, and multi-hazard disaster susceptibility. Leveraging the ICIMOD HKH Glacier Monitoring Dataset (1990–2020) alongside WorldClim climatic variables, SRTM terrain derivatives, and Global Human Settlement Layer (GHSL) population data, an ensemble Extreme Gradient Boosting (XGBoost) model is developed to classify vulnerability levels across 1,247 spatial grid units spanning the HKH study domain. The model achieves an overall classification accuracy of 91.4%, an F1 score of 0.89, and an area under the receiver operating characteristic curve (ROC-AUC) of 0.94 across three vulnerability classes (Low, Moderate, High). SHapley Additive exPlanations (SHAP) analysis reveals that glacier area loss rate, mean annual temperature increase, and population density within hazard-prone zones are the three dominant predictors of high human survival vulnerability. The proposed HSVI framework constitutes a scalable, transparent, and interpretable AI-driven decision-support tool for climate adaptation planning, early-warning systems, and sustainable mountain development policy across the HKH region.

Keywords: XGBoost, Human Survival Vulnerability Index (HSVI), Hindu Kush Himalaya, Glacier Monitoring, Climate Change Adaptation, Explainable AI (XAI), SHAP Analysis, Mountain Ecosystems, Water Security, ICIMOD

Favourable Transformation in the Properties of Liquid Crystal by Gamma Radiation

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ABSTRACT

Gamma ray irradiation technique is the powerful technique to modify the dielectric and electro-optical properties of liquid crystals. It prefers than any other modification technique because no catalysts or additives are required to initiate the reaction. The work reports a comparative study of dielectric and electro-optical properties for both irradiated and unirradiated Nematic liquid crystalline samples. The dielectric spectrum and ionic conductivity is also evaluated and well explained in the present work.

Keywords: Condensed Matter Physics, Gamma Radiation, Dielectric Properties.

Terrain-Aware Wheeled–Legged Robot for Autonomous Robotics Operations in Hill and Mountain Terrains

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ABSTRACT

Robotic mobility in steep natural terrain is limited by irregular topology, loose substrates, and rapidly varying contact conditions in hill and mountain environments. This paper presents a terrain-aware mobile Robot platform specifically designed for persistent operation on such slopes, integrating mechanical adaptation with high-level Robotics intelligence. The proposed system combines a modular wheeled–legged chassis with actively adjustable suspension and a perception-driven locomotion planner that fuses LiDAR–IMU elevation mapping with proprioceptive slip estimation to select safe footholds and trajectories in real time. A model predictive controller reconfigures gait, posture, and wheel torque based on local slope, roughness, and predicted support polygon stability, while a hierarchical supervisor manages mode transitions between hill traversal, mountain ridge negotiation, and descent. Extensive field trials on natural hill and mountain trails with inclinations up to 35 degrees demonstrate a 37% reduction in specific energy consumption, a 42% decrease in pose drift, and a task completion success rate above 95% compared with a state-of-the-art tracked rover baseline. The results highlight that tightly coupled mechanical design and terrain-aware control significantly enhance safety, efficiency, and autonomy of robotic systems deployed in challenging hillside and mountainous terrains.

Keywords: Robot; Robotics; Hill; Mountain; rough terrain locomotion; wheeled–legged platform; terrain-aware control; field experiments

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