UNITED NATIONS DECADE ON ECOSYSTEM RESTORATION 2021-2030

LiFE Lifestyle for Environment

National Conference
on

शाश्वत सृष्टि संरक्षण

SHASHWAT SRISHTI SANRAKSHAN

"A Pledge for Protecting World against Natural Hazards: Agro-Biotechnological Approach"

23-24 August, 2024 | ICAR-CAFRI, JHANSI, U.P.

Organized by

सर्वे भवन्तु सुखिनः
Save the Environment

SAVE THE ENVIRONMENT
KOLKATA / GURUGRAM

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ICAR-CENTRAL AGROFORESTRY RESEARCH INSTITUTE
Jhansi, Uttar Pradesh

In Association with

Indian Society of Agroforestry
Jhansi, Uttar Pradesh

The Society for Science of Climate Change and Sustainable Environment (SSCE), New Delhi

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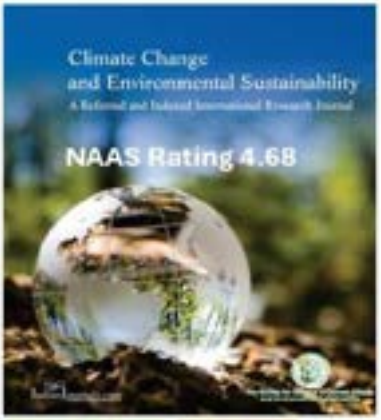
The Society for Science of Climate Change and Sustainable Environment (SSCE) has been formed to lead the awareness drive on various impacts of climate change. Society is planning to initiate awareness drive by writing various articles related to climate change, initiating a review journal, organizing seminars and conferences and highlighting the options of various stakeholders such as farmers, scientists, policymakers, teachers, students and government officers. This awareness drive will help in understanding the causes and consequences of global climate change and their impact on agriculture crop productivity and food security.



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https://ssceonline.wordpress.com

The Society for Science of Climate Change and Sustainable Environment (SSCE), New Delhi, India

कृषि एवं किसान कल्याण मंत्रालय
MINISTRY OF
AGRICULTURE AND
FARMERS WELFARE

मंत्री
कृषि एवं किसान कल्याण मंत्रालय
और ग्रामीण विकास मंत्रालय
भारत सरकार
Minister
Ministry for Agriculture & Farmers Welfare
and Ministry of Rural Development
Government of India

Message

It is with great enthusiasm that I extend my warmest welcome to all delegates of the National Conference on "SHASHWAT SRISTI SANRAKSHAN: A Pledge for Protecting the World against Natural Hazards: Agro-Biotechnological Approach." This conference is not merely an academic gathering; it is a vital platform for addressing some of the most pressing challenges our world faces today. The themes outlined by the organizing committee reflect an urgent need for interdisciplinary dialogue and action, spanning agriculture, biotechnology, and environmental science.

The importance of these themes cannot be overstated. As we navigate an era marked by significant environmental changes and resource constraints, it is imperative to explore and advance strategies that can mitigate these impacts. The focus on sustainable agriculture and agroforestry in the face of climate change, the role of biotechnology in enhancing productivity and environmental stewardship, and the urgent need for effective conservation and resource management are critical to ensuring our planet's resilience. By examining these themes, we aim to foster innovative solutions, drive meaningful research, and catalyse collaborative efforts that will contribute to a more sustainable and prosperous future. This conference represents a crucial step towards bridging knowledge gaps, fostering collaboration, and advancing practical solutions for the global challenges we face.

I look forward to the impactful discussions and collaborative endeavours that will arise from our collective expertise and government is committed to troubleshoot these pressing issues.

(Shivraj Singh Chouhan)

डॉ. हिमांशु पाठक
सचिव (डेयर) एवं महानिदेशक (भाकृअनुप)
Dr HIMANSHU PATHAK
SECRETARY (DARE) & DIRECTOR GENERAL (ICAR)

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भारतीय कृषि अनुसंधान परिषद
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AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)
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E-mail: dg.icar@nic.in

Message

It is my privilege to welcome all the delegates to the National Conference on "SHASHWAT SRISTI SANRAKSHAN: A Pledge for Protecting the World against Natural Hazards: Agro-Biotechnological Approach." As we convene to address the myriad challenges confronting our world, from climate change and biodiversity loss to the urgent need for innovative biotechnological solutions, we embark on a journey of collective action and discovery. Our discussions in this conference will span critical areas such as sustainable agriculture, environmental conservation, and advanced technological tools, each pivotal in shaping a resilient and sustainable future.

This conference represents a significant opportunity to forge new paths and deepen our understanding of how agriculture and biotechnology can interweave with environmental stewardship. Together, we will explore transformative ideas, share pioneering research, and collaborate on actionable strategies that will contribute to a healthier planet and a more sustainable way of life. The engagement and insights we share towards these goals and pledge for our commitment to safeguarding our natural world will be bringing in changes.

I look forward to the impactful conversations and collaborations that will emerge from our time together.

I wish the program a great success.

New Delhi
14 August 2024

(Himanshu Pathak)

रानी लक्ष्मी बाई केन्द्रीय कृषि विश्वविद्यालय
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Rani Lakshmi Bai Central Agricultural University
Gwalior Road, Jhansi 284 003 (U.P.) India

डॉ. अशोक कुमार सिंह
कुलपति
Dr. Ashok Kumar Singh
Vice-Chancellor

Phone : 0510-2730777
E-mail : vcrlbcau@gmail.com
Website : www.rlbcau.ac.in

Message

It is with immense admiration that I extend my heartfelt congratulations to the organizing team of the National Conference on "SHASHWAT SRISTI SANRAKSHAN: A Pledge for Protecting the World against Natural Hazards: Agro-Biotechnological Approach." The conceptualization and realization of this conference stand as a testament to the dedication, vision, and expertise of those involved.

In an era marked by unprecedented environmental challenges and the urgent need for innovative solutions, this conference address critical themes with a clarity and focus that is both inspiring and necessary. The meticulous planning and thoughtful curation of topics reflect a deep understanding of the interconnectedness of agriculture, biotechnology, and environmental science. The breadth and depth of the themes covered—from climate change and biodiversity to advanced technological tools—underscore the conference's pivotal role in advancing our collective knowledge and driving impactful solutions.

I commend the organizing team for their exceptional work in bringing together a distinguished group of experts and practitioners to engage in this vital discourse. Their efforts not only facilitate an important exchange of ideas but also pave the way for future collaborations and advancements in our shared quest for a sustainable and resilient world. I am confident that the insights and discussions generated at this conference will significantly contribute to our ongoing efforts to protect and preserve our natural environment.

Jhansi, Uttar Pradesh
12th August 2024

(A.K. Singh)

Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya
Raja Pancham Singh Marg, Near Akashwani, Gwalior, (M.P.)

Prof. (Dr.) Arvind Kumar Shukla
Vice Chancellor

Message

It is with immense admiration that I extend my heartfelt congratulations to the organizing team of the National Conference on "SHASHWAT SRISTI SANRAKSHAN: A Pledge for Protecting the World against Natural Hazards: Agro-Biotechnological Approach." The conceptualization and realization of this conference stand as a testament to the dedication, vision and expertise of those involved.

The significance of this conference cannot be overstated. At its core lies the imperative to protect and sustain life on our planet, recognizing that hunger and natural hazards not only threaten lives and livelihoods but also undermine the very foundations of sustainable development. By bringing together diverse stakeholders, from academia to government, the conference seeks to harness collective wisdom, expertise, and innovation to forge solutions that are both impactful and scalable.

One of the primary benefits of such a gathering is the opportunity for knowledge sharing. Researchers and practitioners from various disciplines will come together to exchange insights, best practices, and the latest advancements in technology. This exchange is crucial in fostering a deeper understanding of the complex interplay between food systems, climate change, and disaster risk, paving the way for evidence-based interventions and policies. Moreover, the conference offers invaluable networking opportunities.

I am confident that the insights and discussion generated at this conference will significantly contribute to our ongoing efforts to protect and preserve our natural environment.

(Prof. (Dr.) Arvind Kumar Shukla)

AMITY UNIVERSITY
UTTAR PRADESH

DR. W. SELVAMURTHY, Ph.D., D.Sc.
FAMS, FABMS, FIMSA, FIANS, FIAY

President
Amity Science, Technology and Innovation Foundation
Amity Foundation for Science, Technology & Innovation Alliances
Director General, Amity Directorate of Science & Innovation
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August 16, 2024

MESSAGE

The National Conference - SHASHWAT SRISHTI SANRAKSHAN 2024 is indeed a great opportunity representing the collective efforts to address the pressing challenges posed by climate change and natural hazards as there is a critical need for innovative approaches in agriculture and focus on agro-biotechnological solutions. With the advancements in biotechnology, we need to develop agricultural practices that are not only more productive but also resilient to the growing threats posed by environmental challenges.

The development and implementation of advanced biotechnological solutions is vital to ensure food security and protecting livelihoods across vulnerable regions. The path forward requires a multifaceted approach and we should embrace techniques such as precision agriculture, promote sustainable agroforestry practices and leveraging cutting-edge technologies such as gene editing and genomics etc. These innovations not only enhance agricultural productivity but also contribute to environmental sustainability ensuring that we leave behind a healthier planet for future generations.

Fostering cross-sectoral collaborations is very important to overcome complex challenges since coordinated efforts from scientists, policymakers, industry leaders, and local communities can make a difference at a global scale. The scientific advancements can be translated into practical solutions by working together to mitigate the risks of natural disasters and strengthen the resilience of our food systems.

This conference indeed brings a great opportunity for all stakeholders to share insights and form partnerships which have the potential to shape the future of agriculture, making it more resilient and sustainable for generations to come.

I extend my best wishes to all participants and organizers for a successful and impactful conference. I am certain that efforts will lead to meaningful outcomes that will pave a way to a safer and more sustainable world.

Dr. W. Selvamurthy

केन्द्रीय कृषिवानिकी अनुसंधान संस्थान
पहूज बाँध के सामने, झाँसी–ग्वालियर मार्ग, झाँसी 284003 (उ0 प्र0)
Central Agroforestry Research Institute

डा. अ. अरुणाचलम / A. Arunachalam PhD., D.Sc.
निदेशक / Director

Message

I am happy that the Save The Environment (STE) Society is organizing a National Conference on the "SHASHWAT SRISHTI SANRAKSHAN - A Pledge for Protecting World against Natural Hazards" on August 23-24, 2024 in collaboration with ICAR-Central Agroforestry Research Institute (ICAR-CAFRI), Society for Science of Climate Change and Sustainable Environment (SSCE) and the Indian Society of Agroforestry (ISAF) in Jhansi, Uttar Pradesh. I am sure, this conference would provide a good platform for the experts, researchers, and professionals to discuss and deliberate on the challenges and opportunities in the environment sector including the human perspectives and efforts in policy making within context of changing scenario of climate.

Notably, this Conference stands as enabling a unique roadmap for resilient, adaptive, and sustainable future for environmental management while focusing on crop, livestock and other flora and fauna leading to biodiversity conservation endeavor.

I wish the Conference a great success and look forward to meaningful discussions and strategic recommendations.

Date: 18-08-2024

Place: Jhansi, Uttar Pradesh

(A. Arunachalam)

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SAVE THE ENVIRONMENT (STE)

(A SOCIETY FOR RESEARCH, AWARENESS & SOCIAL DEVELOPMENT)

Message

I, on behalf of Save the Environment (STE), am excited to invite you to our conference, **"A Pledge for Protecting the World against Natural Hazards: Agro-Biotechnological Approach,"** scheduled for **23-24th August 2024** at the **ICAR-Central Agroforestry Research Institute (ICAR-CAFRI).** The venue for this significant conference, is one of the specialized institutions under ICAR located in Jhansi. ICAR-CAFRI is dedicated to the research and development of agroforestry practices, focusing on the integration of trees and crops. This gathering is poised to bring together students, researchers, and policymakers to address two of the most urgent challenges facing humanity today that is, ensuring food security and building resilience against natural disasters.

As we sail through an era marked by increasing environmental unpredictability, the importance of uniting diverse perspectives and expertise cannot be overstated. This conference will serve as a dynamic platform for knowledge sharing, where insights and innovations will be exchanged, fostering a deeper understanding of the complex relationships between our food systems, climate change and disaster risks.

For students and early-career researchers, this is a unique opportunity to learn, grow, and connect with seasoned experts from countries. By engaging in workshops, seminars, and collaborative discussions, you will have the chance to shape your future contributions to society and become part of the next generation of leaders in this critical field. For policymakers, the conference offers access to the latest research and evidence-based solutions that can guide the development of robust policies aimed at enhancing food security and strengthening disaster preparedness. The insights gained here will be instrumental in building communities and ensuring sustainable development for future generations.

I extend my heartfelt gratitude to all the stakeholders and collaborators of this conference, including STE, ICAR-CARFRI, Indian Society of Agroforestry, Jhansi, Uttar Pradesh, The Society for Science of Climate Change and Sustainable Environment (SSCE), New Delhi, SKSS-SARVHIT Kalyan Seva Smaiti, Meerut, Bundelkhand University, Jhansi, and IEF, Bundelkhand University, Jhansi, for their unwavering efforts and contributions in bringing this event to fruition. We look forward to your participation in this pivotal event.

Together, let us take a collective pledge to protect our world against natural hazards and forge a path toward a safer and more sustainable future.

Dr. Kshipra Misra
President, Save the Environment, Gurugram / Kolkata

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"The Society for Science of Climate Change and Sustainable Environment"
(Reg. No. S/67691/2009)

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Website: https://ssceonline.wordpress.com, **E-mail:** exesecy.ssce@gmail.com

Prof. Rana Pratap Singh
President

F.No. SSCE/2018/1
17th August 2024

Message

I am happy that the Society for Science of Climate Change and Sustainable Environment (SSCE) is joining hands with the Save The Environment (STE) Society in organizing a National Conference on the "SHASHWAT SRISHTI SANRAKSHAN - A Pledge for Protecting World against Natural Hazards" on August 23-24, 2024 in collaboration with ICAR-Central Agroforestry Research Institute (ICAR-CAFRI), and the Indian Society of Agroforestry (ISAF) in Jhansi, Uttar Pradesh. Growing challenges and opportunities in the environment sector including the human perspectives and efforts in policy making within context of changing scenario of climate warrants focus group discussions on the matter and evolve strategic framework to help enabling the policy making process of the government.

I am sure, this Conference will come out with useful recommendations for a resilient, adaptive, and sustainable future for environmental management.

I wish the Conference a great success.

(Rana Pratap Singh)

School of Chemical Technology
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956

Message

I am very happy to send my best wishes for the success of the upcoming National Conference on SHASHWAT SRISHTI SANRAKSHAN 2024, which is being put together by Save the Environment, Kolkata, in collaboration with the Indian Society of Agroforestry, ICAR-Central Agroforestry Research Institute, and SSCE, New Delhi. In my opinion, this meeting will be very important because it will provide a place for important conversations about how agrobiotechnology and natural hazard mitigation work together. This event is a one-of-a-kind chance to learn and grow because people can talk to experienced professionals, go to life-changing workshops and seminars, and share their own work. These kinds of interactions can have a big effect on their future jobs and contributions to society. This meeting will also leave a lasting legacy of knowledge and action by helping to raise the next generation of leaders and problem-solvers. The meeting has a lot of potential from a policy point of view. Policymakers and decision-makers who attend the event will be able to get insights based on proof, solutions based on data, and policy suggestions based on the latest research. These findings can help strong policies be made to improve food security, make people better prepared for disasters, and make communities stronger.

I want to thank the outstanding leaders of Save the Environment, ICAR-Central Agroforestry Research Institute, the Indian Society of Agroforestry, and SSCE, New Delhi, from the bottom of my heart. I also want to thank all the hard-working members of the organising committee for making this conference possible. I'm sure that the discussions will result in big benefits for the people who are involved, and I want this event to be a huge success again.

Dr. Sankha Chakrabortty
Organizing Secretary
SHASHWAT SRISHTI SANRAKSH-2024

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ABOUT ORGANIZERS

ICAR-CENTRAL AGROFORESTRY RESEARCH INSTITUTE

ICAR-Central Agroforestry Research Institute (ICAR-CAFRI), formerly the National Research Centre for Agroforestry, is a multidisciplinary premier research institute of the Indian Council of Agricultural Research (ICAR) with a major focus on integrating trees, crops and livestock on the same farmland. With vision to improve quality of life of rural people through integration of perennials on agriculture landscape for economic, environmental and social benefits. This is the only dedicated research institute of the country working on key research areas of agroforestry. CAFRI has developed robust agroforestry models and package of practices for different agroclimatic conditions covering small and marginal farmers and provides technical backstopping to the States and stakeholders. For details, please visit: https://cafri.icar.gov.in

SAVE THE ENVIRONMENT

Save The Environment (STE) was founded and registered on 19th November 1990 [Reg no. S/66/489 of 1990-91]. Since then, STE has been privileged to collaborate with organizationsand departments of repute, like WWF (India), AIIHPH, Indo-Canada environment facility, DST and DRDO to counter the long-standing issue of arsenic poisoning of water, especially in rural areas of West Bengal, India. STE has also been actively engaged in spreading awareness among general public for environment protection and water management. For further details please visit: http://stenvironment.org

INDIAN SOCIETY OF AGROFORESTRY

The Indian Society of Agroforestry (ISAF) is a non-for-profit society that dwells on information generation, dissemination and promotion of agroforestry and allied sectors for the cause of enhancing the socio-economic and environmental benefits to the farmers and stakeholders. The Society was founded during the Golden Jubilee Year celebrations of India's Independence in July 1998 with the following objectives:

- To encourage basic, applied and strategic research in the field of agroforestry.
- To disseminate knowledge and technology related to agroforestry.
- To organize & provide facilities for seminars and conferences for agroforestry, scientists, environmentalists, research and development workers and farmers.
- To encourage close cooperation among organizations having interest in the field of agroforestry.

For further details please visit: https://indiansocietyofagroforestry.wordpress.com

THE SOCIETY FOR SCIENCE OF CLIMATE CHANGE AND SUSTAINABLE ENVIRONMENT (SSCE)

The Society for Science of Climate Change and Sustainable Environment (SSCE) has been formed to lead the awareness drive on various impacts of climate change. Society is planning to initiate awareness drive by writing various articles related to climate change, initiating a review journal, organizing seminars and conferences and highlighting the options of various stakeholders such as farmers, scientists, policymakers, teachers, students and government officers. This awareness drive will help in understanding the causes and consequences of global climate change and their impact on agriculture crop productivity and food security. For details, please visit: https://ssceonline.wordpress.com/

SKSS-SARVHIT KALYAN SEVA SAMITI

SKSS-Sarvhit Kalyan Seva Samiti (a non government organisation) operational since 2010 is devoted to the cause of environment protection, reforestation, healthcare and to support women and girl child protection and empowerment. Team Sarvhit is harbinger of hope and sustainability against all odds. Sarvhit has opened chapters of its objectives in different cities over last 14 years and it continues to spread its wings in different corners of the nation.

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Save the Environment

SAVE THE ENVIRONMENT
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National Conference
on

SHASHWAT SRISHTI SANRAKSHAN

"A Pledge for Protecting World against Natural Hazards: Agro-Biotechnological Approach"

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INVITED Speakers

Remediation of Radioactively Contaminated Areas by Phyto/Bioremediation

Dr. Dharmendra K. Gupta

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Abstract

Cleaning up of the environment through plants is considered in diverse environmental pollution problems, either through direct uptake of toxic elements, followed by subsequent transformation, transport, and their accumulation in less toxic forms. Moreover, remediation processes are being augmented by plant root exudates and enzymes that induce microbial diversity in the rhizosphere, biochemical activity in the bulk soil and mineralization. Plants deal with contamination through the strategies of stabilization, exclusion, detoxification and/or their storage in specific cells or cell organelles (vacuoles & cell walls).

In case of fungus/mushrooms several factors influence the bioaccumulation of trace elements. Under natural conditions, elemental accumulation may vary due to major factors like, the substrate on which it is growing (and related bedrock geochemistry), fungal lifestyle (for example, growing as saprotrophs), species etc. Other factors like, organic matter content, pH/Eh conditions, moisture availability, porosity as well as the source term of the contaminants influences the elemental uptake, however, the uptake process is poorly understood in case of macro fungi.

This practical approach is already trailed at field trial site at Chernobyl Nuclear Power Plant blast affected areas (Exclusion Zone) in Ukraine and the results were very positive towards low radioactive contaminated areas in the exclusion zone, to use both fungus and plants together to combat from radioactive toxicity problems in the field to grow food and fodder in future for normal use. The detail of this work is going to be discussed in the meeting.

Brief About **Dr. Dharmendra Kumar Gupta**

Dr. Dharmendra Kumar Gupta worked in several European countries for more than nineteen years, before joining in India in July 2019 as Director(S)/Scientist "F" at Ministry of Environment, Forest and Climate Change, New Delhi, he was working as Sr. Scientist at University of Hannover, Germany for more than six and half years for a soil reclamation (cesium and strontium) project which was executed at Chernobyl Exclusion Zone in Ukraine. The results were very promising and already been published in peer reviewed International Journal, which was very well taken and also used for the decontamination of Fukushima Daiichi area in Japan.

His field of research includes abiotic stress by radionuclides/heavy metals and xenobiotics in plants; antioxidative system in plants, environmental pollution (radionuclides/heavy metals) remediation through plants and microbes (phytoremediation/Bioremediation).
He has been awarded several International awards such as the Japan Society for the Promotion of Science (JSPS), the Belgian Science Policy Award (BELSPO), JAE-Doc. (Spain), TWAS-CNPq (Italy), Royal Society India Fellow (U.K.), MASAV (Israel) and also he is one of the recipients of Jawaharlal Nehru Scholarship for the Year 2000.

Dr. Gupta has published more than 130 International peer reviewed original research/review articles/book chapters with total SCI factor of 454.80, h-Index 47 and i10Index 101. The total citation of his work by other researchers is 9000 (Google Scholar). He has successfully completed 10 multidisciplinar y research projects from International/National bodies.

Besides, he also published 26 books from leading publisher like Springer . Till date his all books are downloaded more than 3,00,000 times. He also served as 2 book Series editor from Springer, Switzerland and 1 from Scientific World, Singapore.

Climate Resilience Through Agroforestry

Dr. G.R. Rao

Principal Scientist, ICAR-CRIDA & Former Director, TFRI, Jabalpur

Abstract

The Intergovernmental Panel on Climate Change (IPCC) prediction of temperature increase between 1.1°C and 6.2°C by the end of the century will most likely create extreme changes in temperature and precipitation. Farmers in developing countries who depend on rain-fed agriculture and natural resources for food production and income generation may particularly experience greater levels of poverty and hunger as their sources of livelihood become increasingly exposed to climate-related risks. The potential fallouts of climate change have been identified to include rise in temperature, much more erratic rainfall regimes, increased frequency and intensity of extreme events, and general unpredictability of agricultural operations among other effects. These have grave economic, social, and ecological consequences for agriculture and food security in many countries particularly, where agriculture is largely rain-fed. Climate change will affect developing countries more severely because of their low capacity for adaptation. Within these countries, the agricultural sector is particularly vulnerable, putting rural populations at risk. In the quest to provide food and fiber to an expanding human population, the provision of agriculture-based ecosystem services that help to moderate climate change is increasingly under threat. Social protection in agricultural settings, however, has not been examined through the lens of adaptive capacity where elements such as assets, institutions, information, innovation and decision-making come into play. Social protection has also not been thoroughly explored within agroforestry contexts, which is an agricultural system that encourages the planting of trees on farms and which currently globally covers 46% of agricultural land where 558 million people live. Therefore, the current understanding of the linkage between adaptive capacity and social protection within agroforestry is limited.Yet agricultural research in the last few decades has been addressing the need to cope with adverse and irregular climatic conditions including rainfall variability or shifting weather patterns. Similarly, there has been a major emphasis on improving the productivity of agricultural systems, leading to the understanding that increasing soil carbon stocks in degraded lands is essential for enhanced productivity. Agroforestry provides a unique opportunity to reconcile the objectives of mitigation and adaptation to climate change. A wide range of studies have substantiated the fact that agroforestry systems, even if they are not primarily designed for carbon sequestration, present a unique opportunity to increase carbon stocks in the terrestrial biosphere.

Brief About **Dr. G. Rajeshwar Rao**, B.Sc.(Ag), M.Sc. & Ph.D.(Fty)

Graduation in Agriculture given me exposure to various disciplines in Agriculture/Horticulture. Training at ICAR-NAARM for a period of five months in Agricultural Research Management helped in learning the various facets of agriculture & allied research project management and basics in Administration of ICAR-Institutes. I have 30 years of R&D and Extension experience in various capacities in ICAR-Institutes (CRIDA, IGFRI & CAFRI). As an Officer-in charge of 700 acres Research Farm at ICAR-CRIDA, implemented the approved projects and research experiments related to various aspects Agriculture/Horticulture/ Agroforestry, helped in understanding various insights in practicing and managing resources and labour. AS Nodal office conducted 3 farmers' Melas at Research farm. As a Director of ICFRE-Tropical Forest Research Institute, TFRI, Jabalpur,M.P. & regional station FRCSD Chindwara, 4 VVKs , got experience in facilitating and monitoring the R&D and Extension programs of the institute;Chaired Research Advisory Group meetings; collaborations with SAUs, KVKs, NABARD, Farmers, World Bank, USAID etc, and other stakeholders for generating funds from external agencies and implementation of extension programmes of the institute As Director I supervised and Monitored Four AICRPs including one on conservation and sustainable management of wild edible fruits. As a member secretary of ICAR-Statutory committees viz., Combined Research Advisory Committee of ICAR-CRIDA, Hyderabad and ICAR-CAZRI, Jodhpur gained experience in Research Project formulation on various issues of National importance in Arid & Dryland Agricuture/Agroforestry. As a Member, Scientific Advisory Committee of Krishi Vigyan Kendra-ICAR-CRIDA got opportunity to learn about the implementation of front-line extension programme such as Technology Assessment and Refinement, I conducted On-Farm trials on 40 acres in 2 districts of Telangana. As a Secretary and member of professional societies viz., Indian Society of Dry land Agriculture, Hyderabad facilitated in publication of research articles and organizing Seminars and symposia in Agriculture and allied subjects. Implementation of Consultancy Projects such as 'Evaluating the work done under Community managed sustainable agriculture (SERP) etc. helped in understanding and implementation of various programmes in Agriculture.

Addressing High-Altitude North-Western Himalayan Water Quality Challenges: Collaborative Solutions and Future Prospects

Dr. Vijay K. Bharti

DRDO-Defence Institute of High Altitude Research (DIHAR)
Leh-194101, UT Ladakh, India.

Abstract

The north-western Himalayan region is India's most important natural water resource, with an extensive glacier reserve that provides water lifelines to millions of people. Indus, Jhelum, Chenab, Beas, R avi, Sutlej, and Kali are the important rivers that originate from Karakoram, Ladakh, Zanskar, and Kailash ranges of the north-western Himalayas, which spread into the Indian states of Uttarakhand, Himachal Pradesh, UT Ladakh, UT Jammu & Kashmir, and Pakistan-occupied part of Kashmir. The various studies revealed the changes in hydrological balance, changes in river flow, deterioration of water quality due to increased anthropogenic activities, high meteorological variability, and the complex interplay between climate change and hydrological processes. Our field survey and laboratory analysis report since 2011-2024 on water quality of springs, ponds, lakes, the Indus River, the Shyok River, the Zanskar River, and groundwater of the Ladakh region suggests the gradual decline of water quality in terms of heavy metals, coliform bacteria, and physico-chemical characteristics. These studies also revealed the seasonal variations in different water resources and the interrelationship in the bioavailability of minerals in plants and livestock. Therefore, these scientific evidences are strongly supporting the immediate need for joint and collaborative efforts for high-altitude water research, development of high-altitude based water technology, preventive community and public health measures, management of the of the Himalayan water ecosystem, and environmental protection among these Himalayan state government departments, water science researchers, engineers, academic and research institutions, NGOs, local communities, and national and global bodies, which will help in protecting these water resources and improving water quality. Future prospects are sharing the data and knowledge on water quality and water resource management, establishment of field water testing labs, three-monthly microbial testing of various water resources, implementation of community-based water quality management, control of human access to important water sources, implementation of pollution control measures, regular community campaigns, and capacity building on the importance of water quality and preventive measures. Therefore, this invited lecture will focus on current status of water quality of these water resources, how extensive R&D on high-altitude water resources and collaborative efforts-based preventive solutions are essential for protecting North-western Himalayan water resources and improving the health of soil, plants, animals, and humans in this region.

Keywords: High-altitude region, North-western Himalayas, Physico-chemical parameters, Indus River, Water quality.

Brief About **Dr. Vijay Kumar Bharti**

Dr. Vijay Kumar Bharti is currently working as Scientist-F (DRDS) and Group Head at DRDO-Defence Institute of High Altitude Research, Leh. He obtained his B.V.Sc. & A.H. in 2002 from Veterinary College, Bidar, Karnataka; his M.V.Sc. from the College of Veterinary Sciences, Hisar, Haryana; and his Ph.D. in 2008 from ICAR-Indian Veterinary Research Institute, Izzatnagar, UP. Dr. Bharti also worked as an ARS scientist at ICAR-CIRG, Makhdoom, UP, in 2009. His work mainly focuses on understanding the adaptation and nutritional physiology of animals under stress in high-altitude environments. He has significantly contributed in the areas of High-altitude water research, extreme climate adaptation physiology and nutrition in animal species, Pineal gland research, and Metal toxicology. He has more than 100 high-impact publications in national and international peer-reviewed journals, two patents granted, and two patent applications under consideration. His work contributed to the registration of new cattle breeds from Ladakh 'Ladakhi' in 2018. Dr. Bharti has developed 09 high-altitude animal technologies and products; among them, the fast-growing broiler goat breed 'SINDHU', the high-mountain hatchery 'Normobaric Hatchery', and dual-purpose chicken lines 'LEHBRO-1 & LEHBRO-2' for meat production are path-breaking research achievements for veterinary sciences in a high-altitude cold desert region of the country and abroad. He has guided seven Ph.D., one M.V.Sc., two M.Sc. theses, and more than 30 graduate/summer trainees for their dissertation/project training. He has received many prestigious awards, recognitions, and appreciation for his academic and research contributions.

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Climate Change and Soil Health: Vulnerability Assessment in Jammu & Kashmir's Himalayan Region

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Abstract

Climate change impact and vulnerability assessment at state and regional levels is necessary to develop adaptation strategies for the biogeographically vital Himalayan region. Recent climatic shifts and changing land use patterns increasingly threaten the region's varied topography and climate. This study aims to assess the vulnerability of soil health due to climate change in the Jammu & Kashmir region of the Indian Himalayas. Utilizing data from soil quality assessments, the research highlights key vulnerabilities including increased soil erosion, reduced soil fertility, and altered soil moisture levels. Unpredictable and irregular rainfall patterns, aggravated by climate change, contribute to heightened risks of landslides and soil erosion, while intensified weather events, such as heavy rainfall and prolonged droughts, destabilize soil further. Erosion rates have surged to 30-50 tons per hectare per year in some areas, leading to significant topsoil loss and threatening agricultural productivity and ecosystem stability. About 7 million hectares (31.6%) experience various forms of soil degradation. Of this degraded land, 77.78% is impacted by water erosion. Additionally, waterlogging and flooding affect 2.85% of the total degraded area. According to the Ministry of Agriculture & Farmers Welfare, about 13,69,000 ha of cultivable area in the state of Jammu & Kashmir is affected by soil erosion. Land use changes, including agricultural expansion, urbanization, and infrastructure development, exacerbate soil compaction, nutrient depletion, and organic matter loss. Without effective soil management strategies, these vulnerabilities are expected to increase, threatening regional food security and ecosystem health. The present study underscores the urgent need for adaptive land management practices and recommendations including sustainable agriculture, reforestation, and erosion control measures to mitigate adverse impacts and enhance soil resilience amidst ongoing environmental changes and interventions, restore health and productivity, and build long-term resilience to climate change for Jammu & Kashmir.

Keywords: Climate Change, Jammu & Kashmir, Vulnerability, Indian Himalayan Region, Soil Health.

Climate Smart Forestry (CSF): Insights from Tree Genetic Resources (TGR)

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Abstract

Climate Smart Forestry (CSF) is a novel concept in era of climate change, encompasses storing carbon in forest ecosystems, building on the principle of reduction and/or removal of GHG emissions, adapting and building forest resilience to climate change and sustainable increase in forest productivity and income. Climate-smart measures include managing forest disturbances and extreme events, selecting resilient trees, implementing forest reserves, combining carbon storage and sequestration. Forests are leveraged as a nature-based solution for climate change. Forest tree species are being threatened by climate change due to fluctuations in the frequency and intensity of heat, drought, salinity and the incidence of pathogens and pests. Therefore, it is essential to explore interactions among biotic and abiotic components, phenotypic plasticity Tree Genetic Resources (TGR) became the imperative element of mitigation and adaptation of forest trees to changing climate. Scientists can utilize (TGR) in adaption of forests to climate change. Specifically, exploring the genomic basis of local adaptation and combining conventional breeding methods are essential for assessing the conditions under which trees will successfully adapt in-situ to global climate change. Predictive genomic approaches that promise increasing adaptive selection accuracy and shortening generation intervals, may also assist the detection of novel allelic variants from tree germplasm, and disclose the genomic potential of adaptation to different environments. Hence, understanding the genomic drivers that underpin adaptive trait variation becomes vital to the conservation TGR and Climate Smart Forest.

Keywords: Tree Genetic Resources, Climate Smart Forestry, adaptive traits, climate change.

Light interception, growth and yield of wheat in Melia dubia-wheat agroforestry system in semi-arid conditions

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Abstract

Agroforestry is a sustainable land-use strategy that enhances overall system productivity by integrating food crops with tree crops or livestock on the same land. This study aimed to optimize the productivity of a Malabar neem (*Melia dubia*)-based agroforestry system by examining the above- and below-ground interactions and their impact on the growth and yield of intercropped wheat (*Triticum aestivum* L.). The experiment evaluated eight treatment combinations based on four directions (North, South, East, and West) and two distances from the tree base (1 meter and 2 meters), using a factorial randomized block design with three replications. Key observations included light intensity (Hz), plant height (cm), dry matter accumulation (g/m^2), chlorophyll content (SPAD value), grain yield (g/m^2), and soil moisture content (%), all of which were statistically analyzed. The study found that light intensity peaked at noon and was lowest at 5:00 pm. Among the treatment combinations, the highest light intensity was recorded at a 2.0 m distance from the tree base in the South direction. Similarly, the highest dry matter accumulation in wheat occurred at the same distance in the South direction. Although no clear directional trend was observed for SPAD values or soil moisture content, both were higher closer (1.0 m) to the tree base.The interactions between Melia and the intercropped wheat, both above-ground (light and space) and below-ground (soil moisture and nutrients), resulted in higher grain yields in the East (157.5 g/m^2) and South (155.6 g/m^2) directions. Wheat grain yield at the 2.0 m distance was 10.92% higher than at the 1.0 m distance from the tree base. These findings suggest that wheat can be successfully cultivated within a Melia-based agroforestry system.

Keywords: Agroforestry, Light interception, Malabar neem, Tree-crop interaction.

Role of Miyawaki Plantation technique in achieving the targets of carbon neutrality: A case study in the metropolitan city of Mumbai, India

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Abstract

It is evident from the current weather extremities across the globe that climate change is an inevitable global challenge which needs to be addressed at top most priority. Industrialization is considered as the primary factor for increase in Greenhouse gas emissions leading to all the global climatic catastrophe. Forests can help to restrict the impact by regulating and stabilizing the climate by capturing the GHGs as carbon stock. Being developing nation arapid industrial growth is expected for economic development, the Miyawaki plantation technique will play a pivotal role in balancing the development and environment. A study was carried out to evaluate the microclimate of manmade forests in highly populated city of Mumbai. A total of eight sites of different age groups were evaluated to understand the micro-climate of the Miyawaki Plantation. Number of trees per hectare, temperature, humidity and light intensity from plantations inside and outside the Miyawaki Plantation data were recorded. As results, In terms of temperature, the difference in temperature between inside and outside the plantation ranged from 0.5°C to 2.4°C between all sites during the month of August. The humidity ranged between 74% and 98% inside the plantation and 66% to 98 % outside the plantation. The intensity of the light ranged between 300 lux - 1533 lux and 1467 lux - 2000 lux on the inside and outside of the plantation, respectively. This difference in light intensity was due to the dense canopy at all plantation sites. Such low light penetration inside the plantation may lead to a plantation site free of weeds. Microclimate plays an important role in forest growth and health. The Miyawaki plantation site has a greater number of trees per hectare of land for maximum carbon sequestration potential as compared to other planted land areas. The adoption of this technique under suitable guidance of reputed institutes will help achieve the targets of carbon neutrality.

Keywords: Climate change, Industrialization, NDC, City Forest and Microclimate.

Need and necessity of incubation to boost agroforestry

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Abstract

Agroforestry, the integration of trees and shrubs into agricultural systems, offers significant environmental, economic, and social benefits. However, its widespread adoption faces numerous challenges, including a lack of awareness, limited technical knowledge, and insufficient financial support. Incubation programs, which provide targeted support to emerging agroforestry enterprises, are crucial in overcoming these barriers and accelerating the growth of this sustainable practice. Incubation centers offer a comprehensive suite of services, including mentorship, training, access to markets, and financial assistance. These resources help agroforestry practitioners enhance their technical skills, adopt innovative practices, and develop viable business models. By facilitating knowledge transfer and innovation, incubators play a pivotal role in optimizing the productivity and sustainability of agroforestry systems. Moreover, incubation helps bridge the gap between research and practical application. Through partnerships with academic institutions and research organizations, incubators can translate scientific advancements into practical solutions for farmers and landowners. This collaboration ensures that agroforestry practices are based on the latest evidence, enhancing their effectiveness and scalability. Financial support is another critical component of incubation. Start-up funding, grants, and investment opportunities provided by incubators enable agroforestry projects to overcome initial financial hurdles. This support not only helps in establishing agroforestry systems but also ensures their long-term sustainability by fostering financially viable enterprises. In conclusion, incubation is essential for promoting agroforestry as it addresses key challenges and accelerates the adoption of this sustainable practice. By providing technical support, facilitating knowledge transfer, and offering financial assistance, incubation programs can significantly enhance the impact of agroforestry, contributing to environmental conservation, economic development, and social well-being.

Keywords: Agroforestry, Business incubation, Ecosystem services and Biodiversity conservation.

Reviewing Socio-ecological importance of Agroforestry practices for Restoring climatic scenarios of Bundelkhand region

Manish Chandra*, Naresh kumar, Asha Ram, A.K. Handa, R.P. Dwivedi, A. Arunachalam

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Abstract

Agroforestry is collective name of land use systems and technologies. Globally, climate change has become big threat of sustainable development due to Human activity and excessive use of resources. Instead of that drought is big challenge which affected the Agriculture systems of Bundelkhand region. In this study we assessed the climatic events and their adverse effects on agriculture productivity, and subsequently evaluated effectiveness of different agroforestry systems, resilience their adverse effects. The finding shows that both, climate change and scarcity of water damage agriculture. Nevertheless, We find that agroforestry practices as an important extant adaptation measure to climate shocks, its resilience benefit are more apparent against severe climatic events in long run. The role of different agroforestry models for enhanced farmers livelihoods through better access to food, timber, fodder, and fuel wood and greater access to socioeconomic resilience. Though agroforestry practices increase species diversity, provide carbon sequestration. The large diameters of tree stored more carbon, anthropogenic and (GHGs) emission can be avoided such carbon sinks are particularly important for reaching net zero emission by 2050. The huge potential of agroforestry now a day's miraculous component of landscape restoration initiatives. In different Agroforestry systems adopted climate change, reduces soil erosion and make ensure microclimate for livestock and crop that mitigate droughts. Our study can be of interest for future policy interventions focusing on sustainable reforestation practices, how to solve the problems faced by the farmers, and livelihood improvement in Bundelkhand region.

Keywords: Agroforestry, Resilience, Livihoods, Carbon sequestration, Bundelkhand region.

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Agroforestry innovations and technologies: a pragmatic approach for sustainable production in changed scenarios

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Abstract

Agroforestry systems combine trees, crops, and animals to effectively reduce the negative effects of climate change, improve the ability to withstand challenges, and encourage the use of sustainable agricultural methods. Agroforestry provides advantages such as carbon capture and storage, soil moisture conservation, and a variety of food sources. Integrating nitrogen-fixing and multipurpose tree species into agroforestry systems enhances soil fertility, biodiversity, fodder, fuel, fibre, and food availability, besides carbon sequestration. Furthermore, the use of precision agricultural techniques, remote sensing, and geospatial analysis improves agroforestry planning, monitoring, and management, which may make it more significant in changing climatic scenarios. The adoption of innovative agroforestry methods and establishing agroforestry value chains may further enhance its role in climate-smart agriculture. Therefore, in order to widely adopt and scale up agroforestry practices, it is crucial to have supportive policy frameworks, institutional backing, and knowledge dissemination. It is well known and documented that agroforestry can help promote climate-resilient livelihoods, ecosystem services, and sustainable rural development. Despite its perceived benefits, its adoption is not as it should be. This paper emphasizes the role of agroforestry innovations and technologies in promoting sustainable food production, mitigating climate change, and building resilient agricultural systems in the context of a fast-evolving world.

Keywords: Agroforestry, climate change, climate smart agriculture, carbon sequestration and food production.

Effect of different spacings of *Ailanthus excelsa* on growth and yield performance of lentil in Bundelkhand

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Abstract

Ailanthus excelsa is an important fast-growing agroforestry tree species for arid and semi-arid regions. It is one of the promising fast-growing multipurpose trees of dry areas due to its ability to grow well with less rainfall and in strong light conditions. It is the tree species of industrial utility. An experiment was carried out in the semi-arid region of Bundelkhand during the Rabi season of 2023-24 to evaluate the influence of different tree spacing on the growth and yield attributes of lentil. During the experiment, two different spacing were studied: 5m × 3m and 5m × 4m. In addition, two different cropping systems specifically sole cropping and intercropping, were examined in relation to Alianthus excelsa. The data analysis revealed that plants grown in open condition had superior growth and productivity traits in comparison to those cultivated under agroforestry. A comprehensive investigation was performed on different growth and yield characteristics, uncovering a significant influence of growing circumstances on both plant growth and yield. The results suggested that in sole cropping, parameters such as plant height, number of pods per plant, number of branches, dry matter accumulation, number of root nodules per plant, number of days taken for 50% flowering, number of days taken to physiological maturity, crop growth rate, absolute growth rate, grain yield, and biological yield were higher compared to agroforestry. Tree spacing had a significant impact on the growth and yield characteristics of lentil. The parameters were spacing had a significantly determined to be more optimal when utilizing a spacing of 5m × 4m as compared to a closer spacing of 5m × 3m. The tree species has the capacity to bring significant benefits and adaptability to the development and prosperity of the Bundelkhand region in the semi-arid portions of India.

Keywords: Lentil, Spacing, Ailanthus excelsa, Agroforestry, Bundelkhand.

Impact of Climate Change on Tomato (*Solanum lycopersicum*) Genotypes in Naturally Ventilated Polyhouses in the Kumaun Hill of Central Himalayas

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Abstract

In the quest to enhance tomato (*Solanum lycopersicum* L.) production in challenging climates, the evaluation of various genotypes under controlled yet naturally ventilated polyhouses conditions offers a promising strategy. This study investigated the performance of selected five genotypes of tomato-Panth Bhar, Pant Tomato-3, Pant olyhous Tomato-3,Heemsphan and Apoorva grown in a Polyhouses situated in the Kumaun Hill of the Central Himalayan region, known for its distinct climatic challenges and altitude-related conditions. Our innovative approach involves a comparative analysis of genotype adaptability and yield efficiency growth parameters within a naturally ventilated Polyhouse environment with natural airflow, we aimed to optimize growth parameters and fruit production of different tomato varieties. Tomato is one of the world's most significant and nutritious vegetable fruits. In India, Main performance indicators such as fruit width, fruit length, average fruit weight, yield per plant and quality attributes were meticulously monitored. Pant bhar is superior over other varieties with respect to fruit length (5.33cm). average fruit weight (84.33g) and fruit yield per plant (4.42kg). Pant tomato -3 is second most superior variety with fruit length (4.63cm), fruit width (5.09cm), average fruit weight (83.85g) and fruit yield per plant (4.42kg). Highest luminous (L*=49.12), TSS (5.93ºB), reducing sugar(1.89%) and total sugar (3.31%) were estimated in genotype pant bhar wheares highest red colour(a*42.43) and total antioxidant activity (27.66MTE) were found in 'Pant tomato-3'.This unique method allowed us to assess not only the genotypic responses to semi-controlled environments but also the Polyhouse's role in modulating microclimatic conditions conducive to tomato cultivation in high-altitude regions. Our findings reveal that specific genotypes exhibited remarkable adaptability and superior yield performance under these semi-controlled conditions. This study would strengthen the adaptability of horticultural crop like tomato grown in naturally ventilated Polyhouse established in the climatically vulnerable Himalayan region .

Keywords: Central Himalayas, Climate change, Fruit yield, Genotypes, High-altitude, Naturally ventilated polyhouses, Tomato.

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Regulation of Shade Responses in Crops-An Agroforestry Standpoint

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Abstract

Incidence of sunlight and its subsequent signalling to drive photosynthesis is an essential requirement to achieve optimum growth and productivity of crops. Shade is manifested by reduced sunlight incidence, which can be caused by a variety of natural and circumstantial factors, including intercropping, fogs, clouds, and the implementation of agroforestry (trees impose shade on understory crops). Moreover, light gradients are ubiquitous in nature, so all plants are exposed to some degrees of shade during its life times. Crop can respond to the varying intensity of shade through avoidance and tolerance mechanism. The minimum light requirement of the plants for its survival is a crucial trait that play a major role in plant community dynamics. There is consensus on the suites of traits that influence shade responses, but debate is over the relative importance of traits, maximizing photosynthetic carbon gain in low light versus those minimizing losses, which can significantly contribute for shade avoidance and tolerance. Although high density planting or vegetative shade evokes several shade avoidance responses (SARs), which includes stem and petiole elongation, reduced branching, early flowering, early dark induce senescence (DIS), these SARs are achieved with compromised yield. However, shade tolerance responses (STRs) are not well understood in crop species, though it is speculated that shade tolerance can be implemented by targeting the components which are also known to regulate shade avoidance responses. SARs are controlled by combined action of light and plant hormone signalling. Photoreceptor facilitated shade response includes phytochrome, cryptochrome and phototropin mediated signalling. It is well known that Arabidopsis genome contain five genes for phytochrome (PHYA-PHYE), where PHYB functions a major regulator of SARs through phosphorylation of the positive regulators of SARs by its ubiquitinated degradations under high R:FR conditions. In addition, plant hormones like auxin and gibberellin integrated with light signalling through YUCCA and DELLA medicated signalling for SARs. Henceforth, understanding of morphological, physiological, biochemical and molecular mechanisms governing shade avoidance responses (SARs) in crops will pave the way to target genes for breeding shade tolerant cultivars by manipulating SARs without yield penalty. Furthermore, identification of traits and genes for STRs will provide an opportunity for gene editing through CRISPR-Cas9 technology to further development of shade tolerant line, which can be integrated in various agroforestry systems/models for sustainable land use and in area having low light condition.

Keywords: Shade, Light, Shade avoidance, Shade tolerance, Agroforestry.

Neglected and Underutilized Horticultural Crops of Bundelkhand Region: Status, Importance, Conservation, and Their Traditional Knowledge

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Abstract

The Bundelkhand region is bestowed with a wide diversity of underutilized fruits (Ankol, Bael, Custard apple, Chironji, Jamun, Kath Jamun, Lasoda, Mahua, Manilla Tamarind, and Woodapple), vegetables (Kakoda, chinch, Chakwad, Nonia, Sorrel, Tomatillo/Husk tomato), and medicinal plants. Besides this, many other plants need to be further explored for their potential uses. This wide variety of underutilized crops, which are neither commercially cultivated nor traded on a large scale, are cultivated or found in the wild, traded, and consumed both locally. In addition, they are exceptionally rich in important phytochemicals and have nutritional, ethnobotanical, and ethnomedicinal value. They are good sources of both macro- and micro-food elements and therefore their consumption has shown great potential in addressing hidden hunger by ensuring that communities are well-nourished. In addition, the fruits contribute significantly to economic welfare and poverty alleviation among smallholder households by providing income and profits from sales of fresh and value-added products. Nevertheless, their domestication receives less attention to the extent that they continue to be branded "underutilized" and "underexploited." Nowadays due to severe climate change and heat wave effect most of the agronomic and horticulture crops are facing severe mortality. Therefore, these crops in the Bundelkhand region are one of the few untapped bioresources that require special attention to address several issues related to food insecurity, sustainable food production, and consumption.

Keywords: Bundelkhand, Conservation, Horticulture, Traditional, Underutilized.

Length-Weight Relationship and Condition Factor of a Threatened Climbing Perch (*Anabas testudineus*) from Arrah (Bihar), India during Non-Breeding Season

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Abstract

The purpose of this study was to calculate the length-weight relationship as well as the condition factor of a threatened freshwater climbing perch, *Anabas testudineus* (total length: 5-18cm; body weight: 12-58g) from Arrah (Bihar), India to assess the importance of allometric factor and well-being. From September 2022 to March 2023, a total of 458 fish specimens were collected for this purpose. For the total fish, the length-weight relationship was calculated as y = 3.610x - 5.619 (logy = 1.836 logx - 0.430) with coefficient determination = 0.914. This indicates that the species' growth is negative allometric and a statistically significant correlation (r) was calculated between the length and weight of the sampled fish. The coefficient determination (R2) ranges from 24-97% (r= 0.488-0.986) indicating a proper growth pattern. Fulton's condition factor values ranged from 1.346 to 3.613 indicating that the fish was in good health. The average values of condition factor (K) of 2.00 and relative condition factor (K') of 0.999 indicate that its habitat is in good condition. This study is useful in providing pertinent information for understanding fish biology, estimating fish conditions in its environment and assessing population dynamic parameters.

Keywords: *Anabas testudineus*, Length-weight relationship, Condition factor, Relative condition factor, Arrah (Bihar), India.

Choices of Tree Species for Deregulation: A Case Study

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Abstract

Deregulation of tree species refers to the process of relaxing restrictions on harvesting and transportation of certain tree species, often to promote economic development or land use changes. Rules and regulations governing tree felling and transit are generally state-specific, despite repeated representations and recommendations from committees and stakeholders. In Assam, there have been sporadic cases of exempting certain tree species from the regulations. Given the importance of trees and agroforestry, it is imperative to reconsider and potentially revise existing practices and procedures related to tree management can lead to several benefits, such as increased timber production, enhanced agricultural productivity, the potential for reforestation efforts and improvement in trees outside forests (TOF). The Trees Outside Forests in India (TOFI) initiative is a five-year program under the Ministry of Environment, Forest and Climate Change (MoEFCC) of the Government of India. The program aims to substantially increase the extent of tree cover outside designated forest areas within seven Indian states-Andhra Pradesh, Assam, Haryana, Odisha, Rajasthan, Tamil Nadu and Uttar Pradesh. Among the seven participating states, only two-Assam with 36.09% forest cover and Odisha have 33.49%, exceed the 33% threshold for forest area. The remaining five states have significantly lower forest coverage: Andhra Pradesh 18.27%, Haryana 3.62%, Rajasthan 4.86% and Uttar Pradesh 6.15%. Deregulation of tree species in TOFI states would strengthen the efforts to improve tree cover outside forest area and thereby human well-being. Examining the tree felling and transit rules and guiding policy-makers for deregulation are among the key objectives of this project. Here, we have analyzed the accuracy of tree species inclusion in felling and transit rules.

Keywords: Agroforestry, Conservation, Deregulation, Felling and Transit rule, Trees Outside Forests.

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Conservation agroforestry exaggerates the benefits of agroforestry on soil fertility enhancement in *Bundelkhand* region

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Abstract

The *Bundelkhand* region in India is characterized by semi-arid conditions and frequent droughts and soil erosions leading to soil degradation and reduced agricultural productivity. Conservation agroforestry, which integrates conservation agriculture practices to agroforestry, has been proposed as a frontier land management strategy to enhance soil health and fertility. The objectives of this study were to evaluate the impact of conservation agroforestry practices on soil physicochemical properties, phyto-availability of nutrients, and their interrelations under teak-based agroforestry systems in the *Bundelkhand* region. The research was conducted at ICAR-CAFRI experimental farm, employing a randomized block design. Three teak-based agroforestry systems *viz*. conservation agroforestry with maize + linseed rotation [CAF (M+L)], conservation agroforestry with sorghum + chickpea rotation [CAF (S+C)] and conventional agroforestry were compared with a traditional cropland (control) system. Soil samples were collected from three soil depth: 0-20, 20-40, and 40-60 cm. Soil reaction of various land uses varied from neutral to slightly alkaline with no salinity. Soil organic C (SOC) and phyto-availability of nutrients (N, P, K, Zn, Fe, Mn, and Cu) concomitantly decreased with increased soil depth. At topsoil (0-20 cm), teak-based conventional agroforestry significantly ($P < 0.05$) enhanced SOC over cropland to the tune of 196.5%; however conservation agroforestry further enhanced SOC over conventional agroforestry to the tune of 9.5% [CAF (M+L)] and 7.0% [CAF (S+C)]. Although teak-based agroforestry systems significantly ($P < 0.05$) enhanced phyto-availability of nitrogen (N) and phosphorus (P) over cropland, however their availability was comparable between the agroforestry systems. Potassium (K) availability did not show any specific trend along the land uses and thus suggested that its availability was primarily governed by K-bearing minerals rather than agroforestry. Results explicitly indicated that agroforestry systems shifted phyto-availability of zinc (Zn) and iron (Fe) from deficient to sufficient range particularly at 0-20 cm. Copper (Cu) and manganese (Mn) phyto-availability also improved in conservation agroforestry over conventional agroforestry. This study demonstrates that teak-based conservation agroforestry practice exhibits an edge to enhance SOC and phyto-availability of nutrients over conventional agroforestry in the *Bundelkhand* region. These improvements are crucial for soil health, water retention, and resilience to drought, suggesting that conservation agroforestry is a viable strategy for sustainable land management in semi-arid regions like *Bundelkhand*.

Keywords: Conservation agriculture; nitrogen; soil properties; teak-based agroforestry; trace elements.

Perspective of Jainism on the Socio-Cultural and Environmental Values of Sacred Trees

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Abstract

Spiritual values attached to plants maintain socio-cultural and ecological values that play a pivotal role in human well-being. This paper documents the trees associated with Jainism in context of their conservation for sustainable supply of their socio-cultural and environmental benefits. There are twenty-four Tirthankara who made penance under different trees attained salvation. These holy trees are known as Kevli Vriksha. The conservation of these sacred trees is gaining an increasing attention in the twenty first century. Arguments for conservation of Kevli trees can be supported through different arguments like narrowly utilitarian, broadly utilitarian, and ethical. The narrowly utilitarian arguments for conserving tree species are based on their instrumental and economic benefits from trees such as food, firewood, timber, fiber, industrial products (tannins, dyes, and resins) and products of medicinal importance. The broadly utilitarian argument focuses on the role of trees in providing many ecosystem services like ornamental, and air pollution control. Ethical argument relates to what we owe to plants with which we share this planet. This arguments advocate conservation of trees based on their intrinsic value. The ancient practices of the different communities have been integral to conservation of natural resources including trees and thereby contributed to sustainable development. Establishment of Tirthankara Vatikas (Garden) is an important strategy to conserve these sacred trees of Jainism and thus promoting a spiritual framework for biological conservation and sustainable utilization. Therefore, a holistic understanding of the sacred trees of Jainism is essential for assessing their socio-cultural and ecological role and formulating strategies for conservation.

Keywords: Conservation, Jainism, Kevli vriksha, Rituals, Sacred tree, Tirthankara.

Cultural and symbolic status of tree in India: A review study

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Abstract

Spiritual values attached to plants maintain socio-cultural and logical importance that keeps human health by ethno-medico botanical knowledge systems. This paper documents the trees and bamboo associated with Jainism. There are twenty-four Teerthankaras and all those Jain Teerthankaras made penance under different twenty-four trees and attained salvation. These trees are known by the name of Kevli Vriksha. Kevli Vriksha is a holly tree which abodes many medicinal secrets. All the parts of tree are used as medicine. Specifically, the leaves and fruits are mostly used as important drug in the ancient Indian system of medicine to cure almost all the common ailments of human being. The results revealed the use of 24 trees belonging to the different ethnic groups of the Jainism. The broadly utilitarian argument focuses on the role of trees in providing many ecosystem services like ornamental, and air pollution control. Ethical argument relates to what we owe to plants with which we share this planet. This argument advocates the conservation of trees based on their intrinsic value. The ancient practices of the different communities in areas covering religious rituals, and ethno-medicine are indicative of the fact that conservation of resources has been a major driving force in the activities of the indigenous people, hence contributing to sustainable development goals. This calls for a spiritual framework for biological conservation and utilization.

Keywords: Jainism, Kevli Vriksha, Rituals, Sacred tree, Salvation, Teerthankaras.

Investigating the impact of salinity stress on above-ground morphological, below-ground root and physicochemical properties of young Mahua (Madhuca longifolia) seedlings using hydroponics and pot culture

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Abstract

Mahua (*Madhuca longifolia*) is an important multipurpose tree species of Central India providing a significant medicinal, socio-cultural and economic benefits particularly in the Bundelkhand region. Abiotic stress being a major stress affecting the overall growth and development of young seedlings, the current study was planned to investigate the impact of salinity stress on above-ground morphological, below-ground root and physicochemical properties of young *M. longifolia* seedlings using hydroponics and pot culture at ICAR-CAFRI, Jhansi during November 2022 to May 2023 by involving two local collections. The results exhibited a non-linear and significant changes ($p < 0.05$) in almost all the above-ground morphological, below-ground root parameters and physicochemical parameters. Most of these parameters initially exhibited the increasing pattern at lower concentration but mean performance got eventually reduced as the concentration of salinity stress increased. The maximum safe salinity stress tolerance limit varied from 150 to 200 mM concentration based on the mean performance of most of the key parameters. Most of morphological, and root parameters exhibited significant and positive associations with physicochemical parameters except MDA , Phe, Pro, STI. Heat map and dendrogram generated two clusters i.e. Cluster 1 which represented the dominance of MDA, Phe, Pro and STI whereas, Cluster 2 represented the remaining morphological parameters like NOL, SL, RL, SdL, CD, SFW, RFW, SdFW SDW, RDW, SdDW, root parameters like ProA, TRL, NRT, NOF, NOS, MaxD, ERV and physicochemical parameters like LAI, SPAD, Caro, RWC and MSI. PCA revealed that PC1 and PC2 contributed alone to 92.44% towards the total variation which are governed by MDA, Phe, Pro, STI (PC1) and NOL, SDL, SFW, SPAD, Caro, MSI (PC2). Genetic studies revealed the higher magnitudes of CV, PCV and GCV were observed for all the parameters indicated the existence of sufficient genetic variability. Similarly, the high estimate of H2 coupled with high GA indicated the preponderance of additive genetic variance in the inheritance of trait. Further studies involving molecular tools and techniques would significantly help in genetic improvement for major economic traits in this species.

Keywords: *Madhuca longifolia*, Salinity stress, Pot culture, Hydroponics, Genetic studies.

Investigating the physio-chemical responses of green gram (*Vigna radiata* L.) under different shade stress regimes for agroforestry interventions

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Abstract

Shade stress is a major abiotic stress in any agroforestry system that may significantly alter the physiology of underlying crops leading to reduction in overall growth and crops yield. Green gram [*Vigna radiata* var. Virat] was evaluated for its physico-chemical responses under different regimes of shade-stress under controlled net house conditions at ICAR-CAFRI, Jhansi during 2023-24. Our findings revealed that the shade-stress at 50% and 75% levels has significantly reduced overall growth parameters emphasizing the significance of optimum light conditions for increasing the crop productivity of green gram. The reduction in the performance of physico-chemical indices like leaf area indices (LAI), SPAD chlorophyll content (CCI), malondialdehyde content (MDA), and NDVI value indicated the reduction in greenness of leaf cover, chlorophyll content, and enhanced reflectance of near-infrared radiation and absorption of red light under shade-stress conditions. Relative water content (RWC), membrane stability index (MSI), antioxidant activities although increased at 50% shade but got significantly reduced at 75% shade which indicted the adaptive response of green gram plants initially at lower shade regime. The shading effect has also suppressed significantly the performance of photosynthetic parameters like net photosynthesis rate (μ mol CO_2 m^{-2} s^{-1}), transpiration rate (m mol H_2O m^{-2} s^{-1}), stomatal conductance (mol H_2O m^{-2} s^{-1}) measured using IRGA (LI-6400 XT Portable Photosynthesis system, LI-COR) which indicated the pattern of conserving water and CO_2 for mitigating the shade stress at initial levels. Further studies at molecular levels are required to identify the underlying mechanisms of shade stress tolerance and developing shade-tolerant cultivars of green gram crop for maximizing the growth and productivity under any agroforestry system.

Keywords: Green gram, Shade stress, Photosynthesis rate, Stomatal conductance, CO_2 assimilation.

Advances in tissue culture applications for perennial trees genetic improvement

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Abstract

Tissue culture techniques have become pivotal in the propagation and improvement of woody tree species, offering substantial advantages in forestry, conservation, and horticulture. It has enabled the rapid mass multiplication of disease-free, high-quality clones for ensuring uniformity and consistency in tree planting. The endangered and recalcitrant tree species have also been effectively cryopreserved *ex-situ* and multiplied using tissue culture. High valued forest and fruit tree species, for their genetic improvement, germplasm conservation and propagation for industry growth and sustainability, a significant advancement has been occurred in recent years. Interestingly, the recent advances in the molecular/genomic/NGS tools have certainly accelerated the possibility of genetic modification in the perennial tree species for various traits. Incorporating desired transgenes using genetic engineering, altering gene expression using CRISPR/Cas-based genome editing, RNAi, etc., *vis-à-vis in-vitro* regeneration approaches have led to the quicker production of desired plant types in some of the tree species. Genetic transformation for inducing insect resistance in Poplar, Eucalyptus, Picea, Ulmus, Pinus, Tsuga, etc., herbicide resistance in Populus alba, Eucalyptus, Picea abies, Oak, and various conifers, disease resistance in Paulownia, Poplar, by involving tissue culture techniques have been reported in recent years. Likewise, abiotic stress tolerance has also been developed in tree species like Poplar. Similarly, transgenic eucalyptus and Poplar have been developed for improved wood properties involving tissue culture. Further, the production of secondary metabolite (SM) from medicinal trees has a significant industrial relevance and utilizing the tissue culture and molecular tools like transcriptomics and metabolomics could provide a good scope for high SM production. Similarly, a number of horticulture tree species like date palm, banana, citrus, etc., have been genetically modified for higher quality and productivity using tissue culture techniques. Although, a considerable number of studies have been reported in this aspect in last few years, there is a high scope and need for exploiting such techniques for rapid genetic modification and tree breeding in the future.

Keywords: Tissue culture, Perennial tree species, Transgenics, Genome editing, CRISPR, RNAi.

Advancing Tree Breeding: Enhancing Productivity through Marker-Assisted Selection in Agroforestry

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Abstract

Trees are essential for human life, offering both tangible benefits like timber, fruit, and medicine, and intangible ecosystem services. The productivity and genetic improvement of these woody perennials depend on both environmental factors and their genetic potential. Conventional tree breeding, despite its limitations, has historically been used to enhance tree productivity. However, recent advancements in marker-assisted selection (MAS) and genomic technologies have revolutionized tree breeding. MAS exploits non-random associations between markers and quantitative trait loci (QTLs) to improve breeding efficiency and reduce operational costs. Furthermore, next-generation sequencing (NGS) and transcriptome analysis have enabled the identification of genes and markers associated with key traits, facilitating the development of genetically improved trees. Genomic selection (GS) represents a paradigm shift, enabling the capture of whole-genome effects and enhancing breeding efficiency. Future perspectives emphasize the need for comprehensive germplasm repositories, advanced sequencing technologies, and the integration of genomic tools to further accelerate tree improvement programs. By leveraging these genetic and genomic resources, significant advancements in tree productivity and sustainability can be achieved.

Keywords: Markers, Genomics, Selection, Tree Breeding, DNA sequencing.

AMMA: Agroforestry for Mitigating Malnutrition and Adaptation

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Abstract

On the occasion of World Environment Day 5th June 2024, the Hon'ble Prime Minister of India, Sh. Narendra Modi launched the campaign 'Ek Ped Maa Ke Naam' (A Tree in Mother's Name) to commemorate the inaugural day of the 1972 Stockholm Conference on the Human Environment. ICAR-Central Agroforestry Research Institute, Jhansi has initiated "AMMA: Agroforestry for Mitigating Malnutrition and Adaptation" to promote agroforestry in rural areas through "AMMA" model of CAFRI Jhansi. In this model, every staff including scientific, technical and administrative personnel planted a tree sapling in the research farm of the institute in his/her mother's name. On the occasion, a walkathon for "AMMA" was organized at the research farm of ICAR-CAFRI Jhansi. All employees, students and contractual workers planted trees in their mother's name. The different tree species planted are namely Aonla, Jackfruit, Jamun, Mahua, Pomegranate, Banana, Guava, Custard apple, Mango, Papaya, Wood Apple, Drumstick, Dragon Fruit, Citrus spp., Teak, Shisham, Mahogany, Manilla Tamarind, Malabar neem, and Sandal. The "AMMA" model will be very effective to care, conserve and protect the plant species because emotional attachment of a person to the plant with his/her mother. 'Matra Devo Bhava' (Mother is God) equated to earth, is very much in the perception and deeply rooted in the minds of Indian people. This AMMA model will fulfill the theme of land restoration check desertification, and enable drought resilience in the country.

Keywords: AMMA, agroforestry, land restoration.

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Perspectives of *Pongamia pinnata* as a tree resource towards ecosystem services and saving the environment from degradation

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Abstract

Importance of the ecosystem for the existence of the living beings of the globe is undoubtedly inevitable. Maintenance of ecosystem balance and environmental quality remains vulnerable in the context of increasing anthropogenic activities for meeting the necessity of human's needs for developmental and industrial growth throughout the ages. Progressive and cumulative impact of various developmental activities have been reflected in the deterioration of environmental quality. Impact of environmental changes are highly associated with the perturbation of ecosystem functions and in many occasions in the ecosystem components. One of the most alarming causes for affecting the quality of ecosystem functions is the climate change which has affected the levels of several components of our atmosphere which directly and indirectly controlling the ecosystem viability and environmental sustainability. Services from the ecosystem as a whole is a matter of immense significance which encompasses a huge range for their essentiality to continue life in the world and it is influenced by many of the biotic and abiotic components. There are many tangible and intangible services are received from the ecosystems. Role of trees in general and their presence across agroecosystems as in agroforestry practices in particular is crucial for ecosystem services. All the categories of ecosystem services namely provisioning, supporting, regulating and cultural services are provided by the trees both in isolation or in a systematic arrangement in any land use systems. Pongamia pinnata commonly known as "karanj" is one of the important multipurpose tree species which acclaims much attention for its wider role in ecosystem services and saving the environment from degradation. Pongamia tree has proven its potential for mitigating various abiotic stresses which includes drought, heat, cold, salinity and protecting environment from various land degradation as well. Its higher carbon assimilation capacity through photosynthesis has suggested its high potential for mitigating carbon emission in the atmosphere which will help to check the rise of atmospheric carbon dioxide (CO2) concentration due to impact of climate change. Its biofuel from the seeds is recognised as renewable energy for substituting the fossil fuel which can importantly contribute to reduce the GHGs in the atmosphere. Pongamia tree can potentially strengthen the ability of terrestrial ecosystems to capture and store atmospheric carbon dioxide (CO2) which thus immensely offsets GHGs emission in terms of carbon removal for making the environment safer in the background of progressive deterioration of environmental quality. Moreover, various potentials of "karanj" tree for saving the environment from degradation have been discussed.

Key words: Agroecosystem; Ecosystem services; Environmental security; Sustainability; Tree resource.

Bamboo –Subabool- Jackbean based hedge row cropping in degraded lands

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Abstract

An experiment wa sconducted in slopy degarded land in forestry farm arae of RLBCAU university during 2020-2023 with objective of restoration of the land and improvement in soil properties. *Babusa vulgaris* planted at 6 x 8 m spacing and subabool hedges maintaed in 8 m strips along the slope while jackbean is intercropped in between the two rows. The all residue from the field and prunning biomass of sobabul was added to the plot twice in a year. After 3 years of study results shown that there was incremental effect in soil orgaic matter, NPK and other soil physical properties. The microbial biomass and other enzymatic activities also improved. The Jakbean intercrop being a hrdy legume also played important role in soil improvement as well as controlling the soil eroson, weed supression and biomass yield of 5-6 tons/ ha. Though its take 3-5 years' time to complete the restoration but initial three years result shown that the fresh biomass of Leucena 5.7 – 6.6 tons/ ha added along with others grass/ intercrop residue of 5.0 - 8.1 tons/ ha in two cycles in a year. The SOC % of soil improved from 0.15 to 0.45 in 3 years along with SMBC (μg/g soil)27.765 and DHA (μg TPF/g/hr)0.240. Further water holding capacity also improved in the interspaces to facilitate the good growth of intercrops. Various positive impacts on soil health (microbial fauna, structural & nutrient status) and ecological services (C sequestration) reflects that the model can be adopted in reclamation and restoration of degraded lands.The biomass can also be used fodder and intercrops as food crops.

Keyword: Bamboo, Jack bean, Subabool, SOC, Hedge row cropping, restoration, degraded lands.

PAPA: Promoting Agroforestry for Plantation in Agricultural-Lands

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Abstract

ICAR-Central Agroforestry Research Institute, Jhansi has initiated "PAPA: Promoting Agroforestry for Plantation in Agricultural-Lands" to promote agroforestry in agricultural-lands on 5th June 2024, World Environment Day. In 'PAPA' model, agroforestry ambassadors like farmers, farm women, and rural youth planted trees on their farms, fields and bunds in their fathers's name. The different tree species planted are namely Aonla, Banana, Guava, Custard apple, Jackfruit, Jamun, Mahua, Pomegranate, Mango, Papaya, Wood Apple, Drumstick, Dragon Fruit, Citrus spp., Teak, Shisham, Mahogany, Manilla Tamarind, Malabar neem, and Sandal. On the occasion a march for 'PAPA' was organized in the village panchayat by farmers, farm women and rural youth. We believe, 'PAPA' model will be very effective to care, conserve and protect the plant species because emotional attachment of person to the plant with his/her father. 'Pitra Devo Bhava' (Father is God) and equated to the sky, is very much in the perception and deeply rooted in the minds of Indian people. This PAPA model will surely fulfill the theme of land restoration, check desertification and enable drought resilience in India.

Keywords: PAPA, agroforestry, land restoration.

Impact of Ecosystem Degradation on Environment and Human Health

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Abstract

Ecosystem degradation has become a pressing global issue as economic growth and development continue to expand worldwide. This phenomenon poses a significant threat to both environmental stability and human welfare. Driven by human activities like deforestation, urbanization, pollution, and climate change, ecosystem degradation gradually erodes the integrity and functionality of natural systems. Ecosystems, comprising intricate networks of living and non-living components, provide crucial services essential for life on Earth. These include provisioning services (e.g., food, water, raw materials), regulating services (e.g., climate control, water purification, pest management), supporting services (e.g., nutrient cycling, soil formation), and cultural services (e.g., recreation, spiritual fulfillment, aesthetic value). As ecosystems degrade, their capacity to deliver these vital services diminishes. For example, deforestation can lead to biodiversity loss, disrupting food chains and depleting resources for local populations. The destruction of wetlands impairs natural flood protection and water filtration processes. Marine pollution threatens fish stocks and weakens coastal defense mechanisms. The consequences of ecosystem degradation on human societies are becoming increasingly apparent. These manifest as reduced agricultural output, more frequent and severe natural disasters, and a decline in cultural and recreational opportunities. As ecosystems lose their resilience and functional capacity, the adverse effects on human well-being intensify. Tackling ecosystem degradation requires a comprehensive strategy encompassing sustainable land management, ecosystem restoration initiatives, and policies aimed at minimizing environmental impact. By acknowledging the inherent value of ecosystem services and the necessity of their preservation, stakeholders can collaborate to maintain ecological equilibrium and ensure the continued provision of these critical benefits. Ultimately, integrating ecological, economic, and social considerations into management approaches is crucial for mitigating the negative effects of ecosystem degradation and fostering a sustainable future for both natural systems and human societies.

Keywords: Biodiversity, Climate change, Ecosystem degradation, Ecosystem services, Environment, Human health

Natural resource management interventions and farm technical efficiency in semi-arid tropics of central India: An analysis accounting for selectivity bias

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Abstract

This study examines the impact of natural resource management (NRM) activities on farm technical efficiency (TE) in semi-arid Lalitpur district of Bundelkhand region in central India. We estimated stochastic production frontiers, considering potential self-selection bias stemming from both observable and unobservable factors in adoption of NRM activities at farm level. The empirical results show that TE for treated group ranges from 0.68 to 0.72 and that of for control ranges from 0.52 to 0.65, depending on how biases are controlled. Additionally, the efficiency levels of both adopters and non-adopters of NRM activities would be underestimated if the selectivity bias is not appropriately accounted. As the average TE is consistently higher for adopter farmers than the control group, promoting NRM based activities would be imperative to increase input use efficiency, especially in resource-deprived rainfed systems in the semi-arid tropics.

Keywords: Natural resource management, Technical efficiency, Stochastic production frontier, self-selection bias, Bundelkhand.

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Enhancing Agricultural Productivity: The Impact and Prospects of Seed Hubs in India

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Abstract

Seeds Hub centres in India is to assist farmers particularly smallholders with major concerns about the quality of seeds, availability, and accessibility. Seed hubs are centralized points created to supply premium seed, encourage varietal diversity, and facilitate farmers' access to better seed varieties. With the utilization of various research and publications, this review article tries to evaluate the impacts of seed hubs on agricultural productivity, farmer incomes, and comprehensive development in rural areas. The quality and availability of seeds have a major impact on agricultural output in India. Crop yields and overall farm production have historically been hampered by poor seed quality and restricted access to new varieties. The assurance for farmers is to receive seeds that are high germination rates, genetically pure, and appropriate for the growing circumstances in their area. These objectives are in line with broader goals to increase agricultural output, guarantee food security, and improve the standard of living for small and marginal farmers. Impact assessments of seed hubs indicate an array of beneficial outcomes. Better pest and disease resistance brought about by the use of enhanced seed varieties has increased the production of crops stability and productivity. The socio-economic effects of seed hubs are equally significant in their achievements. Farmers now get additional resources as a result of increased agricultural yields. Farmers who have utilized seeds from seed hubs have witnessed a average 25% increase in revenue; in certain areas, the improvements have been substantially greater. Farmers are now able to invest in improved-quality farming equipment, their children's education, and greater standard of living because to this upsurge in income., seed centres have created job opportunities in rural communities. Different capacity building programmes have strengthen the knowledge of farmers in their adoption level which have additionally enhanced the skills of rural workers and encouraged them in upscaling their venture skills. Policy recommendations for addressing these issues include public-private partnerships, awareness campaigns, implementation of strict quality control procedures, training program enhancements, distribution network strengthening, and support for small-scale seed entrepreneurs.

Keywords: Seed Hubs, Agricultural Productivity, Farmers Income, Socio economic impact.

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Long-term tillage and residue management in rice-wheat system: An impact on greenhouse gases mitigation and carbon sequestration

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Abstract

The rice-wheat cropping system (RWCS), spanning 10.3 million hectares in the Indian Indo-Gangetic Plains (IGP), is dominated by extensive conventional tillage, rice residue burning, limited use of organic manure, fixed cropping system, and indiscriminate use of fertilizers and agrochemical. This system contributes significantly to greenhouse gas (GHG) emissions, through conventional practices including various farm inputs (herbicides, fertilizers and diesel fuel) and farm operations (pumping irrigation water). Additionally indirect and direct N_2O emissions from the soil, CH_4 emissions from puddled transplanted rice and rice residue burning contributes significantly to GHG emission. In contrast conservation agriculture (CA) and residue management practices not only mitigate the GHG emission but also enhances the soil organic carbon sequestration. In a 17-years (2006-2022) field experiment, we assessed the effects of conservational (reduced/zero) tillage and residue management (incorporation/retention) practices GHG mitigation and carbon sequestration potential of a rice-wheat system in western Indo-Gangetic Plains (IGP) of India. The experiment consisted of one scenario of conventional tillage (Sc-1: puddle transplanted rice – conventional tilled wheat) and four scenarios of conservation tillage and residue management namely (Sc-2: reduce tilled direct seeded rice (RTDSR) – reduce tilled wheat (RTW); Sc-3: RTDSR-RTW + 1/3rd residue incorporation (RI); Sc-4: zero tilled direct seeded rice (ZTDST) – zero tilled wheat (ZTW); and Sc-5: ZTDSR-ZTW + 1/3rd residue retention (RR)). In comparison to reduced/zero tillage, conventional agriculture (Sc-1) contributed the most (11172.60 kg CO_2eq ha^{-1}) which was 63.50-71.68% greater. The total contribution of GHG emissions under the different scenarios exhibited the following trend: total N_2O (33.9-62.9%) > irrigation (23.6%-32.4%) > rice residue burning (30.32%) > methane emission from puddled transplanted rice (6.6%) > diesel consumption (2.7-5.8%) > seeds (0.68-1.31%) > herbicide (0.20-0.79%). In Sc-1, rice residue burning and methane emission contributed about 3387.2 and 742.56 kg CO_2 eq ha^{-1} respectively. From a system perspective, the carbon sequestration potential exhibited the following trend: Sc-5 (5354.24 kg CO_2 eq $ha^{-1}yr^{-1}$) > Sc-4 (4711.69 kg CO_2 eq $ha^{-1}yr^{-1}$) > Sc-3 (4483.86 kg CO_2 eq $ha^{-1}yr^{-1}$) > Sc-2 (3876.65 kg CO_2 eq $ha^{-1}yr^{-1}$) > Sc-1 (2868.89 kg CO_2 eq $ha^{-1}yr^{-1}$). After 17 years of the experimentation the carbon sequestration potential of reduced tillage and zero tillage system was 45.71% and 75.43% greater, respectively, as compared to conventional tillage system. Conventional agriculture (Sc-1) had the higher carbon footprint (703.93 kg CO_2 Mg^{-1}) in comparison to reduced (222.27 kg CO_2 Mg^{-1}) and zero tillage (143.57 kg CO_2 Mg^{-1}), and 222.83% and 432.48% lesser net GHG emissions, respectively. In nutshell, transitioning tilled croplands to conservation tillage-based RW system and residue management reduces GHG emissions by 38-42%, increases soil carbon reserves, lowers carbon footprints, and enhances system productivity.

Keywords: Conservation tillage, Residue management, carbon sequestration, GHG emission

Entomopathogenic fungus Cordyceps as a dual-edged sword benefiting humans and battling insect pests

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Abstract

Cordyceps is the composite of the genus of Ascomycota fungus that grows on the lar va of insects. Approximately 750 species of the genus Cordyceps have been described; most commonly found in South Asia, Europe, and North America. By balancing its host's life cycle, cordyceps species infiltrate insects, arthropods, and other fungi, evading the host's immune system and maximizing their chances of survival and proliferation and their interaction, resulting in the production of diverse secondary metabolites. Blastopores of *C. fumosorosea* have been reported to be a broad-spectrum pest control for *Spodoptera frugiperda* (fall armyworm) in soybean with a mortality of 80%. Cordyceps spp. has also been used as an insecticide to control *Crocidolomia pavonana* in cabbage with a mortality of 86.7%. Spraying of conidia of *C. javanica* has resulted in the control of *Diaphorina citri* (citrus psylla), a pest infecting citrus plants. Apart from this, China, Japan, Korea, and other eastern Asian nations, make use of natural cordyceps for traditional Chinese medicine. Various compounds found in Cordyceps spp. have the power to both boost and regulate the immune system's heightened response. The various species of Cordyceps are beneficial as they have anti-inflammatory, antioxidant, anti-fibrotic, anti-arteriosclerosis, anti-hypertensive, anti-thrombotic, antimalarial, antifungal, hypolipidemic, antidiabetic, hypoglycemic, anti-asthmatic, steroidogenesis, spermatogenic and anti-aging effects. Cordycepin, one of the major secondary metabolites of *C. militaris* is known for its anti-cancer and antidiabetic effects in humans. Aqueous extract of *C. japonica*, *C. sinensis, C. bassiana* and *C. guangdongensis* has been reported to be medically important for humans due to their immunomodulatory, immunostimulatory and anti-inflammatory properties, respectively. Harnessing Cordyceps' health benefits while understanding its nature as a biocontrol agent can lead to innovative solutions in both medicine and agriculture.

Keywords: Cordyceps. Secondary metabolite. Pest control. Immune system

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Novel Approaches for Encapsulating Plant Probiotic Bacteria with Natural Polymer Gums: Applications in Plant Growth Promotion, Pest Control, and Disease Management

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Abstract

Plant pathogens negatively impact the marketable yield of agricultural produce, affecting both quality and quantity, with significant economic consequences. Major causal agents of plant diseases include bacteria, fungi, viruses, and nematodes, which are responsible for 10–40% losses in food crops and horticultural productivity. Microbial agents offer a sustainable solution for managing plant diseases. However, the direct use of microbial agents on field have their own stability challenges. Encapsulation techniques enhance the stability and efficacy of biocontrol agents (BCAs). These formulations improve the shelf life and controlled release of biological components. Biopolymers such as gums, gelatin, starch, and pectin play significant roles in formulating BCAs. Natural polymers, like gums and mucilage, are biocompatible, cost-effective, readily available, and non-toxic. Gums are hydrophilic polysaccharides that form gels or viscous liquids in water and can be categorized into plant, seaweed, and microbial gums based on their origin. These bio-renewable natural polymers are derived from plants such as *Acacia seyal* and *Acacia Senegal* (Arabic gum), *Astragalus gummifer* (Tragacanth gum), *Streculia urens* (Karaya gum), *Anogeissus latifolia* (Ghatti gum), *Amygdalus scoparia* (Zedo gum), and *Pistacia mutica* (mastic gum). Gum biopolymers hold significant potential for encapsulating BCAs. Encapsulating *Bacillus cereus* in gum arabic enhances its viability by 12.5 %., *Bacillus velesensis* encapsulated with alginate mixed with zedo gum control *Gaeumannomyces graminis var. tritici* in wheat. Microcapsules embedded *Streptomyces fulvissimus* show excellent efficacy in suppressing damping-off disease caused by *Pythium aphanidermatum*. Nanotechnology complements to the bio-encapsulation being efficient, non-toxic, and environmentally benign, providing superior performance compared to traditional synthesis methods. Nano-bioformulations, developed from plant growth-promoting microbes (PGPM) such as *Pseudomonas*, *Trichoderma*, *Bacillus*, *Rhizobium*, and *Azotobacter* spp., are capable of modulating key plant hor mones—including auxin, gibberellin, cytokinin, ethylene, and abscisic acid—thereby supporting optimal plant growth and resilience. Nano-bioformulations offer a green alternative to conventional synthetic pesticides, promoting plant growth, enhancing crop yield, and improving the efficacy of plant disease control while maintaining soil fertility.

Keywords: Plant Pathogens. Bioencapsulation. Polymers. Natural Gums. Nanotechnology.

Survey and Assessment of Foliar Disease Incidence of *Madhuca longifolia* in different Nurseries of Madhya Pradesh

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Abstract

Mahua (*Madhuca longifolia*), an economically significant species, faces various foliar diseases that impact its growth and productivity. This study investigates the incidence and status of major diseases affecting Mahua in 10 nurseries across Madhya Pradesh (Betul, Bhopal, Gwalior, Indore, Jabalpur, Jhabua, Khandwa, Ratlam, Rewa, Sagar, and Seoni). The incidence of foliar diseases was assessed through field observations and symptom analysis, and the percent disease incidence (PDI) was calculated. The survey revealed variable fungal disease incidence among nurseries. Ahmedpur Nursery in Bhopal had the highest incidence at 70%, while the Tuki Nursery in Gwalior and Sironja Nursery in Sagar had the lowest at 25%. Other nurseries showed a range of incidence from 30% to 60%. The key fungal pathogens identified were *Alternaria* spp., *Colletotrichum* spp., and *Pestalotiopsis* spp based on symptoms and morphological characteristics. *Pestalotiopsis* leaf spot was very severe, reported in all nursery with incidence ranges from 30-75%, followed by *Alternaria* spp (70%). The seedling wilt caused by *Fusarium* spp. was highest (35%) in Sehari Nursery (Jabalpur). The data suggest prioritizing nurseries like Bhopal (Ahmedpur Nursery) and Jhabua (Moujipada Anas Nursery) for disease management due to their high incidence rates. Also suggests that environmental conditions, nursery practices, or both may be particularly conducive to disease development in this location. The morphology and symptoms revealed that *Fusarium* spp. causes reddish-brown cankers on stems that spread to the roots, leading to severe infection. *Alternaria* spp. produces water-soaked spots on leaves that turn brown, coalesce, and cause defoliation. *Colletotrichum* spp. creates sunken, water-soaked spots on various plant parts, with size and color variations depending on the host. *Pestalotiopsis* spp. results in yellow, brown, or black leaf spots that can merge, forming blight under favourable conditions. Understanding the distribution and severity of these diseases across different nurseries is crucial for developing effective disease management strategies to improve the overall health and productivity of Mahua seedlings.

Keywords: *Mahua*, *Madhuca longifolia, Fungi, Diseases, Nursery, Pathogens.*

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Performance of *Acacia senegal* based bio-fence models to protect field crops from *Anna-pratha* in semi-arid Bundelkhand Region

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Abstract

The *anna-pratha* is a significant threat to crops on farmer's fields in the semi-arid region of Bundelkhand. According one estimate, about 15-20% crop yield is lost due to grazing by *anna-pratha* cattle. *Acacia senegal* is a valuable tree for creating live-fence along field boundary to protect crops from *anna-pratha*. It also offers many benefits including highly priced "gum arabic" that provides additional income to the farmers. To spread knowledge about agroforestry models based on gum-yielding trees and increase their adoption among farmers, particularly small holders in the Bundelkhand region of Central India, the ICAR-Central Agroforestry Research Institute, Jhansi, has taken new initiatives to develop *Acacia senegal* based bio-fence models under the network project on harvesting, processing, and value addition of natural resins and gums (HPVA of NRG). On research farm of the Institute three bio-fence models, aiming to study effectiveness and also demonstrate to farmers, were developed during the 2018. Bio-fence model-1 is aimed to optimize the distance apart *A. senegal* and *C.carandas* (1.0, 1.5 and 2.0 m apart) in single row; bio-fence model-2 is aimed to assess the effectiveness of double row fence consisting of *A. senegal* as outer row and *C. carandas* as inner row. Bio-fence model-3 is aimed to assess the effectiveness of double row fence of *A. senegal* at different spacing on three sides of field boundary of a well-established *Emblica officinalis* orchard. Survival and growth were observed in different bio-fence models, and minimum maintenance pruning was also done. The penetrability of the bio-fenced model against stray cattle is a crucial factor in providing protection to field crops, which was measured by projecting the vertical face of a bio-fence using the Digitiser V 6.3.0 tool. Findings revealed that after five years of growth, the outer row of the double-row model-3 planted 1.5m apart, the trees attained maximum collar diameter (45.4 mm) and height. Growth of *C. carindas* was maximum when it was alternatively placed with *A. senegal* at 1.5 m apart in single-row model 1, followed by in double-row model 2, where it is staggered with *A. senegal* in the inner row. The penetrability of the bio-fenced was measured by projecting the vertical face of a bio-fence using the Digitiser V 6.3.0 tool to assess its percentage occupancy. One side of a 5-year-old *A. senegal* and *C. carandas* based double-row bio-fence was assessed. The length of the fence was 47.0 m. The height, canopy width, and canopy height of *A. senegal* were 3.6±1.1 m, 3.4±0.96 m, and 2.9±1.2 m, respectively. The height of *C. carandas* was 0.8±0.4 m. Data analysis revealed that the projected ground area occupancy (47 m x 2 m) was 94 m^2. The actual ground area occupancy was 160.0 ± 44.0 m^2. This is mainly because of the expanding canopy width of *A. senegal.* The rectangular vertical area occupied by the bio-fence was 60.97 m^2. The opening was demarcated and measured for the area and the data indicated that ~13% of the of the vertical projection of the bio-fence had an opening or gap and the actual vertical area occupied by the fence was 53.15 m^2. The opening/gap at the bottom part of the fence requires routine management. Some of the farmers who adopted *Acacia senegal* bio-fence on their farm reported to have saved loss of 10-15% in crop yields. Conclusively, *Acacia senegal* based bio-fence offers potential solution to the problem of *anna-pratha* in Bundelkhand.

Keywords: *Acacia senegal*, Agroforestry, *Anna-pratha*, Bio-fence, Growth.

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Comparative Analysis of Methodology Utilized for Agroforestry Area Delineation and Assessment

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Abstract

Agroforestry, the integration of trees and shrubs into agricultural landscapes, offers numerous environmental and economic benefits. Accurately identifying agroforestry area is crucial for effective land management and policy-making. This paper reviews various methods used to assess agroforestry area, focusing on their accuracy and applicability and thereby selecting appropriate methods based on the specific context and objectives of agroforestry initiatives. Commonly used methods for agroforestry area estimation include Object-Based Image Analysis (OBIA), sub-pixel classification, pixel based classification (Maximum Likelihood Classification), Machine Learning Approaches (Random Forest and Support Vector Machines) and ground truthing. Remote sensing techniques are at the forefront of agroforestry assessment, with pixel-based classification being one of the most commonly used methods. Object-Based Image Analysis (OBIA) has emerged as a more sophisticated alternative, achieving a high accuracy rate of 91.2% in identifying agroforestry areas. OBIA classifies land cover based on the shapes and patterns of objects, effectively capturing the diverse configurations of trees within agricultural landscapes. Another advanced remote sensing technique is sub-pixel classification, which excels in areas where agroforestry coexists with agricultural land. This method allows for identification of multiple features within a single pixel, providing a more nuanced understanding of agroforestry potential in mixed-use landscapes. Ground-based methods, including tree inventories and field surveys, offer detailed insights into species diversity, biomass and tree health. While these methods provide valuable data, they are labor-intensive and limited in geographical scope, making them less suitable for large-scale assessments. Geospatial technologies further enhance the mapping and delineation of agroforestry areas by integrating various data sources, although their accuracy depends on the quality of the underlying data. Ground-based methods remain essential for validation and detailed studies but are less effective for extensive assessments. But OBIA and sub-pixel classification stand out for their accuracy in complex landscapes. The present analysis would be significant for selecting appropriate method for estimating agroforestry area and thus contributing to more sustainable land management practices.

Keywords: Agroforestry, Geospatial technologies, Object-Based Image Analysis, Remote Sensing, Sub-pixel classification

TOF Land Suitability Analysis in Jammu & Kashmir Using Geospatial Approach

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Abstract

The Indian Himalayan Region (IHR), known for its unique and diverse ecosystems, presents significant opportunities for agroforestry—a sustainable land-use system integrating trees and shrubs with crops and livestock. This research employs Geographic Information Systems (GIS) and Analytic Hierarchy Process (AHP) techniques based on the Google Earth Engine Platform to assess various environmental parameters affecting land productivity and suitability for Trees outside Forests (TOF) and agroforestry practices in Jammu & Kashmir state. The post-monsoon multi-date monthly cloud-free Landsat-8 data and products of the Digital Elevation Model were used to understand the landscape characteristics of TOF. Our approach integrates multiple datasets with Analytic Hierarchy Process (AHP)-based weighted analysis. The suitability analysis is based on Google Earth Engine with critical factors such as soil wetness, slope, elevation, drainage proximity, and existing vegetation cover, ensuring a robust and comprehensive assessment. Jammu and Kashmir (J&K) has a moderate to highly TOF suitability area (37.62%), and a forest area estimated at 31.10%. The resulting TOF land suitability map identifies regions within the J&K that are optimal for different types of agroforestry systems, providing a valuable tool for various stakeholders like policymakers, land managers, academician and farmers. By promoting agroforestry practices and tree plantation outside the forest, this study aims to enhance agricultural productivity, improve biodiversity, urban green space and contribute to climate resilience in the region. The findings highlight the potential of integrating geospatial technologies in sustainable land management and underscore the importance of TOF in addressing environmental and socio-economic challenges in the Indian Himalayan Region.

Keywords: Analytic Hierarchy Process (AHP), Google Earth Engine, Indian Himalayan Region, Jammu and Kashmir, TOF Land Suitability.

BHAI-CHARA Extension Approach for Science Communication and Public Awareness in Agriculture

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Abstract

Beautifully Harnessing Action & Interest to Create Harmony for Augmenting Resilience in Agriculture (BHAI-CHARA) assumes greater relevance in today's agricultural and rural development context particularly for science communication and public awareness in agriculture and allied fields. The BHAI-CHARA extension approach is based on 3Fs: Field, Farmer and Fellow and Call for Harnessing the Action of New Generation for Empowerment (CHANGE). The approach is Farmer (*Annadata*) centric. BHAI-CHARA concept has been developed as an innovative approach in promoting a happy and healthier livelihood in tune with evolving social system environment. Here beautifully is perceived as more than 80% perfectness in action and productivity and harnessing is perceived as optimum use of resources to produce best. Agriculture includes all allied subjects. With shrinking land holding, depleting production resources such as land water, capital, soil fertility/health and laborers requires additional efforts for creating harmony and augmenting resilience with action to achieve quality farm production livelihood. The new emerging problems stubble burning, depleting water table, injudicious use of insecticides/pesticides for the control and management of insect pest &diseases, erratic rainfall, rising temperature, decreasing labour power, small land holding preventing use of new evolved machinery in agriculture production and changing food habits of consumers pose challenges for the profitable farming and retaining the future farmer /rural youths in agriculture. Beautifully harnessing the Actions like advanced training in modern agricultural practices, with using modern communication media would insure the maximum benefit. This requires the action and interest amongst all the stakeholders like Government, Public, Private/NGO and others in close harmony. The essence of approach is Brotherhood and Major focus lies on Harmony with Nature. Father of green revolution India Prof. MS Swaminathan's Sir quote *"Before advising farmers, listen to them"* NCF-2005, is strictly followed in BHAI-CHARA extension approach. This approach is useful in linking farmer-to-farmer for effective science communication and public awareness in agriculture and allied fields.

Evaluating the Effectiveness of Cancer Awareness Programs in Semi-Urban Areas of India

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Abstract

This case study aims to assess the impact and effectiveness of cancer awareness programs implemented in semi-urban areas of India. Given the rising incidence of cancer and the challenges associated with its early detection and treatment, understanding the efficacy of awareness initiatives is crucial for improving health outcomes in these regions. The study employed a mixed-methods approach, combining quantitative surveys and qualitative interviews. Data were collected from participants in two semi-urban communities who had recently attended cancer awareness workshops and outreach programs. Key performance indicators such as knowledge gain, behavioral changes, and screening uptake were measured before and after the program. Additionally, in-depth interviews with program organizers and healthcare providers were conducted to gather insights into program implementation and challenges. The findings indicate a significant improvement in cancer awareness among participants, with a marked increase in knowledge about cancer symptoms, prevention strategies, and the importance of early screening. Post-program surveys revealed a higher intent to seek medical consultations and undergo regular screenings. However, despite these positive outcomes, the study also identified several barriers, including limited access to healthcare facilities, socio-economic constraints, and cultural stigmas, which impeded the program's overall effectiveness. Cancer awareness programs in semi-urban India demonstrate substantial potential in enhancing public knowledge and encouraging proactive health behaviors. Nevertheless, for these programs to achieve greater success, there is a need for targeted interventions that address local barriers, integrate community-specific approaches, and enhance healthcare accessibility. The study highlights the importance of tailoring awareness initiatives to the unique needs of semi-urban populations and calls for continued efforts to strengthen and expand these programs.

Keywords: Cancer, awareness, program, effectiveness, semi urban areas.

Butea monosperma: A potential agroforestry species for sustainable livelihood in Bundelkhand region

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Abstract

Butea monosperma is a valuable agroforestry species known for its vital significance with respect to the rural livelihood as well as environment. It belongs to the family Fabaceae and known as the flame of the forest known for its vibrant orange-red blossoms. In draught-prone regions like Bundelkhand, it is being widely grown, fulfilling diversified needs, creating employment opportunities and providing livelihood security to the rural people. "Butea" means "beautiful flowers" and "monosperma" means "one seed". Although there are four kinds of blossoms being observed i.e. red, yellow, white and blue in which red and yellow are prominent and has been cited in Ayurveda and Unani systems of medicine. Being a multipurpose tree, various NTFPs (Non-timber forest products) are obtained. It is used in making ropes, extraction of gum, lac cultivation, donas, dye ectraction etc. from various parts of the tree. Root fibers are being extracted and processed into ropes and gum is extracted from the tree bark whose production is approximately 300 g per tree in a year. Lac production is a major source for providing monetary gains as 1.5-2.5 kg of lac can be produced from a single tree with an income around Rs. 750-800. Donas are being made by using leaves and around 1400 donas can be made from a tree. As a biodegradable material, dona making has economic and ecological significance as farmers earn income as well as plastic pollution can be reduced and carbon footprint can be lowered. Dye from *B. monomsperma* is extracted from its flowers which offers eco-friendly alternative to other synthetic dyes. It also possesses medicinal, religious and cultural importance. Besides having several benefits, *B. monosperma* is adapted to varying climate making it a resilient choice for agroforestry in different regions for sustainability and livelihood security.

Agro-Horti based Agroforestry Models for Sustainable Rural Livelihood Development for North Eastern States

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Abstract

India holds the second position globally in the production of fruits and vegetables, just behind China. The Northeast region of India, comprising eight states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura), covers 7.7% of the country's total area and hosts nearly 50% of its biodiversity, with about 32% being endemic. This region boasts a rich variety of fruits, vegetables, flowers, spices, medicinal plants, and indigenous crops. In the face of current challenges, policymakers and decision-makers are prioritizing sustainable livelihood options that can withstand climate and environmental changes. This study examines how Agro-Horti based Agroforestry Models enhance ecosystem services in the North Eastern Himalayas. Agro-Horti based Agroforestry Models models have been found to improve nutrient cycling, soil fertility and productivity while reducing soil erosion. They also contribute to biodiversity conservation, water and soil preservation, carbon sequestration and improved crop yields. Additionally, these systems have a positive impact on community living standards. The research evaluates the economic benefits of fruit and vegetable intercropping compared to monocropping. Agroforestry is one of best risk aversion option to make them move out of food insecurity. Generally, agroforestry systems readily bundle both mitigation and adaptation strategies and provide several pathways to securing food security for poor farmers, while contributing to climate change mitigation. Agroforestry should attract more attention in global agendas on climate adaptation and mitigation because of its positive social and environmental impacts. In the context of large-scale land use changes, Agro-Horti based Agroforestry Models show great promise for achieving both ecological and economic sustainability.

Keywords: Agroforestry Models, Land-use Livelihood, NEH region, Human Well-being, Nutrient cycling, Productivity.

Spices Production through Agroforestry in South Asia: Scope and Implications

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Abstract

Spices have been an integral component of culinary art in India and other South Asian countries like Sri Lanka, Bangladesh, Nepal, Pakistan, Bhutan, Afghanistan, and Maldives. Cultivation of spices in agroforestry systems is a money-making strategy for sustaining the growing demand of spices and reducing the genetic erosion of spice species in natural habitats and thereby conserving species diversity of spices. South Asia is known as home of spices and this region enjoys diverse soil and climatic conditions supporting growth of different spice crops. India and Pakistan (each with 52 species) are leading countries in terms of variety of spice crops grown followed by Nepal (31 species), Bangladesh (20 species), Bhutan (20 species), Sri Lanka (20 species), Maldives (8 species) and Afghanistan (4 species). These South Asian countries have been cultivating spices for thousands of years. In South Asia spices are existed in three conditions: (1) under naturally grown as in-situ, (2) in backyard and homegardens for household consumption, and (3) commercial cultivation for domestic and export market. There is a need of analysing the potentiality and status of spice production through agroforestry in South Asia. The growing demand of spices is important for encouraging the cultivation of spices through sustainable systems like agroforestry and home gardening. Therefore, the present article primarily aims to present the current status of spice production and their cultivation through agroforestry systems in South Asia and underlining the key impacts of agroforestry on yield and phytochemical attributes of spices. We also comprehended the policies and institutionalised efforts of South Asian countries for encouraging, promoting and supporting spice cultivation in croplands. Finally, this article discussed the future research aspects on spice-based agroforestry for improving farmers' income, biodiversity conservation, promotion of trees outside forests and sustainable development.

Keywords: Agroforestry, Biodiversity, Intercropping, South Asia, Spices and Sustainable Development .

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A Coherent Approach of Indexing Methods to Assess the Water Quality of River Bodies in Arrah, Bihar, India

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Abstract

Different river bodies are diverse sustaining systems that provide freshwater to rapidly growing needs at the domestic, agricultural and industrial levels of the people of India. The river bodies need periodical examination for conservation and rejuvenation because they are currently under stress due to pollution and climate change. Arrah is a district of Bihar, India and occupies an area of 2395 km2 for agriculture as the predominant activity. It is an attempt to assess the water quality of River Ganga, Sone and Gangi in this area by combining the overall pollution index (OPI), comprehensive pollution index (CPI) and water quality index (WQI) from November 2021 to October 2023 from 648 water samples and nine sampling sites to establish a relationship between any change in water quality and their sources. We assessed eleven water quality parameters following standard methods for winter, summer and monsoon seasons. Observations showed that dissolved oxygen, total alkalinity, fluoride and rarely biochemical oxygen demand exceeded Bureau of Indian Standards (BIS 2012) prescribed limits and indicated deterioration in the water quality of these river bodies. Two-way ANOVA suggested that the water quality parameters of these river bodies showed significant differences ($p<0.05$). We used Numerical equations to transform the concentration values into pollution indices. Values of OPI (1.70 to 2.40) and CPI (0.65 to 0.90) indicate acceptable/slightly polluted/moderately polluted water in these rivers. Values of WQI of these river bodies ranged from 182.0-192.1, 220.1-242.2 and 190.7-238.9 during winter, summer and monsoon seasons, indicating poor/very-poor water quality. The observation shows that the causes of the declining water quality in these water bodies are anthropogenic activity, agricultural waste runoff and entry of untreated sewage. To reduce the time-consuming and expensive water quality monitoring and assessment programmes for these river bodies, the water quality of these water bodies felt the need to adopt proper management policies and conservation efforts.

Keywords: River bodies, physicochemical parameters, seasonal values, water quality indices, ANOVA, India.

Assessment of water quality index of pond water of phulwarisharif area, Patna, India

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Abstract

A pond is a natural or artificial, seasonal or perennial lentic water body. The ponds need periodic assessment for conservation and rejuvenation. Phulwarisharif is a block town of Patna, Bihar, India and includes the Patna Metropolitan region. An attempt was made to compare the present water quality of perennial Manikchand Pond and Phulwarisharif Pond, Phulwarisharif area, Patna using the Comprehensive pollution index (CPI), Overall pollution index (OPI) and Water quality index (WQI) during September 2022-August 2023 from 240 water samples and 10 sampling sites. To assess water quality, thirteen water quality parameters were measured using standard techniques during the post-monsoon, winter, summer, and monsoon seasons. Results indicated that the water quality had deteriorated and that the parameters exceeded BIS (2012) recommended limits are pH, dissolved oxygen, biochemical oxygen demand, total alkalinity, total dissolved solids, turbidity, nitrate and sulfate. The water quality parameters differ significantly ($p<0.05$), according to two-way ANOVA. The values of OPI (2.30 to 2.60) and CPI (1.60 to 1.70) without turbidity and with turbidity (2.40 to 2.70) and CPI (3.60 to 4.40) respectively indicate slightly polluted/polluted and slightly polluted/seriously polluted water in Phulwarisharif pond. But the values of OPI (1.54 to 1.88) and CPI (1.34 to 1.36) without turbidity and with turbidity (1.77 to 2.17) and CPI (3.07 to 3.93) respectively suggest acceptable/polluted and acceptable to slightly polluted/seriously polluted water in Manikchand pond. These indices confer that Phulwarisharif Pond is more polluted than Manikchand Pond. The present observation demonstrates that anthropogenic activity and the entry of untreated sewage are the main contributors to the decline in water quality. The water quality of these ponds felt the need to adopt proper management policies and conservation efforts to decrease the time-consuming and expensive water quality monitoring and assessment programmes.

Keywords: CPI, OPI, WQI, Physicochemical parameters, Manikchand Pond, Phulwarisharif Pond, India.

Potential of trees for water resources conservation: Novel Strategies

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Abstract

Water conservation has become a critical issue in our rapidly changing world. Climate change and human activities are posing unprecedented challenges to our water resources. Climate change is altering precipitation patterns globally, leading to more frequent and severe droughts in many regions. Glaciers, which have long served as crucial freshwater sources for millions, are melting at alarming rates. Agriculture, as the largest consumer of freshwater, contributes to a substantial portion of global water use. Additionally, industrial water uses in developing countries is projected to rise significantly, which underscoring the crucial role of trees as nature's water conservators. Tree enhances water quality by acting as natural filters, with their root systems absorbing excess nutrients and pollutants from runoff. Trees are crucial in regulating the water cycle through transpiration and interception. Extensive root systems of trees often extending 2-3 times their canopy width, prevent soil erosion and stabilize landscapes. Trees also aid in groundwater recharge by slowing runoff and improving soil structure, with forested watersheds reducing surface runoff by up to 30% compared to non-forested areas. By enhancing soil structure and increasing water infiltration, trees significantly mitigate flood risks, reducing peak flows during heavy rainfall events, improves soil water retention, hydraulic redistribution and sustain water availability during drought stress in rain fed area. Many trees e.g *Acacia auriculiformis* is largely being used in area with waterlogging and saline soil due to its rapid growth, ability to fix nitrogen, high water consumption, and tolerance to poor soil conditions. Other accompanying species include *Eucalyptu*s spp, *Populus deltoides* (Poplar), *Dalbergia sissoo* (Shisham), and *Terminalia arjuna* (Arjun), each playing a role in enhancing the overall effectiveness of the reclamation process. Thus, prioritizing tree species in water conservation efforts can provide a sustainable and resilient approach to manage water resources, addressing both current and future needs.

Keywords: Deforestation, Flood mitigation, Tree-based strategies, Water conservation, Water cycle regulation.

Regenerative Agriculture: Redefining Farming for Climate Resilience

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Abstract

Regenerative agriculture is rapidly becoming a dynamic ecological approach to natural resource management, integrating trees within far ms and agricultural landscapes to enhance production, fostering social, economic, and environmental benefits across various levels. Agriculture occupies 38% of the planet's terrestrial surface, using 70% of freshwater resources. Its modern practice is dominated by an industrial–productivity discourse, contributing to simplifying and degrading human and ecological systems. Regenerative agriculture is frequently juxtaposed with conventional farming, which is often linked to soil degradation, loss of biodiversity, and heightened greenhouse gas emissions. Although definitions of regenerative agriculture can vary, its core practices generally include minimizing or eliminating tillage, implementing cover cropping and crop rotation, reducing or discontinuing the use of synthetic inputs such as agrichemicals, incorporating organic materials produced on the farm, emphasizing the use of perennials and agroforestry, integrating crop-livestock systems and managing grazing in a controlled manner. Studies across these different regenerative agriculture practices indicate that the increase in soil organic carbon, in comparison with conventional practices, varies widely (ranging from a nonsignificant difference to as high as 3 Mg C/ha/y).

Regenerative agriculture enhances crop yields by focusing on the regeneration of soil health, increasing biodiversity and improving water cycles. It plays a crucial role in carbon sequestration and mitigating climate change. This paradigm shift in agricultural practices provides a comprehensive solution to the interconnected challenges of environmental sustainability, and climate resilience. Additionally, securing food for all requires a paradigm shift from our traditional intelligence to artificial intelligence for precise soil fertility management to enhance sustainable productivity. As the global agricultural sector grapples with the impacts of climate change, regenerative agriculture emerges as a forward-thinking strategy that aligns human activities with natural systems, ensuring the long-term sustainability of farming practices and the planet. Further research into increasing the storage of stable carbon in soils could substantiate the long-term benefits of regenerative agriculture, and ensure its effectiveness on climate resilience. This shift can potentially enhance socioeconomic and environmental resilience throughout the food supply chain.

Keywords: Conventional farming, climate change, sustainability, and stable carbon.

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Enhancement of seed germination and quality seedlings production of *Albizia lebbeck* (L.) Benth through pre-sowing treatments and growing media

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Abstract

Albizia lebbeck (L.) Benth (Leguminosae) is a medium-sized deciduous tree and commonly grown as a shade tree in pastures and tea plantations. It is a good soil binder, an excellent fuel-wood species, having excellent coppicing ability, site adaptability and nitrogen fixing capacity. All these characteristics make *A. lebbeck* a popular species for reforestation of degraded sites, fuelwood plantations and agroforestry systems. The seeds of A. lebbeck have been observed to exhibit physical dormancy due to hardness of the seed coat. Raising the seedlings from such seeds become a problem due to delayed and poor germination. Acid scarification and mechanical scarification are most common methods to overcome physical dormancy of seeds, although these are costlier and laborious methods. Hence, an experiment was conducted to develop a simple and cost-effective method for getting assured and good seed germination of *A. lebbeck* seeds. The healthy and matured seeds were subjected to seven pre-sowing treatments laid out using completely randomized design with four replications. From this study, it was concluded that hot water pre-sowing treatment gave the highest germination i.e. more than 90 %. Moreover, hot water pre-sowing treatment is economically cheaper and easy to execute. Hence, it is far mer friendly and can easily be adopted by the far mers, nursery growers and other stakeholders as it saves the time and money to raise quality seedlings of *A. lebbeck*. Among different growing media, soil+sand+vermicompost (1:1:1) resulted quality seedlings as this consortium of growing media registered maximum values for different seedling growth attributes like shoot length, root length, collar diameter and seedling quality index. Thus, growing media consisting of soil+sand+vermicompost (1:1:1) may be used for quality seedling production of *A. lebbeck*.

Keywords: Albizia lebbeck Pre-sowing treatments, Dormancy, Seed germination, Seedling quality.

Ecosystem Services in Agroforestry Systems: Enhancing Biodiversity, Soil Health, and Climate Resilience with Potential for Farmer Compensation

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Abstract

Agroforestry systems, which integrate trees with crops and/or livestock, offer a multifaceted approach to sustainable land use, delivering a wide array of ecosystem services. These systems enhance biodiversity by providing habitats for various species and promoting ecological balance. They contribute significantly to soil health through improved nutrient cycling, enhanced organic matter content, and reduced erosion. Agroforestry practices also play a vital role in carbon sequestration, helping to mitigate climate change by capturing and storing atmospheric carbon in both biomass and soil. Furthermore, agroforestry systems regulate water cycles by improving water infiltration, reducing runoff, and maintaining groundwater levels. They also support pollination services, which are crucial for crop productivity. In addition to these ecological benefits, agroforestry enhances farm resilience against climate extremes by diversifying production systems, reducing the risk of crop failure, and improving microclimates within the agricultural landscape. Overall, agroforestry systems represent a sustainable land management strategy that not only supports agricultural productivity but also contributes to environmental conservation and climate change mitigation, offering a holistic approach to ecosystem service provision. Based upon the ecosystem services generated by the agroforestry systems, farmers should be compensated for these ecosystem services. For instance, farmers might receive compensation for the carbon stored in trees or the improved water quality resulting from reduced soil erosion. This financial support not only promotes sustainable land use but also provides economic benefits to rural communities, encouraging broader adoption of agroforestry as a land management strategy.

Keyword: Agroforestry, Carbon Credit, Payment of ecosystem services.

Agroforestry as a Strategy for Sustainable Soil Management

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Abstract

Soil, the foundation for plant growth, forms from the breakdown of parent rock materials through the combined actions of plants, humans and climate. As global population rises, increasing demand for food and fiber, livestock feed and wood fuel puts immense pressure on land resources. This has led to unsustainable Farming methods like intensive tillage, monoculture, excessive use of fertilizers and agrochemicals, deforestation and overgrazing. These moder n farming methods significantly contribute to soil health degradation and climate change, which further exacerbates soil deterioration. Agroforestry systems offer a sustainable solution to these challenges. These systems, which integrate perennial woody plants with agricultural or forage crops on the same piece of land, have been practiced by farmers for generations. Agroforestry is widely distributed throughout the tropics, with various models adapted to specific biophysical, social, economic and environmental conditions of different regions. These systems enhance organic residue input and decomposition, facilitate nitrogen fixation, improve nutrient cycling, increase carbon sequestration, control erosion, and ameliorate microclimates. By fostering these processes, agroforestry is essential in preserving and enhancing soil health. This paper aims to provide a comprehensive overview of agroforestry, including its importance, history, scope, and potential. It also examines the crucial role that agroforestry systems play in managing soil health throughout tropical regions globally. By highlighting these aspects, the paper underscores the value of agroforestry as a win-win strategy for sustainable land management and soil health improvement in the face of growing environmental challenges.

Keyword: Agroforestry System; Agro-Chemicals; Climate Change; Deforestation; Ecological Services; Nutrient Cycling; Soil Health.

Advantage of E-Commerce model for Agricultural Produce in India

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Abstract

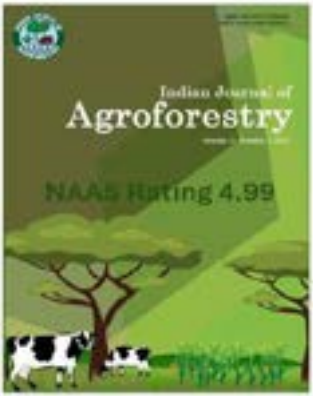
The rapid development of technology and the growing prevalence of Internet access have brought about significant changes in the agricultural sector through the utilization of E-Commerce. In India, numerous E-Commerce platforms like (e-Nam, AgriStack, Agrimp and e-samridhi etc) have been established with the objective of standardizing agricultural trade practices across integrated markets by eliminating information disparities between buyers and sellers. Despite the abundance of opportunities, stakeholders have exhibited hesitance toward embracing this novel technology for trading agricultural goods. One of the primary concerns revolves around the inadequacies of the pricing mechanisms employed by online trading portals, which fail to optimize revenue during periods of high demand and low supply, or protect against losses resulting from product deterioration or down selling. This static pricing approach deters potential sellers from engaging with online platforms as it offers limited benefits to customers. To address these challenges, the implementation of a continuously adaptable dynamic pricing mechanism, capable of responding to market conditions and product quality fluctuations, emerges as a critical requirement to safeguard seller revenue and sustain customer interest. This paper delves into an exploration of various existing dynamic pricing mechanisms and assesses their applicability within the realm of agro-marketing. Additionally, it articulates key research challenges pertaining to the dynamic pricing approach in E-Commerce. It is imperative that the development of a pricing mechanism in the dynamic E-Commerce environment accounts for factors such as demand, supply, and product freshness.

Keywords: E-commerce, Agro-marketing, Dynamic, Platforms, Technology, Agricultural.

The Indian Society of Agroforestry (ISAF) is a non-for-profit society that dwells on information generation, dissemination and promotion of agroforestry and allied sectors for the cause of enhancing the socio-economic and environmental benefits to the farmers and stakeholders.

The Society was founded during the Golden Jubilee Year celebrations of India's Independence in July, 1998 with the following objectives:

- To encourage basic, applied and strategic research in the field of agroforestry.
- To disseminate knowledge and technology related to agroforestry.
- To organize & provide facilities for seminars and conferences for agroforestry, scientists, environmentalists, research and development workers and farmers.
- To encourage close cooperation among organizations having interest in the field of agroforestry.



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