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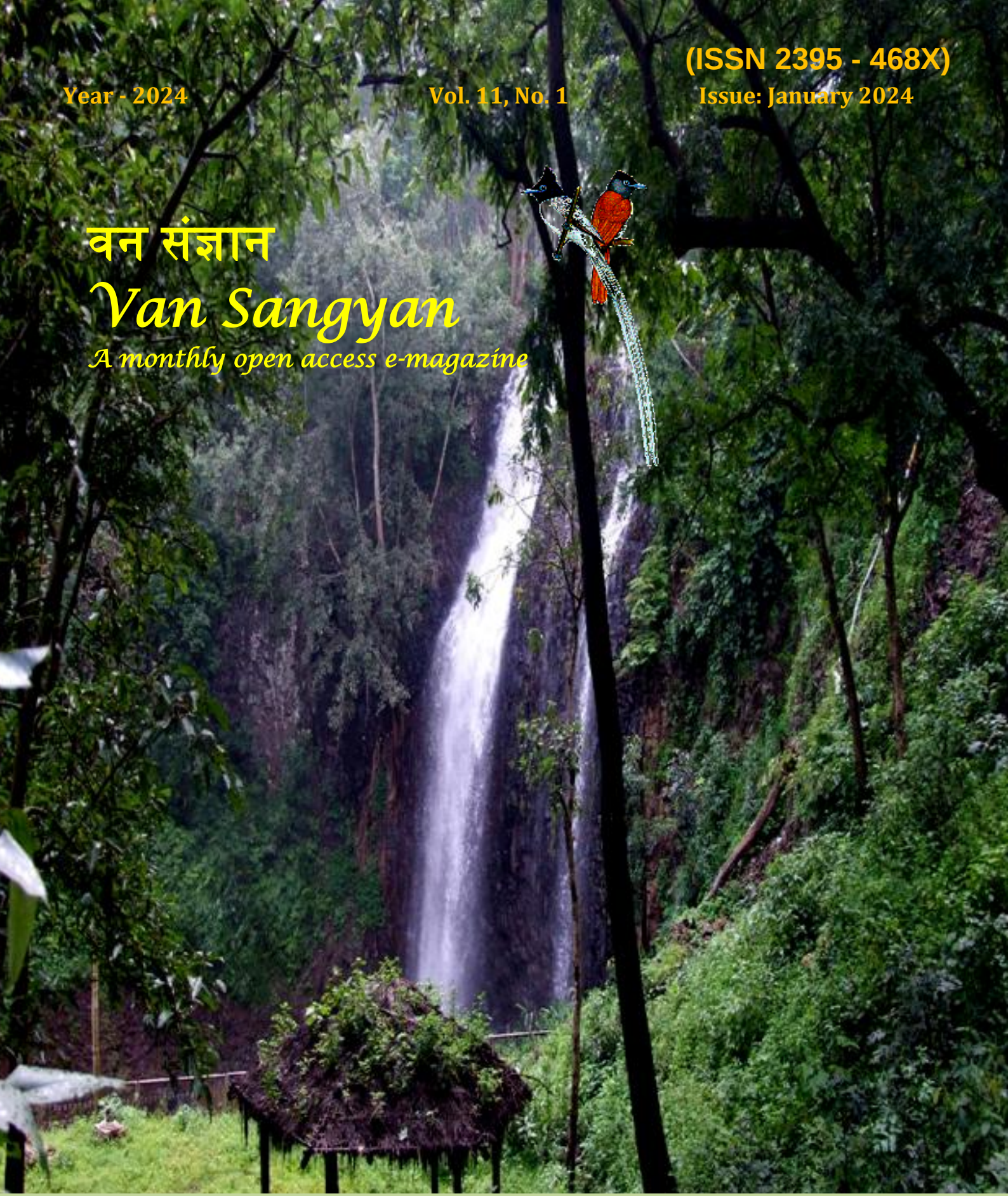

वन संज्ञान
Van Sangyan
A monthly open access e-magazine

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Van Sangyan

Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

by e-mail to vansangyan_tfri@icfre.org

or, through post to The Editor, Van Sangyan,
Tropical Forest Research Institute,
PO-RFRC, Mandla Road,
Jabalpur (M.P.) - 482021.

The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve

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From the Editor's desk

Agroforestry, a sustainable land management system, integrates trees and shrubs into agricultural landscapes to create diversified and resilient farming systems. This concept combines traditional agricultural practices with forestry techniques, offering a multitude of possibilities for enhancing productivity, biodiversity, and ecosystem services. By strategically incorporating trees on farms, agroforestry systems provide multiple benefits such as improved soil health, water conservation, carbon sequestration, and enhanced biodiversity. Moreover, agroforestry offers opportunities for smallholder farmers to diversify their income streams. Agroforestry practices offer significant potential for achieving several Sustainable Development Goals (SDGs) established by the United Nations y promoting sustainable agriculture, enhancing food security, supporting rural livelihoods, and mitigating environmental degradation. As the world grapples with challenges like climate change, soil degradation, and food insecurity, agroforestry emerges as a promising solution that aligns agricultural production with environmental conservation and resilience.

In line with the above this issue of Van Sangyan contains an article on कृषिवानिकी: दृष्टिकोण एवं संभावनाएं. There are also useful articles viz. Agroforestry practices for achieving sustainable development goals, Resilience strategies for heatwaves and their impact on forestry and agriculture sectors, An insight into the timber trees of Telangana, Global warming and climate change: A looming crisis for humanity, Isabgol: an important medicinal plant, Species Recovery Programme- A step towards Conservation, Organic farming certification and present scenario in India, सरसो के प्रमुख कीट एंव एकीकृत कीट प्रबंधन तकनीके and जलवायु परिवर्तन में सूर्य की भूमिका .

.

Looking forward to meet you all through forthcoming issues

Dr. Naseer Mohammad

Chief Editor

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कृषिवानिकी: दृष्टिकोण एवं संभावनाएं

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परिचय

कृषि और जनवायु परिवर्तन का आपस में गहरा संबंध है। कृषि वैश्विक ग्रीनहाउस गैस उत्सर्जन के लगभग 30 प्रतिशत के लिए जिम्मेदार है और 80 प्रतिशत उष्णकटिबंधीय वनों की कटाई का मूल कारण है। गहन कृषि जो मोनोकल्चर की विशेषता है, उन क्षेत्रों में से एक है जो CO_2 उत्सर्जन की उच्चतम मात्रा उत्पन्न करता है। सतत कृषि कई तरह से जलवायु परिवर्तन का समाधान है। कृषि परिस्थितिकीय तरीके, शून्य बजट प्राकृतिक खेती, ऊर्ध्वाधर खेती आदि इसी तरह के कुछ पद्धति है। शोधकर्ताओं के अनुसार कृषिवानिकी एकऐसी कृषि पद्धति है जो प्राकृतिक परिस्थितिक तंत्र का पोधण करती है, और परेशान करने वाले रूझानों का उलट सकती है। सन् 2014 में भारत रोजगार, उत्पादकता और पर्यावरण संरक्षण को बढ़ावा देने के लिए कृषिवानिकी नीति अपनाने वाला पहला देश बन गया। सन् 2016 में, राष्ट्रीय कृषिवानिकी नीति (एन ए पी) के तहत कृषिवानिकी पर एक उप-मिशन (एस एम ए एफ)(SMAF) शुरू किया गया था, जिसमें कृषिवानिकी को एक राष्ट्रीय प्रयास में बदलने के लिए लगभग रू0 1000 करोड़ का लागत दी गई थी, जिसका टैगलाइन था "हर मेड़ पर पेड़"। इसके उपरान्त सन् 2022-2023 के केन्द्रीय वजट में भी वित्त मंत्री निर्मला सीतारमण ने घोषणा की कि सरकार द्वारा कृषिवानिकी को बढ़ावा दिया जायेगा। इन अथक प्रयासों के द्वारा हम भारतीय वन नीति (1988) द्वारा निर्धारित भौगोलिक क्षेत्र का 33 प्रतिशत भाग वन या वृक्ष आच्छादन को प्राप्त कर सकते हैं।

परिभाषा

कृषिवानिकी भूमि उपयोग प्रणालियों और प्रौद्योगिकी के लिए एक सामूहिक नाम है जिसमें वृक्षों व झाड़ियों का पर्यावरण, आर्थिक और सामाजिक लाभ के लिए फसलों एवं पशुपालन प्रणालियों में जानबूझकर एकीकरण किया जाता है। कृषिवानिकी में फसलों और पशुओं के साथ वृक्षों और मूल्यवान वृक्षों की खेती एवं उनके उपयोग को महत्ता दी जाती है। कृषिवानिकी अपने घटकों के बीच सकारात्मक बातचीत की तलाश करती है, जिसका उद्देश्य पारम्परिक कृषि के माध्यम से भूमि से अधिक पारिस्थितिक रूप से विधि और सामाजिक रूप से उत्पादक क्षमता प्राप्त करना है।कृषिवानिकी कई प्रकार के एकीकृत भूमि प्रबंधन (जो भूमि पर मानव प्रभावों को कम करता है) को लागू करने का एक व्यावहारिक और कम लागत वाला साधन है। कृषिवानिकी में अतिरिक्त और विधि आर्थिक लाभ की महत्वपूर्ण भूमिका है और यह किसानों के लिए एक प्रमुख प्रेरणा कारक के रूप में कार्य करता है। कृषिवानिकी के द्वारा किसान फसल उत्पादन के साथ-2 घरेलू खपत के लिए लकड़ी, चारा और ईंधन की लकड़ी, गैर लकड़ी वन उत्पाद, फल, मेवे और औषधीय पौधों का अतिरिक्त उत्पादन लेकर सामाजिक एवं आर्थिक रूप से सुदृढ़ हो सकते हैं।

कृषिवानिकी पद्धति में आमतौर पर फसलों (धान, दलहन, तिलहन आदि) के साथ तेजी से बढ़ने वाले एवं कम जीवन अवधि वाले वृक्षों जैसे- यूकेलिप्टस, सागैन,पापलर, चिनार, कैजुरिना(झाउ), मीलिया प्रजाति, ऐलेन्थस(महारूख), अल्वीजिया प्रजाति (सिरीस), गमेलिना (खम्हार), कदम्ब और बांस आदि वृक्षों का चयन किसानों द्वारा किया जाता है। यह दीर्घकालिक, टिकाऊ और नवीनीकरण वन प्रबंधन को बढ़ावा देकर हरित अर्थव्यवस्था में योगदान देता है, विशेषतः छोटे पैमाने के उत्पादकों को हालांकि कृषिवानिकी की आधुनिक अवधारणा 20वीं शताब्दी की शुरूआत में उभरी, कृषि प्रणालियों में बारहमासी वृक्षों का उपयोग प्राचीन है। रोमन काल में इसके अभ्यास का लिखित विवरण भी उपलब्ध है। दरअसल फसलों और जानवरों के साथ वृक्षों को जोड़ने की दुनिया भर में एक लम्बी परंपरा रही है। 2004 में विश्व बैंक ने अनुमान लगाया था कि 1.2 बिलियन लोगों द्वारा कृषिवानिकी प्रथाओं का उपयोग किया जा रहा है। कृषिवानिकी से बेहतर खाद्य सुरक्षा, जलवायु परिवर्तन अनुकूलन और शमन, एवं आजीविका में लचीलापन की दिशा में लाभ होता है, इसीलिए आजकल वैश्विक नीति प्रक्रियाओं में कृषिवानिकी पर अधिक ध्यान दिया जा रहा है।

कृषिवानिकी का उद्देष्य

1. आधुनिक और पारम्परिक भूमि उपयोग प्रणालियों को जोड़ना।
2. फसलों या पशु मूल्यवान लकड़ी एवं कृषि के साथ-साथ पेड़ों का भी प्रबंधन।
3. संसाधन आधार की सुरक्षा के साथ अधिक से अधिक उत्पादन लेना।
4. फसल उत्पादकता में बढ़ोत्तरी।
5. ड.+) खराब मौसम से मिट्टी पशुधन फसलों की सुरक्षा।
6. पानी की गुणवत्ता में सुधार।
7. रोजगार एवं आय उत्पन्न करना।
8. जैव विविधता एवं मिट्टी की उर्वरता में वृद्धि।
9. अनुपजाऊ भूमि का वैकल्पिक उपयोग कर पोषक तत्वों के जमाव से भूमि की गुणवत्ता में सुधार।
10. ग्रीनहाउस गैसों को कम करना तथा वन्यजीवों के लिए आवास प्रदान करना।
11. वनों का विकास एवं कार्यमूलक आधार पर उनका वर्गीकरण करना।

कृषिवानिकी के प्रकार

एग्रीसिल्वीकल्चर (कृषि फसलें+वन्य वृक्ष)

इस प्रणाली को विभिन्न रूपों में बांटा गया है जैसे- ढैंचा प्रणाली, शेल्टरबेल्ट्स, विंडब्रेक, एलेक्रापिंग, रिपेरियन बफर आदि।

सिल्वीपास्चुरल (वन्य वृक्ष+चारागाह)

यह निश्चित रूप से सबसे प्रमुख कृषिवानिकी अभ्यास है। इसमें पेड़ों को चारे और पशुधन उत्पादन के साथ एकीकृत किया जाता है। इस प्रणाली को तीन प्रकार से विभाजित किया गया है:

- प्रोटीन बैंक
- चारे के पेड़ों और हेजेज के जीवित बाड़
- चारागाह पर वृक्ष और झाड़ियां।

एग्री-सिल्वी-पास्चुरल (कृषि फसलें++वन्य वृक्ष+चारागाह)

इस प्रणाली को दो उपसमूहों में बांटा गया है, होम गार्डन और वुडी हेजरोज।

एग्रीहार्टीकल्चर (कृषि फसलें+फल वृक्ष)

इस प्रणाली में कृषि फसलों का फल वृक्षों के बीच में उगाया जाता है।

एग्री-हार्टी-सिल्वीकल्चर (कृषि फसलें+फल वृक्ष+वन्य वृक्ष)

इस कृषिवानिकी प्रणाली में कृषि फसलों एवं वृक्षों के साथ-साथ वन्य फल वृक्षों को भी उगाया जाता है।

कृषिवानिकी से लाभ

पर्यावरणीय लाभ

1. मिट्टी में पोषक तत्वों की वृद्धि और गहरी जड़ों की वजह से पोषक तत्वों का बेहतर पुनर्चक्रण।
2. मिट्टी की संरचना में निरन्तर कार्बोनिक पदार्थों के मिलान से सुधार।
3. प्राकृतिक वनों पर कम दबाव तथा वनों की कटाई की दर में गिरावट।
4. सूक्ष्म जलवायु में सुधार एवं कार्बन प्रच्छादन के माध्यम से जलवायु परिवर्तन को कम करने में मदद।
5. सतही अपवाह, पोषक तत्वों की निक्षालन और मिट्टी के कटाव में गिरावट।+
6. पारिस्थितिक तंत्र की अधिक कुशल सुरक्षा।
7. पेड़ तेज हवाओं को रोककर फसलों को नुकसान से बचाते हैं।

सामाजिक लाभ

1. रोजगार प्राप्ति एवं ज्यादा आय से ग्रामीण जीवन स्तर में बढ़ोत्तरी।
2. बढ़िया एवं विभिन्न प्रकार के खाद्य उत्पादों में बढ़ोत्तरी के कारण पोषण और स्वास्थ्य में सुधार।
3. स्थानान्तरण कृषि की जगह समुदायों का स्थिरीकरण एवं उन्नति।
4. स्थानीय समुदायों और संस्कृतियों को फलने फूलने में मदद।
5. पशुओं के चारे, ईंधन आदि आवश्यकताओं का समुचित प्रबंध।

आर्थिक लाभ

1. एकल फसल प्रणाली की तुलना में फसलों की विफलताओं में कमी।
2. एकाधिक उत्पाद एवं उनके उत्पादन में बढ़ोत्तरी।
3. वर्ष भर रोजगार मिलने का प्रबंध।
4. कृषि आय के स्तरों में वृद्धि।

कृषिवानिकी की सम्भावनाएं

कृषिवानिकी के व्यापक दायरे और विविध लाभों के कारण इसमें कई सम्भावनाएं हैं, उदाहरण स्वरूप उत्पादकता में वृद्धि, मिट्टी की उर्वरता में सुधार, पोषक तत्वों का चक्रण, सूक्ष्म जलवायु में सुधार, कार्बन पृथक्करण, जैव-जल निकासी, जैव ऊर्जा, जैव ईंधन आदि। कृषिवानिकी जल संरक्षण को मृदा संरक्षण से जोड़ने के लिए बेहतरीन अवसर प्रदान करती है। गरीबी उन्मूलन, आदिवासी विकास, रोजगार सृजन और महिला सशक्तीकरण कृषिवानिकी प्रणाली द्वारा प्रदान किये जाने वाले अन्य संभावित लाभ हैं। इसलिए अगर कृषिवानिकी ठीक से विकसित हो तो इसमें सामाजिक-आर्थिक रूप से अधिक स्थिरता में सुधार करने और परिदृश्य को बेहतर बनाने की क्षमता है। उचित मूल्यांकन और चयन प्रक्रिया कृषिवानिकी का मुख्य उद्देश्य है। इसलिए अनुसंधान और कृषिवानिकी में विकास और अधिक होना चाहिए, ताकि किसानों के बीच पक्षपात और शोधकर्ताओं के जोखिम को कम किया जा सके। खेती मुख्य कार्य है, इसलिए भविष्य में इसकी गहन सफलता के लिए सरकार के प्रोत्साहन और नीतियों की जरूरत है। इन नीतियों से स्थायी कृषि पद्धतियों का मूल्यांकन, सामाजिक-आर्थिक जरूरतों का समर्थन, बेहतर मजबूत देशव्यापी वैज्ञानिक अध्ययन, कृषिवानिकी क्षमता की समझ और जलवायु परिवर्तन शमन के लिए नृवंश विज्ञान और मानव कल्याण के लिए प्रोत्साहन प्रदान होगा। क्षेत्र विशिष्ट कृषिवानिकी माडल, दूरस्थ कृषिवानिकी

मूल्यांकन के लिए संवेदन और जीआईएस माडलिंग, जो कृषि प्रणालियों को मजबूत कर सकती है, क्षेत्रीय रूप से आवश्यक है।

निष्कर्ष

कृषिवानिकी एक ही भूमि के टुकड़े पर एक साथ वन और खेत की फसलों की खेती है। यह भूमि को उपजाऊ बनाने के साथ खेत की फसल को छाया प्रदान करती है तथा राजस्व में वृद्धि करती है। वृक्ष मिट्टी के संसाधनों का पूर्ण उपयोग करने के साथ ही वातावरण को स्वच्छ बनाते हैं। इस प्रणाली से लोगों के रोजगार और आय के सृजन में मदद मिलती है। लोगों को कृषिवानिकी के दायरे और लाभों के बारे में जागरूक होना चाहिए और उन्हें भारत में कृषिवानिकी के कार्यान्वयन और विकास में भाग लेना चाहिए। स्थानीय लोगों की भागीदारी के बिना कोई भी योजना और कार्यक्रम सफलतापूर्वक लागू नहीं किया जा सकता है। जब अधिकांश लोग वृक्षारोपण के कार्य और संरक्षण में सहयोग करने को तैयार होंगे, तो यह कार्यक्रम एक बड़ी सफलता बनेगा।

Agroforestry practices for achieving sustainable development goals

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Abstract

Agroforestry as a land use system can help to achieve at least nine of the 17 sustainable development goals. It is an important tool for both climate mitigation and adaptation. Agroforestry combats poverty and hunger, increases biodiversity, gives women greater control over resources and frees up women's time. Studying the contribution of agroforestry practices in the context of Sustainable Development Goals is crucial when the COVID-19 pandemic has hindered the achievement of many of the crucial SDGs. Agroforestry can significantly and effectively support SDG-1, SDG-2, SDG-11, SDG-13 and SDG-15 directly to reduce poverty, improve food security, build liveable, healthy cities, and provide a sustainable, prosperous environment under the current climate change conditions, while indirectly supporting other SDGs such as bettering health and education, empowering women, and promoting effective coexistence. In order to accomplish the objectives of sustainable development, an integrated landscape approach will offer the means to guarantee that the most suitable methods and approaches are adopted in the proper location for the proper reasons.

Keywords: Agroforestry, sustainable development goals, climate change, integrated approach.

Introduction

The Sustainable Development Goals (SDGs) are a set of 17 workable areas and 169 targets adopted by the United Nations General Assembly in 2015, aspiring to be fulfilled by the year 2030. It complements the eight Millennium Development Goals (MDGs) to attain sustainability in social, environmental, and economic growth (Salvia *et al.* 2019). For these goals, land use, particularly food systems, has been seen as a single point of convergence. We now require agriculture that can "multi-functionally" boost food production while also enhancing social and environmental goals, as pledged to in the Sustainable Development Goals (SDGs). Farming must become more robust to many threats such as climate change, soil degradation, and market volatility, all of which impair sustainability (Waldron *et al.* 2017).

As per the recent reports by the Agroforestry Network, land management systems such as agroforestry have the potential to achieve nine out of the 17 SDGs with a relatively higher focus on goals such as 1 (No Poverty), 2 (Zero Hunger), 13 (Climate Action), and 15 (Life on Land) than others (Agroforestry Network 2018). Agroforestry is a combination of land-use systems that incorporates trees and shrubs on farmlands and rural landscapes with or without animals to improve productivity,

profitability, diversity, and ecosystem sustainability, according to the National Agroforestry Policy (2014). Understanding agroforestry techniques offers commendable chances to find answers to the global issues of self-sufficiency and the provision of essentials (Singh *et al.* 2022).

Here are a few instances showing how agroforestry contributes to the achievement of at least nine of the 17 SDGs through sustainable food production, ecosystem services, and financial gains:

Agroforestry for SDG 1 & 2: Ending Poverty and Hunger

It is estimated that 648 million (about eight percent of the global population) is living in poverty, whereof 43.1% live in rural areas and a majority work in agriculture (World Bank 2022). Between 691 and 783 million people faced hunger in 2022 (FAO 2022). Agroforestry contributes to food security in multiple ways. Agroforestry is a system that integrates land uses (forest and open-field agriculture) and with the right combinations of trees, crops, and livestock, it can provide a variety of goods, benefits, and services simultaneously, including nourishing food, renewable energy, clean water, and biodiversity preservation. Studies also show that planting nitrogen-fixing trees can increase yields up to several hundred percent. However, crop yields can also be affected negatively if the density of trees is too high, which can lead to crops competing with trees for nutrients, light and water (Akinnifesi *et al.* 2009).

Agroforestry for SDG 3: Ensure healthy lives and promote well-being for all at all ages

Farmers profit significantly from agroforestry systems in terms of health. One example is the possibility of reduced pest control with chemical pesticides, which has severe consequences for the environment and human health. The effects of pests and diseases on crops can be reduced in agroforestry systems.

Agroforestry for SDG 5: Achieve gender equality and empower all women and girls

Agroforestry can improve women's empowerment, involvement, and access to economic and natural resources. Agroforestry is a land management strategy that can help women and minimise gender inequality in various ways. Women have always been responsible for gathering fuel wood. They spend less time and walk shorter distances hunting for fuel in the forest when agroforestry is implemented because they can access firewood at home. This also means increased personal safety, more time for income-generating activities such as picking fruits and other tree products to sell. Agroforestry can provide unique opportunities for women to play a central role in food production and value chains despite limited access to land.

Agroforestry for SDG 6: Ensure availability and sustainable management of water and sanitation for all

Trees are vital for the creation of rain on a regional and continental scale because forested areas produce more water vapour and increase relative humidity. Furthermore, an intermediate tree density can maximise groundwater recharge in conditions that are common throughout

much of the seasonally dry tropics. Without the trees, these tropical soils lose their bigger pores, preventing most of the water from penetrating deep into the soils. As a result, agroforestry plays a significant role in mitigating the consequences of deforestation by increasing tree cover on already deforested land and so contributing to increased rainfall.

Agroforestry for SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all

Currently, 2.4 billion people rely on firewood to cook their food. Deforestation makes it more difficult for individuals, particularly women and girls, to obtain firewood, requiring them to walk further. Agroforestry can help to lessen forest pressure by providing farmers with bioenergy, timber, and other forest products.

Agroforestry for SDG 12: Ensure sustainable consumption and production patterns

As the world's remaining forests are threatened by rising demand for food, feed, fibre, and fuel, women and men in developing nations will face new problems, particularly in a changing climate. Agroforestry is a promising land management method that has the potential to improve livelihoods of farmers while lowering pressure on forests, contributing to more sustainable production patterns.

Agroforestry for SDG 13: Combating climate change and its impacts

Agriculture, forestry and other land uses are major contributors to greenhouse gas emissions, accounting for 21% of total global emissions. Deforestation, raising animals and managing soil and nutrients all result in emissions. Agriculture contributes to emissions, but it is also severely impacted by climate change, with decreased crop yields being one example. When determining global and national carbon budgets, trees on agricultural lands are typically not taken into account for their potential for mitigation, but they are recognised as a Clean Development Mechanism used to offset emissions from higher income countries. Even though it is difficult to estimate the above and belowground carbon storage, studies show that agroforestry increases carbon storage aboveground in biomass, and belowground through enhanced root production, organic material from roots incorporated into the soil, and litter fall (Kim *et al.* 2016). While storing less carbon than forested areas, agroforestry holds more carbon than pastures and fields with annual crops. Additionally, storage potential is higher near the equator and in humid regions compared to arid and semiarid climates. Increasing resilience to climate changes and shocks like droughts and floods is another possibility presented by agroforestry. Agroforestry results in a more diverse farm and variety of food, which helps lessen the vulnerability of farmers' livelihoods.

Agroforestry for SDG 15: Life on land (Halting biodiversity loss)

More than 75% of the terrestrial biodiversity on the planet is found in forests. Turning forests into agricultural land is the major reason for biodiversity losses in tropical regions, where most of the world's biodiversity reserves are found (Scales and Marsden 2008). A big part of

the reason for the rise of agriculture in these areas is the rapid rate of population increase and the international commerce of agricultural products like soy, beef and palm oil. This deforestation increases the greenhouse gas effect, since trees absorb carbon dioxide. Biodiversity is crucial to global food production and food systems resilience, especially in the light of climate change, but is at risk due to the growing demand for food and biofuel (Agroforestry Network 2018). Agroforestry systems are significant in reducing biodiversity loss because they provide habitat for a wider range of species than agricultural fields with annual crops.

Conclusion

Nine out of the 17 Sustainable Development Goals (SDG) can be attained with the help of agroforestry as a land use system. Agroforestry is an important technique for both climate mitigation and adaptation because trees play a significant role in the storage of enormous amounts of carbon and because it helps farmers become more resilient to shocks caused by the climate and unpredictable weather. Agroforestry helps smallholder farmers who are struggling to make ends meet by reducing poverty and hunger and by boosting yields and providing a wider range of livelihood options. If done correctly, agroforestry can reduce dependency on a single crop and improve soil fertility, both of which are crucial components of raising food security. Agroforestry can boost biodiversity because trees in these systems serve as habitat for many different species, a "buffer zone" against destruction, and a "green corridor" that permits species to move across landscapes, which is essential for their survival. Agroforestry can strengthen women control over resources and free up women's time. One benefit of agroforestry is that it reduces the amount of time needed to travel vast distances in search of fuel in the forests. Accessing firewood at the door can improve women's (and men's) personal safety and free up more time for activities that generate cash because this is usually seen as a woman's chore. Agroforestry practises have the potential to benefit both men and women if they are implemented properly. For instance, women and men can share knowledge about which trees to plant and how to manage trade-offs, such as the ideal tree density for a system to function optimally.

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Resilience strategies for heatwaves and their impact on forestry and agriculture sectors

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Introduction

Heat Wave as an extreme weather event has recently has become a concern for disaster management in India due to widespread and severe impact on health and environment. For last few years, heat wave during the summer season is increasingly affecting morbidity and mortality in the country. Looking at the current scenario, effective response is important for saving peoples life and health, besides evolving strategies for future risk mitigation and management of heat waves conditions. Extreme weather conditions have become so obvious and impacted lives across the world particularly over the last decade and more. Hence, ways and means to understand and cope with extreme heat events have become essential to coping strategies for communities.

The 2010 Indian heat wave can be considered a wakeup call that inter-governmental agency action, preparedness and community outreach becomes imperative to save lives lost due to such extreme events. In India, 2014 surpassed 2010 as the warmest year in a global temperature record that stretches back to 1880s. The 10 warmest years on record have all occurred since 1997, a reflection of planetary warming that scientists predict is a consequence of anthropogenic emissions and poses profound long-term risk to civilization. The death toll due to heat waves is crossing a certain mark and the situation has tightened its grip on states of Odisha, Telangana, Andhra Pradesh, and other states as well. The question remains whether we are adequately preparing to deal with such eventualities. From the view of hazard mitigation, rising number of heat wave related deaths is expected to serve as danger signal and corroborate the need to develop innovative methods to control summer-time losses.

The earth's average temperature has been rising since the late 1970s. However, the year 2021 has broken the historical record of the global climate in many ways. The average global temperature across land and ocean surface areas in 2021 was 1.12°C higher than the twentieth- century average. Heat waves are becoming extremely intense and frequent in various parts of the world including India leading to losses in agricultural productivity and thousands of deaths. The Sixth Assessment Report of the IPCC has also reiterated that climate change is real and its impact is being felt throughout the globe. In many parts of India, warmer summer and droughts have

significantly impacted agriculture. Global food production is steadily increasing, but the rate of increase especially for major cereal crops is declining.

Heatwave by WMO

The World Meteorological Organization, defines a heat wave as 5 or more consecutive days of prolonged heat in which the daily maximum temperature is higher than the average maximum temperature by 5 degree or more

Heatwave by IMD

The IMD has given the following criteria for heatwave "If maximum temperature of a station reaches at least 40˚c or more for Plains and at least 30˚C or more for hilly regions."

How IMD predicts the Heat wave?

IMD predicts heat wave based on synoptic analysis of various meteorological parameters and from the consensus guidance from various regional & global numerical prediction models like, WRF, GFS, GEFS, NCUM, UMEPS, UM Regional etc. run in Ministry of Earth Sciences (MoES) and other international models available under bilateral multi-institutional arrangement. Heat wave as a hazard causing disaster scenario, is little more than the physical phenomenon of high heat conditions, and is characterized as a complex of hydro-climatic risks coupled with social, occupational, and public health risks. A Heat Wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the summer season in the North-Western parts of India. Heat Waves typically occur between March and June, and in some rare cases even extend till July. The extreme temperatures and resultant atmospheric conditions adversely affect people living in these regions as they cause physiological stress, sometimes resulting in death. As such there is no universal definition for heat wave. It is generally defined as a prolonged period of excessive heat. The Indian Meteorological Department(IMD) has the following criteria for Heat Waves as

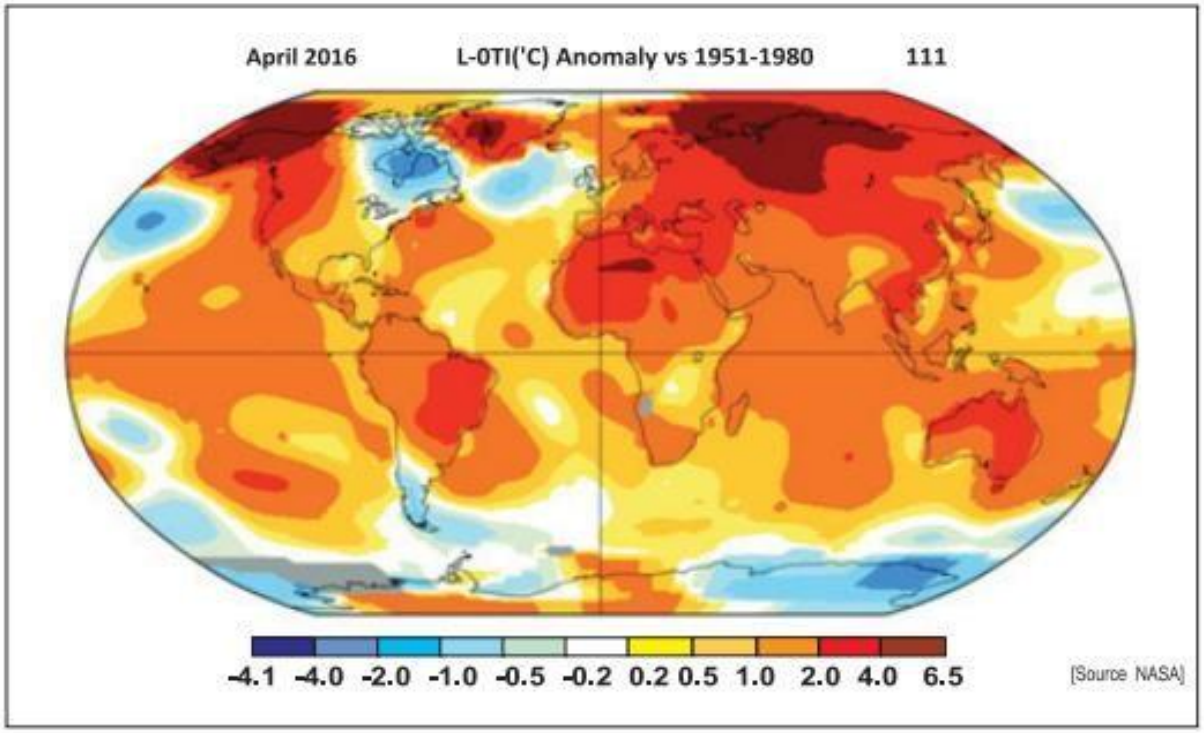
- Heat wave need not be considered till maximum temperature of a station reaches at least 40^0C for plains and at-least 30^0C for Hilly regions
- When normal maximum temperature of a station is less than or equal to 40^0C heat wave Departure from normal is 5^0C to 6^0C and severe heat wave departure from normal is 7^0C or more
- When normal maximum temperature of a station is more than 40^0C heat wave departure from normal is 4^0C to 5^0C and severe heat Wave Departure from normal is 6^0C or more.
- When actual maximum temperature remains 45^0C or more irrespective of normal maximum temperature, heat waves should be declared.

In 2015, the heat wave in India is known for more than 2,300 deaths, making it the 5^{th} worst globally in terms of number of deaths. Most of the deaths were reported in Andhra Pradesh, Telangana, Punjab, Odisha, and Bihar. In 2016, global temperatures continuedto soar. The month of April 2016, for example, saw highest recorded average global temperature. India too witnessed one of the severe heat wave

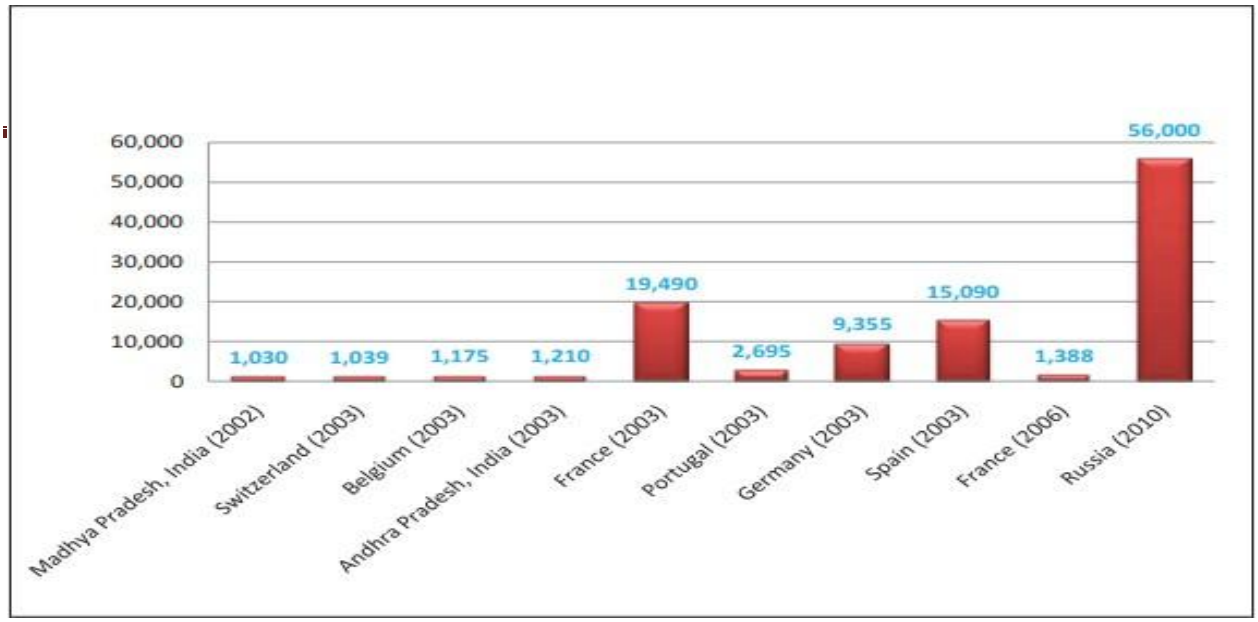
conditions during April 2016 which contributed to many heats related deaths.

Global Heat wave conditions in April 2016:

In India, unlike March-April 2015, in 2016, people did not get much relief from high temperatures due to the absence ofthunderstorms and rain. Temperatures in some areas had crossed 45°C and were consistently above normal in many parts of West Bengal, Odisha, Bihar, Jharkhand, Uttar Pradesh, Maharashtra, Telangana, and Andhra Pradesh. Between mid-March and mid-April 2016, maximum temperatures (excluding north-eastern states and Jammu and Kashmir) have been above normal by 2-4°C with the greatest impact in north-central and eastern India.



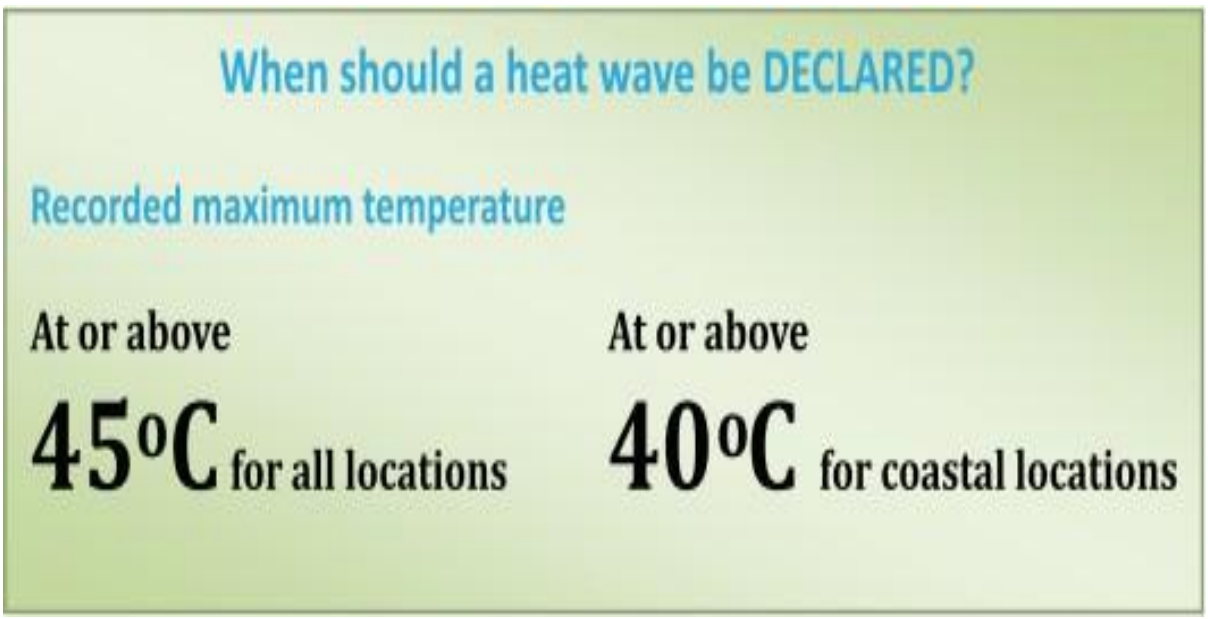
Ten highest mortality heat events across globe (2001-2010)



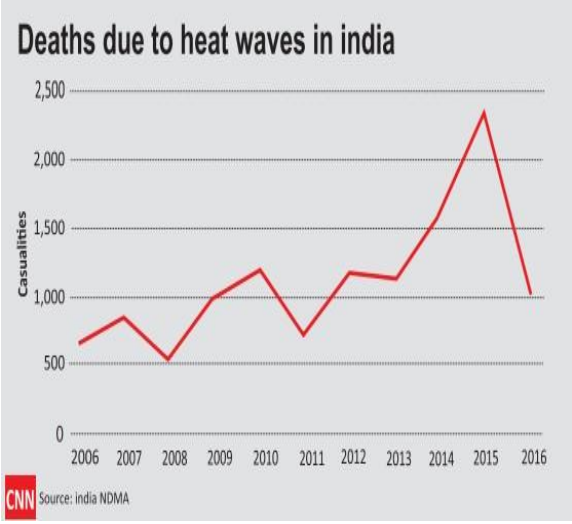
More than 370,000 people died due to exposure to extreme weather and climate conditions (20 per cent higher than 1991-2000) and death due to heat wave alone amounted to 136,000 in 2001-2010, compared to less than 6,000 in 1991-2000 (the increase of more than 2,000 per cent was due to heat wave in Europe in 2003 and in Russia in 2010). Some 44% of countries recorded hottest temperature during 2001-2010, compared to 24% in 1991-2000. In terms of the India's heat records, the reason attributed was due to a combination of seasonal climatology, prevailing circulation (wind, cloudiness) and long-term trends associated with global warming.

Heat wave conditions in India

According to a study done by researchers from IIT Bombay, TISS and Monash University, Australia, the frequency, and intensity of heat waves is going to increase in the future. In a paper published in the April 2015 issue of the Journal of Regional Environmental Change, they wrote "heat waves are projected to be more intense, have longer durations and occur at a higher frequency and earlier in the year." Apart from predicting that heat waves will become more common in south India, the scientists say that "In northern India, the



average number of days with extreme heat stress condition during pre-monsoon hot season will reach 30. The intensification of heat waves might lead to severe heat stress and increased mortality thus, calling for immediate attention and mitigation and coping strategies.



Another reason for the rise in heat was due to sparser pre-monsoon season showers, which brought less moisture than normal to the area, leaving large parts of India arid and dry. The sudden end of pre-monsoon rain showers, an uncommon trend in India, has contributed to the heat waves. Additionally, the monsoon season is later and further south than the normal trend. This weather pattern, coupled with the El Nino effect, which often increases temperatures in Asia, combined to create the record high temperatures. High humidity compounded the effects of the temperatures on residents. The "Loo," a dry wind originating from Pakistan and northwest India, has contributed to increasing the temperature in India.

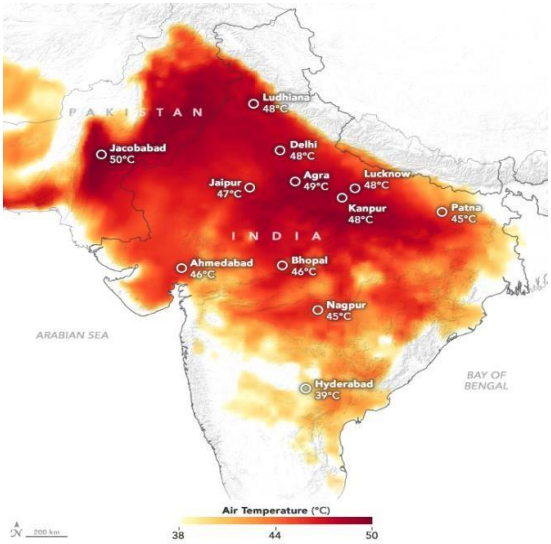
Technologies/strategies for heat wave management

Crops

Increase in temperatures in many parts of India has triggered the heat wave conditions during March-April 2022, impacting the yields of rabi crops particularly wheat. The prevailing maximum temperatures have increased by 4-5o C compared to the previous year at several locations. Wheat crop experienced heat stress during 3rd and 4th weeks of March where the crop is at milking stage and resulted in shriveled grains, affecting both quality and weight of output.

In India, wheat crop was sown in an area of about 31 million ha during 2021-22 crop season. Out of this approximately 75 percent lies under timely sown (planted on or before November 15). Timely sown crop was in excellent condition under NWPZ (Haryana, Punjab, West UP) and NEPZ (east UP, Bihar and West Bengal) till second week of March but suddenly rise in temperature affected the crop. The late sown crop (in about 6-7 million ha area) got affected severely.

Various technologies are available to minimize the yield loss in wheat due to heat wave and some of them are



transferred to farmers' fields. Several heat tolerant wheat varieties, PBW 803, DBW 187 and DBW 222 can tolerate high temperatures and can produce normal

yields compared to local variety HD-3086 (Table 5). Technologies such as residue management of rice by various machines enable timely sowing of wheat. Direct seeding of rice can result in early maturity by 10 days which can enable timely sowing of wheat. Spray of KNO3 @ 0.5% at boot leaf and anthesis stages can minimise the yield loss. Providing additional irrigation through effective methods during heat stress period can alleviate the stress with optimal water use.

Horticulture

In Uttar Pradesh, about 5°C temperature increase in March from the normal has resulted in mango flower drop and lots of Jhumka problem in mango due to poor pollination. Due to recent increase in temperature in Vidarbha region, citrus orchards witnessed fruit drop in several areas. In order to mitigate these problems, ICAR-Central Citrus Research Institute (CCRI) and ICAR-Central Institute for Sub Tropical Horticulture (CISH) have issued advisories for orchard growers to be followed during the months of April-May.

- If the orchard is more than 6 years age, 150-240 litres water/day/tree is required. Drip irrigation with organic mulch should be preferred. In conventional method of irrigation, time of irrigation is to be prolonged.
- Mulching helps in maintaining the soil moisture for long period. Mulch the soil with paddy straw or locally available organic or inorganic material. Black polythene material would be essential to prevent excess evaporation.
- Foliar spray of 2-4% Kaolin is recommended depending on the severity to reduce the transpiration. Two foliar spays of Potassium nitrate 1-1.5% may also be done at an interval of 15 days during April-May.
- Apply Copper oxychloride 50 WP @ 25g/10 litre water for controlling fruit blight infection.
- Water stress conditions often aggravate the mite problem during these months. Therefore, foliar application of Dicofol 18.5EC @27 ml or Propargite 57EC @ 20 ml or Ethion 50EC @20 ml in 10 litre water twice at 15 days interval is necessary during summer, particularly during the stress in late summer.
- The sudden rise in temperature has also triggered new vegetative flush in mango, which acted as powerful sink for assimilates than the fruits resulting severe fruit drop in mango. The fruit set also reduced due to minimal activity of pollinators owing to heat wave.
- Frequently irrigate citrus field to counter the effect of heat waves was suggested at many locations.

Technological options to mitigate the effect of heat wave on vegetables

Tomato

- Maintain soil moisture near to field capacity by frequent irrigation. In drip irrigated crop, system need be operated twice for half-an hour daily (morning and evening). Under surface irrigation system, tomato crop should be irrigated twice a week with 4 cm water each time.
- Use organic mulch of 5-7 cm

thickness around the plant to maintain congenial soil and micro-climate nearby plants.

- Use 3-4 rows of maize as border crop to reduce the impact of heat wave on main crop.Border crop should be repeated at every 20-25 m distance.
- Two sprays of plant growth substances such as Salicylic acid (250 µmol/ lit) or Sodium nitroprusside (SNP @ 25 µmol/ lit) is also helpful in improving fruit set and size.
- Cultivate high temperature tolerant hybrids such as, Kashi Tapas and Kashi Adbhut.

Cucurbitaceous vegetables (Sponge gourd, Cucumber, Muskmelon)

- Soil moisture management, application of organic mulch and maize as border crop as in the case of tomato is recommended.
- Use shading net of 50% (1.5-2.0 m above the field surface) to reduce the intensity of solar radiation.
- Make 2-3 sprays of pesticides (Lambda Cyhalothrin 2.5% EC @ 1 ml/lit or mixture of Acetamiprid (0.5 g) + Pyriproxyfen (1 ml/ lit).
- **Cowpea**
- Maintain higher soil moisture in the field by frequent irrigations.
- Use 3-4 rows of maize as border crop to reduce the impact of heat wave on main crop.

Livestock

- Provide insulation on top of the shed with sprinklers and use of foggers in animal sheds to sprinkle the water on animals and maintain optimum body temperature conditions.
- Install fans and coolers in animal sheds to bring down the temperatures and to reduce the impact of heat stress.
- Use shade nets for animal sheds to reduce the direct sun light and reduce the heat stress.
- Proper feed supplementation with mineral mixture @ 50 g/day/animal and UMMB blocks to be taken up to provide sufficient nutrients and to enhance the milk yields up to 1-1.5 l/day/animal.
- Encourage indoor feeding with green fodder instead of outdoor grazing to reduce the heat stress and increase the feed intake
- Water bath to lactating animals to reduce the sun stroke.

Poultry

- Poultry house temperature can be reduced up to 3-5°C by providing insulation on top of the roof with water sprinklers, providing foggers inside the house with forced ventilation, providing side curtains and sprinkling water on the curtains are some approaches to minimize the losses.
- Increase the nutrient density (primarily energy and amino acids) of diets by about 10% to compensate the reduced feed (nutrient) intake during heat stress.
- Feed the birds during early morning (before 5 AM) and late evening (after 5 PM) to increase feed intake and avoid production of metabolic heat during peak hours of high ambient temperature.
- Provide cool water during hotter

part of the day tokeep the body temperature under control.

Fisheries

- To hold one ton of fish, nearly 3-4 LPS (180-240 LPM) of water flow is required at an average temperature of 15°C. In higher water temperature, water flow should be increased as 300-350 LPM to maintain sufficient level of dissolved oxygen i.e.,> 7 ppm.
- Water depth in the fish pond should be raised from 0.8 m to 1.0 m by adding fresh water.
- Thinning of the growing stock should be done @ 10-15 kg/m3 compared to 15-20 kg/ m3 under normal condition.
- Reduce the quantity of feed by 10-20% compared to normal condition.

Effects of Heatwaves on Forest

Heatwaves can have significant and far-reaching effects on forests, impacting their overall health, biodiversity, and ecosystem functioning.

Increased tree mortality

Heatwaves can result in elevated tree mortality rates. For example, a study published in the journal Nature in 2020 analyzed data from more than 1 million forest plots across the globe and found that heatwaves have caused a significant increase in tree mortality in recent decades. The study reported that heat-related tree mortality events have become at least 3 times more frequent over the past century. A study in California found that heatwave in 2002 caused an increase mortality rate up to 60%.

Reduced forest productivity

Heatwaves can have detrimental effects on forest productivity. A study published in the journal Nature in 2018 analyzed satellite data and found that global forest productivity declined by approximately 2.9% from 2000 to 2010 due to increased heat stress. The study projected that if global temperatures continue to rise, forest productivity could decrease further, impacting carbon sequestration and ecosystem services provided by forests. In Thailand 3 consecutive days of high temperature (>40) reduced annual tree growth rate by 2-3%.

Increased wildfire risk

Heatwaves contribute to the conditions conducive to wildfires. According to the European Forest Fire Information System (EFFIS), heatwaves have been associated with an increase in the number and severity of wildfires in Europe. For instance, during the European heatwave in 2019, an unprecedented number of wildfires occurred across several countries, including Sweden and Greece.

Altered species composition and distribution

Heatwaves can lead to changes in forest composition and distribution. A study published in the journal Global Change Biology in 2019 examined long-term forest monitoring data in Europe and found evidence of a shift in tree species composition towards more drought-tolerant and heat- tolerant species. The study highlighted that such changes could have long-lasting impacts on forest ecosystems and biodiversity.

Impacts on water resources

Heatwaves can affect water availability in forested areas. A study published in the journal Environmental Research Letters in 2019 analyzed data from 1979 to 2015 and

found that heatwaves have led to reductions in soil moisture and streamflow in forests across Europe. These changes in water availability can impact the health and functioning of forest ecosystems and have implications for downstream water resources.

Increased susceptibility to pests and diseases

Heatwaves weaken trees, making them more vulnerable to pest infestations and diseases. Prolonged heat stress can compromise a tree's defense mechanisms, making it less able to fend off attacks from insects, fungi, and pathogens. This can lead to outbreaks of pests and diseases that can further harm forest health.

Altered species composition and distribution

Certain tree species may be more resilient to heatwaves than others, leading to shifts in the composition and distribution of forest ecosystems. Heat-intolerant species may decline, while more heat-tolerant species may become dominant. This can result in changes in the structure and function of the forest ecosystem, affecting wildlife habitats and biodiversity.

Disruption of ecological interactions

Heatwaves can disrupt the intricate ecological interactions within forests. For example, shifts in flowering and fruiting timings of trees due to heat stress can disrupt pollination and seed dispersal processes. This can have cascading effects on other species that depend on these interactions for their survival and reproduction.

Effect of Heat waves on Wood Production

Reduced wood growth and yield

Heatwaves can negatively impact wood production by affecting the growth and yield of trees. High temperatures and drought conditions during heatwaves can lead to water stress, limiting the availability of water for tree growth. This can result in reduced wood formation, decreased tree growth rates, and ultimately lower wood production. In India heatwaves can reduce the productivity of teak plantations by up to 50%. Heatwave event in 2017, the growth of pine trees in central Europe decreased by up to 60%.

Altered wood quality

Heat stress can affect the quality of wood produced by trees. Increased temperatures can disrupt the process of lignin formation, which is important for wood strength and durability. This can result in weaker and less valuable wood with reduced commercial viability. Heatwaves can increase the number of resin canals in the wood, which can lower the value of the timber and reduce its durability.

Shifts in tree species composition

Heatwaves can lead to shifts in tree species composition, which can have implications for wood production. Certain tree species may be more resilient to heatwaves than others, leading to changes in the dominant tree species in forested areas. This can influence the availability and quality of wood resources.

Effect of Heatwaves on Wildlife

Heatwaves can have significant impacts on wildlife, affecting their behavior, habitat, and overall survival.

Increased mortality

Heatwaves can lead to increased mortality among wildlife populations, particularly in species that are sensitive to high temperatures. Heat stress can cause dehydration, heat exhaustion, and organ

failure in animals, especially those that cannot adequately cool down or find shelter in extreme heat conditions.

Disruption of behavior and feeding patterns

Heatwaves can disrupt the behavior and feeding patterns of wildlife. Many animals, such as mammals and birds, have specific temperature thresholds beyond which their activity levels decrease to avoid overheating. Heatwaves can disrupt their normal activity patterns, leading to reduced foraging and hunting success.

Habitat loss and fragmentation

Heatwaves can result in habitat loss and fragmentation, particularly in ecosystems that are already stressed by other factors such as drought or human activities. Extreme heat and drought can lead to the drying up of water sources, reducing available habitat for aquatic species and those dependent on water bodies. Heat stress can also affect plant communities, altering food availability and habitat structure for terrestrial species.

Changes in species distribution

Heatwaves can influence the distribution of wildlife species, leading to shifts in their range. Some species may move to higher elevations or migrate to more suitable habitats with more favorable temperature conditions. This can result in changes in species interactions, competition, and potential conflicts with other resident species.

Impact on reproductive success

Heatwaves can negatively impact reproductive success in wildlife. Elevated temperatures can disrupt breeding cycles, affect reproductive physiology, and reduce reproductive output. For example, heat stress can lead to reduced fertility, nest abandonment, and decreased hatching success in birds and reptiles.

Increased susceptibility to diseases and parasites

Heatwaves can weaken the immune systems of wildlife, making them more susceptible to diseases and parasites. Heat stress can impair an animal's ability to fight off infections and increase the prevalence and severity of diseases. It can also create favorable conditions for the proliferation of parasites, such as ticks and fleas.

Impact on migratory patterns

Heatwaves can influence the timing and routes of animal migrations. Some species, particularly birds and mammals, rely on predictable temperature patterns to time their migrations accurately. Changes in temperature patterns due to heatwaves can disrupt these migratory behaviors, affecting the availability of critical resources and potentially impacting population dynamics.

Adaptation strategies for Heatwaves

Adaptation strategies for the forestry sector can help mitigate the impacts of heatwaves on forests and promote their resilience.

Diversify tree species

Diversifying tree species within forests can increase their resilience to heatwaves. Planting a variety of tree species that are adapted to different temperature and moisture conditions can help ensure that some species are more likely to withstand heat stress. This can also reduce the risk of widespread tree mortality and maintain ecosystem functionality.

Assisted migration and assisted gene flow

Assisted migration involves the intentional

movement of tree species or populations to more suitable habitats in response to changing climate conditions. Assisted gene flow focuses on promoting the transfer of genetic material between tree populations to enhance the adaptive potential of forests. These strategies can help facilitate the establishment of tree populations that are better adapted to future heatwave conditions.

Forest management practices

Adaptive Forest management practices can help mitigate the impacts of heatwaves. This includes promoting sustainable logging practices to maintain forest structure and health, reducing forest fragmentation to enhance connectivity and resilience, and implementing silvicultural techniques such as thinning and pruning to reduce competition and promote the growth of more resilient tree species.

Restoration and reforestation

Restoring and reforesting degraded areas can enhance forest resilience to heatwaves. Restoring native vegetation can help create diverse and resilient ecosystems that are better able to withstand extreme heat events. Reforestation efforts can focus on selecting tree species that are well-suited to the local climate and consideringfuture climate projections.

Water management

Implementing water management strategies in forests can help alleviate the impacts of heatwaves. This includes improving water retention through techniques like mulching, reestablishing riparian zones to maintain water availability, and managing water resources to ensure sufficient moisture for tree survival during drought periods.

Monitoring and research

Continued monitoring and research are essential for understanding the specific impacts of heatwaves on forests and developing effective adaptation strategies. Collecting data on forest health, tree growth, and mortality rates can help identify vulnerable areas and guide targeted adaptation efforts. Research on tree genetics, resilience mechanisms, and the impacts of heat stress can inform the development of more effective adaptation strategies.

Collaboration and knowledge sharing

Collaboration among stakeholders, including forest managers, researchers, policymakers, and local communities, is crucial for successful adaptation in the forestry sector. Sharing knowledge, experiences, and best practices can help improve understanding, build capacity, and foster collective action in response to heatwave impacts.

Government Initiatives to Combat the Heatwaves (World)

Great Green Wall

The Great Green Wall is an ambitious initiative in Africa aimed at combating desertification, land degradation, and climate change by creating a mosaic of green landscapes across the Sahel region. It was launched in 2007 by the African Union and the United Nations Environment Programme (UNEP) and is often referred to as the "Great Green Wall of Africa." The primary goal of the Great Green Wall is to restore and sustainably manage land resources, promote biodiversity, and improve the livelihoods of communities in the Sahel region. The Sahel spans across more than 20 countries in northern Africa, including Senegal, Mali, Niger, Chad, Sudan, and Ethiopia.

The Bonn Challenge (2011)

The Bonn Challenge is a global effort launched in 2011 to restore degraded and deforested landscapes by bringing together governments, organizations, and other stakeholders to make commitments towards forest landscape restoration (FLR). The initiative was announced at a ministerial roundtable during the International Year of Forests held in Bonn, Germany.

The main objective of the Bonn Challenge is to restore 350 million hectares of degraded and deforested land by 2030. This ambitious target was established to address multiple environmental, social, and economic challenges, including biodiversity loss, climate change mitigation and adaptation, water resource management, and rural development.

Forest Landscape Restoration, Brazil: (2014)

This is the goal of the Brazil to restore 12 million hectares of degraded land in Brazil by 2030. FLR in Brazil involves restoring degraded forests, promoting sustainable land use practices, and improving the resilience of forest ecosystems. The country has a diverse range of ecosystems, including the Amazon rainforest, the Atlantic Forest, and the Cerrado, all of which have faced significant deforestation and degradation.

Billion Trees plantation Programme

Pakistan's Billion Trees Afforestation Project (BTAP), launched in 2014, is a large-scale initiative aimed at addressing deforestation, mitigating climate change, and promoting sustainable land management. The project's goal was to plant one billion trees across the country by 2018.

Three-North Shelterbelt Project

The Three-North Shelterbelt Project, also known as the "Great Green Wall," is a massive afforestation effort launched in the early 1970s. The project aims to create a protective forest belt in the northern part of China, stretching across multiple provinces, to combat desertification and reduce sandstorms. It involves planting trees, particularly drought-resistant species, to stabilize sand dunes, prevent soil erosion, and restore degraded land.

Government Initiatives to Combat the Heatwaves (India)

India has implemented several afforestation and reforestation programs to combat deforestation, restore degraded lands, and promote sustainable forest management.

National Afforestation Program (NAP) and Green India Mission (GIM)

- The National Afforestation Program (NAP) was initiated in 2002, aiming to increase forest and tree cover in the country.
- The Green India Mission (GIM) was launched in 2014 as a part of the National Action Plan on Climate Change, with the goal of increasing forest cover and improving ecosystem services.
- According to the India State of Forest Report (ISFR) 2019, the total forest and tree cover in India increased by 3,976 square kilometers (0.56%) between 2017 and 2019.

Compensatory Afforestation Fund Management and Planning Authority (CAMPA)

- The Compensatory Afforestation Fund Management and Planning

Authority (CAMPA) were established to manage funds collected for compensatory afforestation and other related activities.

- As of 2019, the CAMPA funds had accumulated to around INR 66,000 crores (approximately USD 9.1 billion).

National Mission for a Green India (GIM)

- The National Mission for a Green India (GIM) is a component of the National Action Plan on Climate Change and focuses on afforestation, reforestation, and forest conservation.
- As of 2020, under the GIM, around 14.35 lakh hectares (approximately 3.54 million acres) of forest and non-forest land have been targeted for afforestation and ecosystem restoration.

Government Initiatives to Combat the Heatwaves (Telangana)

Telangana, a state in southern India, has implemented several afforestation programs to increase forest cover, combat deforestation, restore degraded lands, and promote sustainable land management.

Telangana Ku Haritha Haram

- Telangana Ku Haritha Haram (TKHH) is a flagship afforestation program launched in 2015 with the goal of increasing the green cover in the state.
- The program aims to plant 230 crore (2.3 billion) tree saplings across the state, covering both forest areas and non-forest lands.
- It focuses on restoring degraded forests, rejuvenating watersheds, promoting urban forestry, and creating green spaces in rural and urban areas.
- Telangana Ku Haritha Haram has been implemented through various government departments, involving the participation of communities, NGOs, educational institutions, and other stakeholders.

Telangana Forest Department Initiatives

- The Telangana Forest Department has implemented various afforestation initiatives, including the "Vana Mahotsav" tree planting festival.
- The department conducts massive tree plantation drives, awareness campaigns, and community engagement programs to promote afforestation and conservation.
- It also focuses on ecological restoration, habitat improvement, and biodiversity conservation through active management of protected areas, wildlife sanctuaries, and national parks.

1. **Compensatory Afforestation:**

- Telangana actively participates in the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) program, which aims to utilize funds collected for compensatory afforestation.
- The funds are utilized for afforestation activities, ecological restoration, and conservation initiatives, with a focus on compensating for forest land diversion for development projects.

Conclusion

Heatwaves are a growing concern in the context of climate change. They have wide-ranging impacts on human health, ecosystems, and the economy. Urgent global action is needed to address the root causes of climate change and to implement effective measures to mitigate and adapt to the increasing frequency and intensity of heatwaves.

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An insight into the timber trees of Telangana

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Introduction

Telangana has a total area of 1, 12, 077 sq. km, or 3.41% of the country's total area. According to Champion and Seth, the state's forests can be classified as dry teak forest, southern dry mixed deciduous forest, dry deciduous scrub, dry Savannah forest, Hardwickia forest, dry bamboo brakes, and southern thorn forest. In accordance with the ISFR 2021, there are 21,213.98 sq. km of total forest land, of which 1,623.90 sq. km are very dense forest (VDF), 9118.68 sq. km are moderately dense forest (MDF), and 10,471.40 sq. km are open forest (OF).

The top-storey of the forests is mainly comprised of various timber species such as *Tectona grandis, Terminalia alata, Holarrhena pubescens, Lagerstroemia parviflora, Anogeissus latifolia, Diospyros melanoxylon, Xylia xylocarpa, Chloroxylon swietenia, Lannea coromandelica,* and *Miliusa tomentosa*, as well as multi-use species such as *Madhuca longifolia var. latifolia* and *D. melanoxylon* and ecologically valuable open canopy. In this manuscript, we are giving an insight into the major timber trees of Telangana.

***Tectona grandis* (Common Name: Teeku, Family: Lamiaceae)**

Distribution in Telangana: Nizamabad, Rangareddy, Karimnagar, Jagital, Adilabad, Nirmal

Silvicultural Characteristics

Warm, tropical temperatures, alluvial soils with a pH range of 6.5 to 7.5, and moderate precipitation levels are ideal for the growth of teak. It is a species that needs light and may be found anywhere from the seashore to an elevation of about 1200 m, with an average annual rainfall of 800-2500 mm (Troup, 1975)

Wood properties

Heartwood ranges in colour from yellow-brown to dark golden-brown, is evenly grained, medium-lustrous, and has greyish or white sapwood. It has a high level of durability, a moderate amount of hardness and weight, and little stiffness. Also, the wood has excellent dimensional stability, steam bending, and moderate bending strength.

Utilization

Farming tools, furniture, house construction, boat building, walking sticks, veneer, carvings, and indoor furnishings.

***Dalbergia latifolia* (Common Name: Rosewood, Family: Fabaceae)**

Distribution in Telangana

Rangareddy, Nizamabad

Silvicultural Characteristics

It uses a modest amount of light, is aided by overhead lighting, and stands in some shadow during the early stages of development. It is prone to developing crooked and branchy if planted in an area with too much open space. Although the tree is certainly drought-resistant, drought harms seedlings. The seedlings and saplings will be quickly browsed by cattle

and goats, but in areas with a lot of weeds, gentle grazing may help the plants grow. The tree can grow well in deep, moist, and well-drained soils, but it cannot resist shallow, dry soils. It can also grow well in poor, dry soils.

Wood properties

Heartwood comes in a variety of colours, including light golden brown, light purple with dark streaks, and deep purple with thin black lines. Heartwood weighs roughly 850 kilogrammes per cubic metre and darkens with age. The high hardwood lacks any noticeable yearly rings.

Utilization

Wood is used for a variety of things, including furniture, plywood, veneer, decorative items, building materials, and musical instruments.

***Dalbergia sissoo* (Common Name: Sissam, Family: Fabaceae)**

Distribution in Telangana

Nizamabad, Rajanna-Sircilla, Nalgonda, Rangareddy, Mahbubnagar, Karimnagar, Sangareddy and Medak.

Silvicultural Characteristics

Typically a strong, frost-resistant species, the leaves are severely impacted by the cold, but the tree is not substantially harmed. Although it is fairly hardy in its natural state, irrigated plantations suffer badly if the water supply is cut off for any length of time. Not fire-resistant, but it is a good coppicer.

Wood properties

The heartwood, which is golden brown to deep brown with darker streaks, is firmly separated from the sapwood, which is pale yellow or greyish white. It has a medium-coarse texture, a straight to interlocked grain, and a hard and heavy composition (sp. gr. 0.63-0.83 air-dry).

Utilization

Boatbuilding, Furniture, Flooring, Music Instruments (Percussion), Veneer, Plywood, and Turned Objects

***Mangifera indica* (Common Name: Mamidi, Family: Anacardiaceae)**

Distribution in Telangana

Nizamabad, Adilabad, Warangal, Mahabubnagar, Hanumankonda, Jagital, Normal, Peddapalli, Medak, Kamareddy.

Silvicultural Characteristics

A shade bearer tree that can resist occasional frosts but is susceptible to extreme droughts and frosts

Wood properties

Mango wood has a golden to light brown appearance. Although it is a type of hardwood, its flexibility makes it perfect for crafts. It has a medium to gritty texture and a fine, thick grain.

Utilization

Building materials for homes, flooring, paneling, veneer, plywood, turned objects, furniture and kitchen utensils

5. *Gmelina arborea* (Common Name: Gummidi teku, Family: Lamiaceae)

Distributionin Telangana

Rangareddy

Silvicultural Characteristics

A species that prefers light and can withstand more shade than teak. It possesses a strong ability to recover from frost damage, is moderately cold-hardy, and does not endure prolonged drought. It coppices well, but no root suckers were seen. Deer quickly browse saplings, which causes significant damage to early plantations. When there is a lack of forage, cattle will often browse young vegetation.

Wood properties

It is a strong, ever-grained, soft-light, yellowish or greyish white wood that

seasons well without warping or breaking. It is also very good for paneling, carriages, furniture, boxes, and all types of woodwork. Even for plywood and match producers, it has been deemed to be quite good.

Utilization

Furniture, building and structural work, general carpentry, packaging, carvings, utility furniture, decorative veneers with exceptional woodworking qualities, light flooring for musical instruments, matches, particle board, etc.

***Givotia rottleriformes* (Common Name: Poniki, Family: Euphorbaceae)**

Distributionin Telangana

Adilabad

Silvicultural Characteristics

It is a small to medium-sized tree and generally grows in rocky areas. Information on the silviculture characteristics of this species is not widely available.

Wood properties

The white wood of the tree is exceedingly light, soft, even-grained, and durable. It is also used in carving figures, toys, and fancy items.

Utilization

Wood is used for toy-making. In coastal areas, the wood was used to make catamarans.

Fig 1. *Tectona grandis* tree
(Source: https://greencleanguide.com)

Fig 2. *Tectona grandis* timber
(Source: https://www.exportersindia.com)

Fig 3. *Dalbergia latifolia* tree
(Source: https://indiabiodiversity.org)

Fig 4. *Dalbergia latifolia* timber
(Source: https://www.indiamart.com)

Table No 1. Potential timber trees from Telangana

Sl No	Species name	Common Name	Family	Timber utilility
1.	*Haldina cordifolia*	Rudraganapu	Rubiaceae	Timber is ideal for flooring, panelling, and train cars and is mostly utilised for structural work. In addition, it is utilised in the manufacture of rulers, window frames, furniture, bobbins, and piano keys. It also use for pencil making industry
1.	*Mitragyna parvifolia*	Battaganapu	Rubiaceae	Used for making furniture, agricultural implements, cooperages, paper industry, etc.
2.	*Hardwickia binata*	Naravepu	Fabaceae	Dwajasthambhams and hardwood use, used for lumber, fuel wood, fibire, charcoal making, furniture, and the capability to conserve soil and water, rope making, beams, bridges, engineering structures, exterior fitting, fences, floaring, for heavy construction, for light

				construction, hydraulic works
3.	*Diospyros melanoxylon*	Tuniki	Ebenaceae	Furniture and wooden vessels, used for building, shoulder poles, mine props and shafts of carriages. Wood of this tree is also utilized for making boxes, combs, ploughs and beams. ***It*** is also reported to be good fuel wood
4.	*Sterculia urens*	Tapsi	Malvaceae	Furniture and softwood uses, Leather and allied products, paper and pulp industries
5.	*Terminalia elliptica*	Nalla maddi	Combretaceae	Agricultural Implements, Furniture, House Construction, Walking sticks,cabinetwork, joinery, paneling, specialty items, boat-building, railroad cross-ties (treated), decorative veneers and for musical instruments
6.	*Terminalia arjuna*	Tella maddi	Combretaceae	Agricultural Implements, Furniture, House Construction, used mostly locally for general carpentry and for making farm implements. Timber is locally used for carts, agricultural implements, water troughs, traps, boat building, house building, electric poles, tool-handles and jetty-piles. It also provides satisfactory rayon-grade pulp in mixture with other woods
7.	*Tamarindus indica*	Chinta	Caesalpinaceae	Furniture , paneling and decorative mouldings, carvings, household objects, turned objects
8.	*Albizia lebbeck*	Dirisana	Mimosaceae	House Construction, Packing Cages, Furniture, veneer, turned objects, carving, and other small

				specialty wood items.
9.	*Albizia amara*	Narlangi	Mimosaceae	House Construction, Walking sticks, Furniture making, Agricultural implements and construction
10.	*Acacia chundra*	Sundra	Mimosaceae	Agricultural Implements, Furniture, House Construction, Walking sticks, rice pounders and as fuel wood.
11.	*Lannea coromandelica*	Dumpidi	Anacardiaceae	Agricultural Implements, House Construction, Walking sticks, plywood making
12.	*Azadirachta indica*	Vepa	Meliaceae	Agricultural Implements, Cabinetry, Furniture, House Construction, Packing Cages, used as fuel, charcoal making
13.	*Melia azedarach*	TurkaVepa	Meliaceae	Agricultural Implements, Furniture, House construction, Walking sticks, plywood, boxes, poles, tool handles, cabinet making

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Global warming and climate change: A looming crisis for humanity

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Introduction

Global warming and climate change have emerged as one of the most pressing challenges facing humanity in the 21st century. The Earth's climate is rapidly changing due to the accumulation of greenhouse gases in the atmosphere, primarily from human activities. This article delves into the profound impacts of global warming and climate change on humans, highlighting the urgency of addressing this crisis.

Understanding global warming and climate change

Global warming refers to the long-term increase in Earth's average surface temperature, primarily caused by the release of greenhouse gases like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) into the atmosphere. These gases trap heat from the sun, creating a "greenhouse effect" that leads to a rise in global temperatures. Climate change, on the other hand, encompasses broader shifts in climate patterns, including temperature extremes, altered precipitation, and more frequent and severe weather events, all attributed to global warming.

Human activities driving climate change

Human activities are the primary drivers of global warming and climate change. The burning of fossil fuels (coal, oil, and natural gas) for energy production and transportation releases significant amounts of CO2 into the atmosphere. Deforestation, another human activity, reduces the planet's capacity to absorb CO2, contributing to the problem. Additionally, industrial processes, agriculture, and land-use changes release methane and nitrous oxide, exacerbating the greenhouse effect.

Impacts on humans

1. Rising Temperatures: The most immediate and evident impact of global warming is rising temperatures. Extreme heat waves become more frequent, posing serious health risks, especially to vulnerable populations like the elderly and children. High temperatures can also damage crops, leading to food shortages.
2. More Frequent and Severe Weather Events: Climate change is responsible for an increase in the frequency and intensity of extreme weather events such as hurricanes, droughts, floods, and wildfires. These disasters cause loss of life, destruction of infrastructure, and economic turmoil.
3. Food and Water Security: Altered precipitation patterns and increased temperatures disrupt agriculture. Crop yields decline, and water scarcity becomes more

widespread, threatening food and water security. This can lead to conflicts over resources.

4. Health Impacts: Climate change affects human health in various ways. The spread of diseases like malaria and dengue fever expands into new regions as warming temperatures create favorable conditions for disease vectors. Air pollution worsens as higher temperatures exacerbate smog formation, leading to respiratory problems.
5. Displacement and Migration: Rising sea levels and extreme weather events force people to flee their homes. Climate-induced migration poses social and political challenges, potentially leading to conflicts and refugee crises.
6. Economic Consequences: The economic toll of climate change is substantial. The costs associated with disaster recovery, healthcare, and lost productivity due to extreme weather events and health issues run into trillions of dollars.
7. Biodiversity Loss: Climate change threatens biodiversity as many species struggle to adapt to changing conditions or face extinction. This loss has cascading effects on ecosystems, including those that humans rely on for food and resources.

Mitigating climate change

Addressing global warming and climate change requires immediate and concerted efforts on multiple fronts:

1. Reducing Greenhouse Gas Emissions: Transitioning to renewable energy sources, improving energy efficiency, and implementing carbon pricing mechanisms are essential to reducing emissions.
2. Reforestation and Sustainable Land Use: Protecting and restoring forests, as well as adopting sustainable land-use practices, can help sequester carbon and mitigate climate change.
3. International Cooperation: Climate change is a global issue that demands international cooperation. Agreements like the Paris Agreement aim to unite nations in their efforts to limit global temperature rise.
4. Adaptation and Resilience: Building resilient infrastructure and communities that can withstand the impacts of climate change is crucial. This includes improving disaster preparedness and response.
5. Sustainable Agriculture: Promoting sustainable farming practices can reduce emissions from agriculture and enhance food security.

Conclusion

Global warming and climate change are not distant threats but pressing challenges that affect the lives of people around the world today. The impacts on human health, ecosystems, economies, and security are profound and require immediate action. It is imperative that governments, businesses, and individuals work together to mitigate greenhouse gas emissions, adapt to changing conditions, and transition to a more sustainable and

resilient future. The choices made in the coming years will determine the fate of our planet and the well-being of future generations.

Isabgol: an important medicinal plant

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Introduction

Recent years have seen a major spurt in the demand for medicinal plants in the country and for their export. More and more farmers are entering this most potential sector. The National Centre for Medicinal and Aromatic Plants (NRCMAP), Anand has developed packages and practices for the cultivation of Isabgol.

Isabgol (*Plantago ovata* Forsk.) is an important medicinal crop grown during the *rabi* season mainly in Gujrat, Madhya Pradesh and Rajasthan. The seed coat known as husk has medicinal properties and is used against constipation, irritation, of the digestive tract etc. it is also used in food industries for the preparation of ice cream, candy, biscuits etc. at present, India is the sole exporter of the Isabgol husk and seed to the international market.

Common names

Ishagola, Isabghul, Spogel seed, Ispaghal, Psyllium seed, Flea seed, Plantain seed, Isabgol and Ishabgul Spogel seed.

Origin and distribution

Isabgol (*Plantago ovata* Forsk.) belonging to the family Plantaginaceae has good export potential and can be exploited commercially. It is indigenous to the Mediterranean region and West Asia. It has been introduced in India & Cultivated, especially in Gujarat and some parts of Rajasthan. It is also found in Punjab plains and low hills from Sutlej westwards, Sindh and Baluchistan. The area under cultivation is estimated about 50,000 ha with a production of 48,000 tonnes of seeds. Psyllium is the common name used for several members of the plant genus *Plantago* whose seeds are used commercially for the production of mucilage. The genus *Plantago* contains over 200 species. *P. ovata* and *P. psyllium* are produced commercially in several European countries, the former Soviet Union, Pakistan, and India. *Plantago* seed known commercially as black, French or Spanish psyllium is obtained from *P. psyllium* and *P. arenaria*.

Parts used

Husk from spikes and seeds.

Active principle

Protein, polysaccharides, cellulose, pectin, oil and muscilage.

Uses

The husk is used as a single drug for the cure of constipation and dysentery. The drug is used in inflammatory conditions of the mucous membrane of gastrointestinal and genitourinary tracts and against irritation. It is also used as a demulcent, cooling and diuretic.

Species

1. Spanish or French Psyllium seed: *Plantago psyrium* Linn, or of *Plantago indica* Linn. (*P. arenaric* Wald.)

2. Blonde Psyllium or Indian Plantago: *Plantago ovata* Fork

Varieties

RI-87, RI-89, AMB-2, GI-1, GI-2, MI-4, MIB-121, HI-34, HI-2, HI-1, HI-5, JI-4, NIHARIKA. Gujarat Isabgol-1, variety yields 800-900 kg of seeds per hectare. The new variety 'Gujarat Isabgol-2' has the potential to yield 1,000 kg of seeds per hectare.

Soil

It is an irrigated crop, which grows well on light soils; soil with poor drainage is not conducive to good growth of this crop. A silty-loam soil having a soil pH of 4.7 to 7.7 with high nitrogen and low moisture content is ideal for the growth of plants and the high yield of seeds.

Climate

Isabgol thrives well in warm-temperate regions. It requires cool and dry weather & is sown during winter months. Sowing during the first week of November gives the best yields. Early sowing makes the crop vulnerable to downy mildew disease, whereas late sowing provides a lesser period of growth in winter along with the possibility of shattering of seed due to summer rains in April-May. At maturity, if the weather is humid, its seeds shatter resulting reduction in yield. Heavy dew or even a light shower will proportionately decrease the yield, at times leading to even total loss of the crop.

Propagation

Through Seeds

Land preparation and planting

The field must be free of weeds and clods. The number of ploughings, harrowing and hoeing depend upon the soil conditions, previous crop and degree of weed infestation. About 10-15 tonnes of FYM per hectare is mixed into the soil at the time of the last ploughing. The field should be divided into suitable plots of convenient size depending upon the soil's texture, the field's slope and the quantum of irrigation. For light soil with an even contour, a plot size of 8.0 m x 3.0 m will be convenient.

To obtain a high percentage of germination, seeds should be taken from the crop harvested at the end of the preceding crop season. Old seeds tend to lose viability under ordinary storage conditions. Seed at the rate of 4-8 kg per hectare is sown after treating it with any mercurial seed-dresser at the rate of 3 g/kg of seed, to protect the seedlings from the possible attack of damping off. The seeds are small and light. Hence before sowing, the seed is mixed with a sufficient quantity of fine sand or sieved farmyard manure. The seeds are broadcasted because sowing in lines at different spacing does not increase the seed yield. After broadcasting, seeds are swept lightly with a broom to cover them with some soil. Broom, however, should be swept in one direction only, to avoid deep burial of the seed for uniform germination. The sowing should immediately be followed by irrigation. Germination begins four days after sowing. If delayed, it should be stimulated by another watering.

Sowing time

Early sowing increases vegetative growth while late sowing reduces total growth and increases the risk of seed shattering due to pre-monsoon rains towards maturity. The ideal sowing time is the second fortnight of November. Drastic yield loss is encountered when sowing is delayed beyond the first fortnight of December.

Manures and fertilizers

The medicinal plants have to be grown without chemical fertilizers and the use of pesticides. Organic manures like, Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used as per the requirement of the species.

The crop requires a very low level of Nitrogen. Hence inorganic Nitrogen should only be applied if the available Nitrogen in the soil is less than 120 kg/ha. In general, the application of 20-30 kg/ha Nitrogen and 15-25 kg/ha Phosphorous is optimum. Half of the Nitrogen and a full dose of Phosphorous should be applied with the last ploughing and the remaining half of the Nitrogen should be top-dressed at 40 days after sowing.

Irrigation

Immediately after sowing, light irrigation is essential. First irrigation should be given with a light flow or shower of water otherwise, with the fast current of water most of the seeds will be swept to one side of the plot and the germination and distribution will not be uniform. The seeds germinate in 6-7 days. If the germination is poor, second irrigation should be given. Later on, irrigations are given as and when required. Last irrigation should be given at the time when a maximum number of spikes shoots up. The crop requires a total of 6-7 irrigations for its good productivity in medium sandy soils.

Weeding

Periodical weeding and hoeing are required.

Intercultural operation

Two hand weedings are generally required within two months of sowing, first weeding should be undertaken 20-25 days after sowing.

Plant protection

To prevent diseases, bio-pesticides could be prepared (either single or mixture) from Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc.

Disease and insect-pest management

Downy mildew is the major disease of Isabgol. Adoption of more than the recommended dose of nitrogen, seed rate and irrigation makes the crop more susceptible to this disease. The disease can effectively be controlled by seed treatment with **Metalaxyl** 0.2% (Ridomil MZ) on the first occurrence of disease, followed by two sprayings at 12-14 days intervals. Effective disease management can increase seed yield by more than 40% over the untreated crop. However, spraying of fungicides and insecticides must be stopped at least 45 days before harvesting to avoid pesticide residue problems in the produces.

Aphid is the major insect pest of this crop. Aphids generally appear 50-60 days after sowing. Two sprayings of 0.01% Imidacloprid at an interval of 12-15 days can effectively check the pest. The first spray should generally be done during the first fortnight of February, as it increases seed yield by nearly 40% over unsprayed crops. The crop takes 110-120 days to mature. At maturity (by March-April) the leaves become yellowish and spikes turn brownish. To avoid seed loss by shattering, slightly unripe spikes should be harvested, if there is a possibility of unseasonal rain. However, the husk quality of such a crop deteriorated.

Harvest

Blooming begins two months after sowing and the crop becomes ready for harvest in February-March (110-130 days after

sowing). When mature, the crop turns yellowish and the spikes turn brownish. The seeds are shed when the spikes are pressed even slightly. At the time of harvest, the atmosphere must be dry and there should be no moisture on the plant, harvesting will lead to considerable seed shattering. Hence, the crop should be harvested after 10 am.

Yield

Seed: 900-1500 kg/ha, Husk: 225-375 kg/ha

Post-harvest technology

Harvested plants spread over and after 2 days they are threshed with tractor/bullocks. Pinkish-type husks are removed from the seed coat by processing through a series of grinding in mills to separate the husk.

Species recovery programme- A step towards conservation

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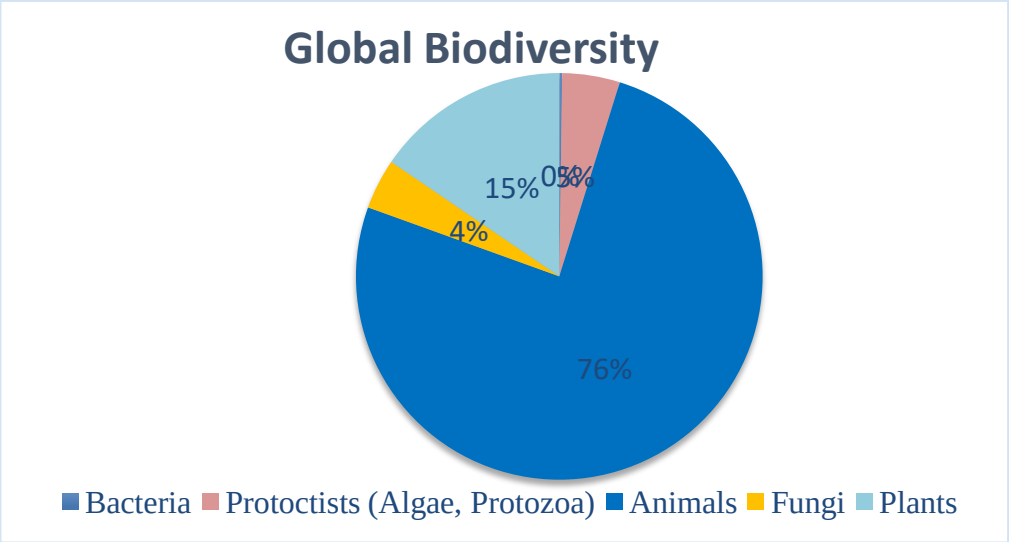
Introduction

Biodiversity is a term used to describe the enormous variety of life on Earth. It can be used more specifically to refer to all of the species in one region or ecosystem. However, only around 1.2 million species have been identified and described so far, most of which are insects. At least 40,000 different plant species live in the Amazon rainforest of South America, one of the most biologically diverse regions on the planet. Scientists have identified about 1.75 million different species. That includes 13,20,000 Animal species, 2,70,000 species of plants, 80000 species of Protoctists (Algae, Protozoa), 70000 species of Fungi and 4,000 species of Bacteria (WCMC, 2000)

Global Status of Biodiversity

S. No	Kingdom	No of species
1	Bacteria	4000
2	Protoctists (Algae, Protozoa)	80,000
3	Animals	13,20,000
4	Fungi	70,000
5	Plants	2,70,000
	Total	17,44,000

(https://www.unep-wcmc.org/en)



This is only a small portion of the total number of species on Earth. There are million more species yet to be discovered and named. Extinction is a natural process; some species naturally die out while new species evolve. But human activity has changed the natural processes of extinction and evolution (WIIENVIS, 2022).

Threatened species-India

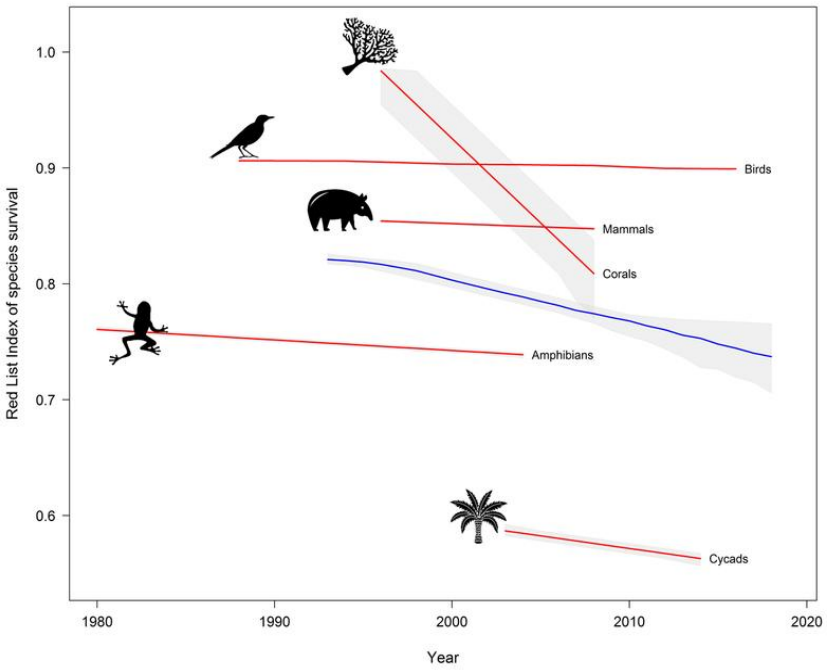
S. No	Taxonomic category	No. of species
1	Mammals	99
2	Birds	91
3	Reptiles	106
4	Amphibians	83
5	Fishes	292
6	Molluscs	7
7	Other invertebrates	135
8	Plants	539
9	Fungi	4
	Total	**1356**

(IUCN, 2022)

According to data given IUCN (2022) almost 28% (>42000) species are under threatened category in which cycads occupied top position in declining race followed by amphibians. Among the global threatened species India occupies 3.22% (1356) species. These species need to be conserved or else they may extinct from the world, as a goal of conserving threatened species a scheme named as Species Recovery Programme started. It is a conservation programme meant for providing support to protected areas by protection of wildlife outside protected areas and recovery programmes for saving Threatened species and habitats (MoEF&CC). Recovery is the process by which the decline of a threatened species is arrested or reversed and threats removed so that its survival in the wild can be ensured. In global level Recovery programme started by enacting the endangered species act 1973 in USA. In India it was initiated by Ministry of Environment and Forest as a scheme of 'Assistance for the Development of National Parks and Sanctuaries' was reformulated and renamed as 'Integrated Development of Wildlife Habitats (IDWH)' during the 11th Plan period (2007-2012).

There has always been special concern about extinction because of its irreversibility, and the loss of a species will entail loss of unique elements or combinations of diversity at gene and

organism level. In this regard, the fossil record demonstrates two important facts. Firstlythat, although relative rates have varied greatly, over geological time as a whole there has been a net excess of species originations over species extinctions (i.e., biodiversity has increased). Secondly, that virtually all the species that have ever existed are now extinct, and the extinction of every species is a natural and expected event. Self-evidently there must always have been species at risk of extinction, i.e., "threatened species" (Turnhout and Purvis, 2020).



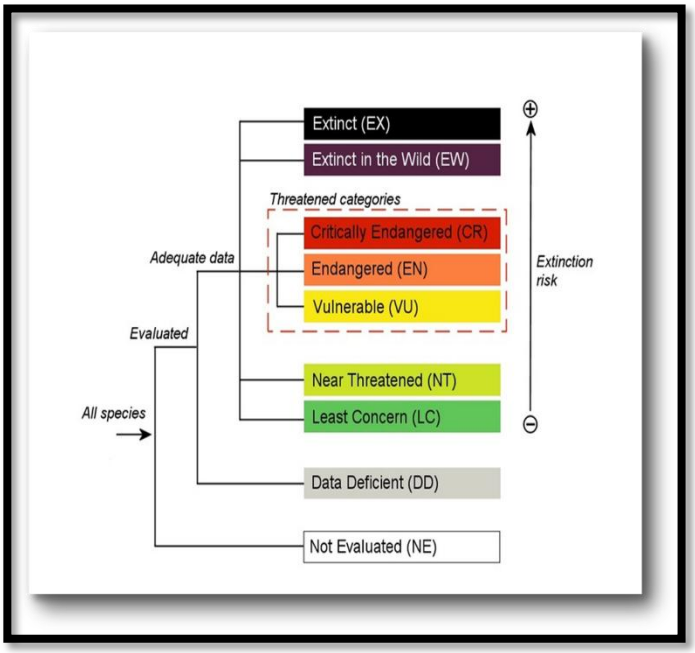
Global Red list Index (IUCN, 2022)

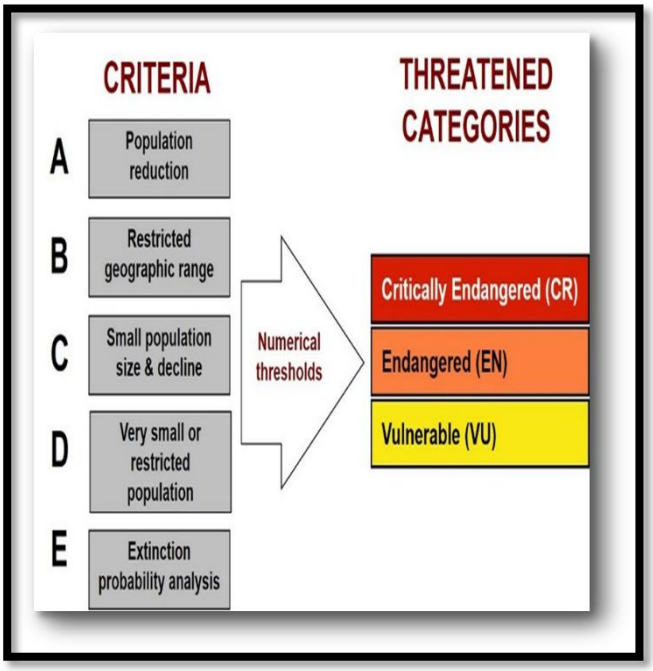
The Red List Index (RLI) of species survival for mammals, birds, amphibians, reef-forming corals and cycads. The blue line indicates the overall RLI for all the taxa combined. Coral species are moving towards increased extinction risk most rapidly, while amphibians are, on average, the most threatened animal group. An RLI value of 1.0 equates to all species qualifying as Least Concern. An RLI value of 0 equates to all species having gone Extinct. A constant RLI value over time indicates that the overall extinction risk for the group is unchanged. If the rate of biodiversity loss were reducing, the RLI would show an upward trend. Confidence intervals (shown in grey) are calculated to consider number of Data Deficient species in each group and the uncertainty over exactly when changes in status occurred, given that assessments are repeated only at multi-year intervals, and therefore the precise value for any particular year is uncertain. Currently, the RLI is available for five taxonomic groups only (those in which all species have been assessed at least twice): birds, mammals, amphibians, cycads and warm-water reef-forming corals. It has also been aggregated into a single index for those five groups. The

RLI clearly demonstrates that the status of these major groups is still declining.

Threatened species criteria

The definitions of the three threatened categories (vulnerable, endangered, and critically endangered) are based on five criteria: population reduction rate, geographic range, population size, population restrictions, and probability of extinction(IUCN, 1994).





1. Critically Endangered

a) Population reduction rate: A critically endangered species' population has declined between 80 and 90 percent. This decline is measured over 10 years or three generations of the species, whichever is longer. A species is classified as critically endangered when its population has declined at least 90 percent and the cause of the decline is known. A species is also classified as endangered when its population has declined at least 80 percent and the cause of the decline is not known.

b) Geographic range: A critically endangered species' extent of occurrence is less than 100 square kilometers (39 square miles). A critically endangered species' area of occupancy is estimated to be less than 10 square kilometers (4 square miles).

c) Population size: A species is classified as critically endangered when there are fewer than 250 mature individuals. A species is also classified as critically endangered when the number of mature individuals declines by at least 25 percent within three years or one generation, whichever is longer.

2. Endangered

a) Population reduction rate: A species is classified as endangered when its population has declined between 50 and 70 percent. This decline is measured over 10 years or three generations of the species, whichever is longer. A species is classified as endangered when its population has declined at least 70 percent and the cause of the decline is known. A species is also classified as endangered when its population has declined at least 50 percent and the cause of the decline is not known.

b) Geographic range: An endangered species' extent of occurrence is less than 5,000 square kilometers (1,930 square miles). An endangered species' area of occupancy is less than 500 square kilometers (193 square miles).

c) Population size: A species is classified as endangered when there are fewer than 2,500 mature individuals. When a species population declines by at least 20 percent within five years or two generations, it is also classified as endangered

3. Vulnerable

1) Population reduction rate: A species is classified as vulnerable if its population has declined between 30 and 50 percent. This decline is measured over 10 years or three generations of the species. A species is also classified as vulnerable if its population has declined at least 30 percent and the cause of the decline is not known. A new, unknown virus, for example, could kill hundreds or even thousands of individuals before being identified.

2) Geographic range: A species is vulnerable if its "extent of occurrence" is estimated to be less than 20,000 square kilometers (7,722 square miles). An extent of occurrence is the smallest area that could contain all sites of a species' population. If all members of a species could survive in a single area, the size of that area is the species' extent of occurrence. A species is also classified as vulnerable if its "area of occupancy" is estimated to be less than 2,000 square kilometers (772 square miles). An area of occupancy is where a specific population of that species resides. This area is often a breeding or nesting site in a species range.

3) Population size: Species with fewer than 10,000 mature individuals are vulnerable. The, we use our own and third-party cookies to enhance your experience. Species is also vulnerable if that population declines by at least 10 percent within 10 years or three generations, whichever is longer.

Species recovery plan

The country's flagship and charismatic species face a variety of threats, ranging from habitat destruction and illegal wildlife trade to reduction in forest cover outside protected areas. Significant populations of these species exist outside Protected Areas moving for dispersal from their natal habitats or for seasonal migrations. The erstwhile Ministry of Environment and Forest scheme of 'Assistance for the Development of National Parks and Sanctuaries' was reformulated and renamed as 'Integrated Development of Wildlife Habitats (IDWH)' during the 11th Plan period (2007-2012).

The MoEF&CC, in consultation with Wildlife Institute of India and other scientific institutions/ organizations, identified 16 terrestrial and 6 aquatic species with the objective of saving critically endangered species/ecosystems that to ensure their protection outside Protected Areas, across the wider landscape/seascape. Species Recovery Plans were prepared for several of these species. The Lion (*Panthera leopersica*) and Rhinoceros (*Rhinoceros unicornis*) populations are showing an increasing trend, and the Sangai (*Rucervuseldiieldii*) and Hangul (*Cervus elaphushanglu*) populations are stable; but the populations of the Great Indian bustard (*Ardeotisnigriceps*) and the Nicobar megapode (*Megapodius nicobariensis*)

have recorded declines. Vulture populations, in particular *Gyps bengalensis*, that had declined substantially in recent times have registered a small upward trend, indicating that conservation measures taken for the species are showing a positive outcome. Efforts are underway for developing protocols for monitoring the status and trends of the remaining IDWH species (WIIENVIS, 2022).

What are the species that need recovery?

An important first step in addressing the recovery of critically endangered species has often been to recognize which of them need to be recovered, as the list seems to be enormous. Considering the time and resources, one needs to make a judicious decision of identifying the species that need to be recovered.

For many of critically endangered species, critical information is lacking on the type and extent of threat and to what extent habitat alteration influences their decline. However, for the conservation and recovery of RET species, collating data on the population size and identifying specific threats and developing mitigating strategies could be attempted. Specifically, species recovery programmes could be targeted at

(a) Globally threatened:priority to species with small population size, showing decreasing natural population, with intrinsic reproductive problems and high economic value/highly harvested)

(b) Precarious habitats: such as *Myristica* swamps, riverine species

(c) Species with reproductive constraints and population decline: such as *Bruguierasexangula*

(d) Highly traded: Such as *Rawolfiaserpentina*

In case of plant species for example, out of the 387 Red-listed plants of India, 77 species are assigned as critically endangered species, 6 are extinct and two species are extinct in the wild. These 77 species could be taken up for recovery on a priority basis, following which the next 172 species, which are characterized as endangered, could be considered. In other words, a systematic species recovery needs to be carried out to restore the populations of these species (Ravikanth*et al.*, 2018).

Approaches to the species recovery programme

A variety of methods can be used to recover critically endangered species, such as protective measures to prevent extinction or further decline, consultation to avoid adverse impacts, habitat acquisition and restoration, and other on-the-ground activities for managing and monitoring endangered and threatened species. Recovery of the critically endangered species could be done at the landscape level, species level or population level.

I. Landscape/habitat/community level

Considering that habitat loss and over-harvesting have been the primary cause of species endangerment, a central component of species recovery has been to establish a network of conservation areas and reserves that represent all the pertinent terrestrial and riparian natural communities. In India, there are about 103 national parks and 531 wildlife sanctuaries covering 4.8% of land area. The country also has 18 biosphere reserves, besides a number of tiger and elephant reserves and 25 Ramsar wetland sites. However, critics

claim that the protected areas cannot serve as effective means of conservation, because often these forests are vulnerable to anthropogenic pressures or have been subjected to intensive harvest pressures. The World Bank/World Wildlife Fund (WWF) Alliance has shown that less than one quarter of declared national parks, wildlife refuges and other protected areas in 10 key forested countries is well managed, and many have no management at all. In other words, only 1% of the protected land area is secured from serious threats such as human settlement, agriculture, logging, hunting, mining, pollution, war and tourism, among other pressures. In India, 65% of these protected areas is inhabited by the indigenous communities15. However, officially designated conservation areas have been effective in reducing forest clearance and, to a lesser degree, effective at mitigating logging, hunting, fire and grazing. Establishing smaller specialty reserves is also necessary for the conservation of specific taxa. Moreover, recovery of certain species with highly restricted geographic ranges or specialized habitat requirements needs

special management. For example, in South India, the Foundation for Revitalization of Local Health Traditions (FRLHT), Bengaluru has specifically identified in situ conservation areas for the conservation of endangered medicinal plant species (medicinal plant conservation areas; MPCAs). The Athanasian Lion-tailed Macaque Conservation Reserve, Gibbon Sanctuary, Sessa Orchid Sanctuary, etc. have been established to preserve specific taxa. However, till date no specific protected area has been established in India to protect a single endangered plant species, except for the species groups such as the Varey Rhododendron Sanctuary in Sikkim or the Sessa Orchid Sanctuary in Arunachal Pradesh.

II. Species level

The community-level approach facilitates recovery but does not negate the need to consider the requirements of each species. However, individual recovery plans with greater emphasis on species which are at the brink of extinction need focused attention. The individual recovery criteria for the critically endangered species need plans to track their progress towards recovery. Species restoration plans need to be established to a point where they no longer require protection and their population is stabilized. At the species level, recovery can be by individual species, reintroduction of the species, carrying out genetic enrichment, or by rehabilitating species into newer habitats. This process of recovery involves arresting the decline of the species by removing all the external threats, so that they can bounce back to their original status. For example, by banning the harvest of an endangered species such as Santalum album, an attempt was made to restore the population to genetically viable size. Similarly, many animal species such as the tiger and elephant have been recovered and their population stabilized through species-specific programmes such as 'Project Tiger' and 'Project Elephant'.

(a) Species reintroduction: A further possible step in the recovery of an endangered species is to introduce/reintroduce propagules into sites where the species is likely to survive,

and/or to replenish existing populations. Such recovery plans for endangered plants often call for the creation of new, self-sustaining populations within their historic range and characteristic habitat4. Reintroduction can also be done into an area where species can potentially survive. Nowadays, several tools exist which can identify potential sites for species reintroduction based on the ecological niche of the species.

(a) Reintroduction of a species within historical range: Reintroduction in sites where the species is known to have existed, but is now extinct. In this case, specific information about the habitat characteristics of the source population must be matched as close as possible to provide the best chance for survival.

(b) Enrichment planting: This involves introducing propagules or plants into existing wild populations which have reduced to very few numbers.

(c) Introduction of a species to a site outside the known historical range: This involves reintroducing in a site outside of the known historical range of the species, as that is the only place safe from the threats that brought the species to extinction (Ravikanth*et al.,* 2018)

Potential problems in reintroduction

a) Founding population size: For reintroduction programmes, it is necessary that there are sufficient individuals in the founding population. The population genetic theory predicts that the presence of a small number of individuals sustained over many generations in a partially or completely isolated population will lead to depletion of genetic diversity. Thus, optimum founding population must be considered for any recovery programme.

b) Ecological interactions: For any species, which has very close symbiotic associations (for example, fig wasp), maintenance of ecological interactions is a big challenge. When reintroducing a species, it is necessary to obtain information on the pollinators and seed dispersal agents. For example, wind-pollinated species need to be planted close enough to ensure successful cross-pollination, and species which require a bird or an insect pollinator need to be planted in an area where an appropriate pollinator is known to exist. In a situation, where a reintroduced population needs to be kept as distinct from a wild population, the site must be far enough not to allow crosspollination. Similarly, for reintroduction of dioecious species, ensuring the sex ratio or sufficient number of individuals to increase the effective population size must be considered.

c) Genetic enrichment: Conceptually, the genetic enrichment refers to an *in-situ* site that serves as a repository of genes of as many diverse populations of a species as possible to represent the widest possible spectrum of genetic variability. The genetic enrichment can be carried out by identifying suitable genetic banks which function as *in situ* ‘sinks’ into which gene pools from various ‘source’ sites are introduced and maintained. In this way, genetic enrichment could be regarded as a modification of the existing protocols of *in situ* conservation with provision for gene flow into it. By virtue of such gene introductions, genetic enrichment facilitates the maintenance of a ‘global’ allelic set of the species. Further, because of continuous interaction between and among the different allelic sets maintained,

the genetic diversity would be allowed to 'evolve' as it would in any other natural habitat.

d) Rehabilitation: In instances where the habitat has been completely destroyed (for the construction of dams, mining or other developmental activities), rehabilitation of the species of that region could be attempted. Rehabilitation of a species in areas suitable for its optimum survival and growth from areas where the habitat is completely altered/destroyed is often necessary so that the species can recover and continue to survive.

III. Populations

In most economically important species, it is common to encounter different populations having unique merits and potential performance. In these cases, species recovery programmes could be attempted at the population level. In cases where unique populations or unique clones/ varieties of species are identified, attempts to recover these should be made with an ultimate aim of maintaining genetic purity of the clones/varieties.For example; thinly sandal could be a unique clone rich in sotalol, which could be conserved. Similarly, there have been numerable clones identified in teak, each with a characteristic trait (Ravikanth*et al.*, 2018)

Case study–1

In vitro multiplication and restoration of selected rare, endangered and threatened plants of India

Sooriamuthu Seeni and S. William Decruse, 2016 conducted research in western Ghats Nine RET species, comprising medicinal plants (*Decalepis arayalpathra* (Joseph & Chandra.) Venter, *Calophyllum apetalum* Willd., *Blepharistemma membranifolia* (Miq.) Ding Hou.), orchids (*Paphiopedilum druryi* (Bedd.) Stein, *Ipseamalabarica* (Reichb.f.) Hook. f., *Dendrobium heterocarpum* Wall. ex. Lindl., Vanda coerulea) and rattans (*Calamus travancoricus* Bedd.Ex.Becc. and Hook.f., *C. nagabettai* Fernandez and Dey) were used for in vitro multiplication.Results showed thatout of the three medicinal plants tried, *Decalepis arayalpathra* is a shrub and *C. apetalum* and *B. membranifolia* are trees. Nodal explants responded with single axillary shoot formation in D. *arayalpathra* and 3–7 axillary buds in others. The axillary shoots showed rapid growth and in vitro derived shoots/nodes could be repeatedly sub-cultured at 6–8-week intervals to scale up multiplication so that 300– 600 shoots could be raised in a year starting from a single node. Seeds of *D. heterocarpum*, *P. druryi*, and *I. malabarica* were germinated optimally using casein acid hydrolysate to produce protocorms. And they concluded as both embryo and tissue cultures may be employed for species recovery. However, for purpose of retaining genetic diversity, embryo cultures may be desirable. There is no difference in establishment rates between embryo and tissue-derived plants of orchids and rattans.Micropropagated plants reintroduced during pre-monsoon/monsoon showers (May–June; October) were best established.

Case study 2

Indian mangroves: Insights, interventions and implications

Studies on genetic diversity estimates conducted in different parts of the world often contradict. This could be largely owing to the sampling methods deployed

by individual researchers and teams. In the case of B. sexangula the differences between the two local populations namely Kumbalangi and Panangad are very low. This could be owing to their origins being traced to highly related progenitor population. However, there is adequate variation within population and hence this can be used to continue controlled

Fig 6.8. Planting of Control Pollinated Propagules

pollination. A major reproductive bottleneck noted was poor visitation of sunbirds (8±3visits/day/tree). In peak flowering seasons 97% of senesced flowers showed no pollen deposition. Using DNA assay high level of genetic relatedness between and within the populations was confirmed. Studies on breeding behavior indicated that the species was adapted to mixed-mating. Control pollination resulted in 90% of fruit set. The propagules were allowed to mature for 160-180 days on trees and then were harvested and raised in nursery. Seedlings over one feet were reintroduced in to mangrove patches or developed as linear rows. About 400 individuals were successfully reintroduced until May, 2013. Over 90% of control pollinated propagules planted during July, 2012 have grown over 1 meter in height. In future, it seems control pollination and DNA marker diversitystimation could be effective synergistic tools in restoring RET mangroves that are constrained by genetic bottle neck.

Conclusion

Species Recovery Programme is an attempt to re-establish a wild population of a species in a location where it used to occur. It is a form of "Bridge between In-situ conservation and Ex-situ conservation," which also includes reinforcement of existing populations, or attempts to establish a species outside its indigenous range for conservation purposes. Conservation translocations are often part of species recovery programs, but they are also used to restore ecosystems by reintroducing species that were key components of those systems, or if necessary, by introducing species expected to play similar ecological roles as the extinct species.

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Organic farming certification and present scenario in India

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Abstract

Organic agriculture is an integrated production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. The Concept of food quality has changed dramatically in the recent years. It now refers not only to the characteristics of the final product, but also the way in which it is produced, processed and transported. There is an increasing interest in organic production all over the globe. With certification, there adds the confidence in the market place. Certification within organic agriculture exhibits flexibility with respect to practices used to demonstrate that a product meets published quality standards. The certification of organic products is essential to distinguish it from those produced by conventional methods, and to get an appropriate price for the organic product in the market. It is also a pre-requisite for its acceptability by the consumers. This paper looks into the purpose of certification, kinds of certification and process of certification of organic inputs and products.

Keywords: Certification, USDA, APEDA, Inputs and Products, NPOP

Introduction

There are several definitions of organic farming and the one given by the US department of agriculture (USDA) is considered most coherent and stringent. It is defined as "A system that is designed and maintained to produce agricultural products by the use of methods and substances that maintain the integrity of organic agricultural products until they reach the consumer. This is accomplished by using substances, to full fill any specific fluctuation within the system so as to maintain long term soil biological activity, ensure effective peak management, recycle wastes to return nutrients to the land, provide attentive care for farm animals and handle the agricultural products without the use of extraneous synthetic additives or processing in accordance with the act and the regulations in this part (USDA National organic programme 2002)". An important event in the history of the modern nascent organic farming in India was the unveiling of the national programme for organic production on 8th may, 2000 and the subsequent accreditation and certification programme in October, 2001. Organic products are grown under a system of agriculture without the use of chemical fertilizers and pesticides with an environmentally and socially responsible approach. This is a method of farming that works at grass root level preserving the reproductive and regenerative capacity of the soil, good plant nutrition, and sound soil management, produces nutritious food rich in vitality which has resistance to diseases. India is bestowed with lot of potential to produce all varieties of organic products

due to its various agro climatic conditions. In several parts of the country, the inherited tradition of organic farming is an added advantage. This holds promise for the organic producers to tap the market which is growing steadily in the domestic and export sector. As per the available statistics, India's rank 6th in terms of World's Organic Agricultural land and 1st in terms of total number of producers as per 2021 data (Source: FIBL & IFOAM Year Book, 2023). The APEDA, Ministry of Commerce & Industries, Government of India is implementing the National Programme for Organic Production (NPOP). The programme involves the accreditation of Certification Bodies, standards for organic production, promotion of organic farming and marketing etc. The NPOP standards for production and accreditation system have been recognized by European Commission and Switzerland for unprocessed plant products as equivalent to their country standards. With these recognitions, Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries. APEDA is also in the process of negotiation with Australia, South Korea, Taiwan, Canada, Japan etc.

Area

As on 31st March 2023 total area under organic certification process (registered under National Programme for Organic Production) is 10.17 mha (2022-23). This includes 5391792.97 ha cultivable area and another 4780130.56 ha for wild harvest collection (Anonymous, 2023A). Among all the states, Madhya Pradesh has covered largest area under organic certification followed by, Maharashtra, Gujarat, Rajasthan, Odisha, Karnataka, Uttarakhand, Sikkim, Chhattisgarh, Uttar Pradesh and Jharkhand.

Production

India produced around 2.9 Million MT (2022-23) of certified organic products which includes all varieties of food products namely Oil Seeds, fibre, Sugar cane, Cereals & Millets, Cotton, Pulses, Aromatic & Medicinal Plants, Tea, Coffee, Fruits, Spices, Dry Fruits, Vegetables, Processed foods etc (Anonymous, 2023A). The production is not limited to the edible sector but also produces organic cotton fibre, functional food products etc. Among different states Madhya Pradesh is the largest producer followed by Maharashtra, Rajasthan, Karnataka, and Odisha. In terms of commodities, Fibre crops are the single largest category followed by Oil Seeds, Sugar crops, Cereals and Millets, Medicinal/ Herbal and Aromatic plants, Spices & Condiments, Fresh Fruit Vegetable, Pulses, Tea & Coffee.

Exports

The total volume of export during 2022-23 was 312800.51 MT. The organic food export realization was around INR 5525.18 Crore (708.33 million USD) (Anonymous, 2023A). Organic products are exported to USA, European Union, Canada, Great Britain, Switzerland, Turkey, Australia, Ecuador, Korea Republic, Vietnam, Japan, etc.

Organic Certification

It is a system of regulation designed to ensure organic producers and processors follow strict quality standards and accurately describe an environmentally sound production process. A certificate is a written guarantee issued by an independent certification agency and it officially states

that the production processes or product complies with certain standards. Organic certification provides third party confirmation, thus there is assured and added confidence in the market place.

Purpose of certification

1. Address a growing worldwide demand for organic food
2. For producers, certification identifies suppliers of products approved for use in certified operations.
3. For consumers, certified organic serves as a product assurance.
4. Third party assurance from producer to the consumer separated by the distance.
5. For uniform label.
6. Assurance to the consumers that its concern for healthy food has been addressed.
7. Effective marketing tool for image, credibility, visibility and transparency.

Note: Some initiatives taken by government to promote organic farming:

1. FAO- DAC project on organic farming
2. Paramparagat krishi vikas yojana scheme
3. National food security mission
4. Rashtriya krishi vikas yojana

The organic quality control involves four steps

1. Accreditation
2. Standards
3. Inspection
4. Certification

Accreditation

A Procedure adopted by the National Accreditation body for ascertaining the competence of a certification body to certify organic farms, products and processes as per the National Standards for Organic Products.

Steps in Accreditation of Inspection and Certification agencies:

- Applicant seeking Accreditation as an agency should submit an application to the authorized officer
- Accreditation fee along with the application form should be submitted along with the bank draft in favour of APEDA payable at New Delhi. The certificate of Accreditation will be valid for a period of 3 years from the date of issue. Renewal fee id 10,000/-
- An Accredited inspection and certification agencies shall be allotted a specific Accreditation number
- On approval of Accreditation APEDA shall inform the certification agency about the approval and shall issue the certificate of Accreditation within a period of 15 days
- The certification agencies applying for Accreditation should be actively engaged in programmes related to organic agriculture movement or production and their programmes should have been in operation for at least 1 year

National Accreditation agencies

- Agricultural and processed food product export developmental authority(APEDA) www.apeda.com
- Spice Board www.indianspices.com

- Coffee Board www.indiacoffee.org.in
- Tea Board www.teaboard.gov.in
- Coconut Development Board
- Cocoa and Cashew Board

APEDA is a nodal agency and can certify all types of products producers and processors but, other agencies can certify the specific products, its producers and processors only.

National Standards for Organic food processing and handling as per NPOP

1. Choice of crops and varieties: When organic seed and plant material are available they shall be used. When certified organic seed and plant material are not available, chemically untreated conventional materials shall be used. Use of genetically engineered seeds, pollen, transgenic plants or not allowed.
2. Duration of conversion Period: Plant products produced can be certified organic when the national standards requirements have been met during a conversion period of at least 2 years before sowing.
3. Soil and Water conservation: Clearing of land through the means of burning organic matter example slash and burn, straw burning, shall be restricted to the minimum. Excessive exploitation and depletion of water resources shall not be allowed.
4. Ingredients: 100% of the ingredients used in processing shall be organic except when an organic ingredient is not available in sufficient quality or quantity, non-organic ingredients may be used to minimum extent.
5. Processing Methods: They should be based on mechanised, physical and biological processes.
6. Packaging: ecologically sound materials shall be used for packaging of organic products. Use of PVC, laminates, aluminium should be avoided. Materials used for packaging should be bio degradable and recycling, reusable.
7. Processing, Grading and Packaging: Processing technologies like solar drying, freeze drying, hot air chambers are permitted. Irradiation of agricultural produce is not permitted. No synthetic additives are to be used.
8. Storage and Transport: Product integrity should be maintained during storage and transportation of organic products. They must be protected at all times from co-mingling with non-organic products and substances not permitted in organic farming.
9. Labelling: When the full standard requirements are full filled products shall be sold as produce of organic agriculture.

When a minimum of 95% of ingredients are of certified organic origin, products may be labelled as "Certified Organic".

When less than 95% but not less than 70% of the ingredients are of certified organic origin, products may not be called "Organic"

Organic products shall not be labelled as GE or GM free in order to avoid

potentially misleading claims about the end product.

Inspection

1. Onsite visits to verify that the performance of an operation is in accordance with specific standards.
2. Evaluation and verification of agricultural production, processing and trading
3. Inspection requires complete documentation by producers, processors, and handlers.
4. Findings are presented in a report to the certifier.

Certification

It represents a written assurance by a third party of the conformity of a product, process or service to specified requirements.

Kinds of certification

Foreign certification

A lot of export oriented organic projects in developing countries are inspected and certified by certification bodies based in the importing countries. Costs of certification are high.

Co-certification

Western certification agencies started to build up local branch officers for conducting the inspections and to work with local inspection staff.

Indigenous certification

Indigenous certifications especially support the development of domestic market for organic products. They usually offer cheaper inspection fees.

Smallholder group certification

When large numbers of smallholders are to be inspected by a foreign certification body, the involved costs can be very high. In such cases, small holder group certification can be done. Only one application is required to certify the entire farms of such smallholder group and the certification and inspection fee is shared by each individual farmer.

Note: Every certifier can implement a certification process only accredited with accrediting agency.

Certification process

- Submission of application to the certification agency.
- Scrutiny of application by the respective authority.

Certification records and reports

Operator files shall be up to date and contain all relevant information, including history and product specifications which will enable the agencies to make competent and objective decision. Records will be maintained by the inspection and certification agencies for any violations, exceptions and disciplinary measures.

Integrity of the system

The certified operators shall sign contracts, agreements or affidavits obliging them inter alia to follow the production standards and other published requirements for certification, accept inspections supply accurate information.

Marks and certificates

Certificate of registration or scope certificate: It includes

1. Name and address of the operator.
2. Name and address of the certification programme and accreditation number.
3. Reference to the applicable standards.
4. Products or product categories.
5. Date of issue.
6. Validity

Transaction certificate

The inspection and certification agencies may issue transaction certificate only if the seller provides all the required details.

They shall take reasonable measures to verify that the information provided is correct before issuing the certificate.

Product certificate: The certifier on request of the operator will issue product certificate to the buyer. Product certificate contain the information like name and description of seller and buyer, date of delivery of product, date of issue of certificate etc.

Labelling

Labelling helps in easy recognition of organic quality and certification system, organic products, confirms the fulfilment of the label regulations and the legal rules and help to achieve a better price for organic products.

The logo used under the certification programme will be called India organic. This shall be the seal used on all the certified organic products, which would identify that the product is organically produced and originates from India. Symbolizing the rhythm of cosmic and earth forces represented by the blue and brown waves of force and energy. India Organic logo celebrates the essence of nature. These forces work in harmony upon the earth's environment and this rhythm is reinforced and supported by the green plant growth. The cosmic force in the blue symbolizes universal purity. Richness of soil, nourished with natural ingredients in organic farming, is symbolized by the earth forces in golden brown. The plant in green uses the colour of nature and natural products untouched by chemicals.

The blue background is the symbolic of earth's environment that is congenial for life to thrive in and is also free of pollution and harmful chemicals. **"**Indian Organic" will be granted on the basis of compliance with the NSOP communicating the genuineness as well as the origin of the product, this trademark will be owned by the government of India. As most of the Indian farmers are illiterate, small and marginal farmer who could not afford to pay the certification and group certification, hence participatory guarantee system was initiated.

Participatory Guarantee System of Certification (PGS)

Small holding farmer groups who apply similar production systems and whose farms are in geographical proximity can register for a grower group certification. The certification provides common marketing facility to the members of the group and the cost involved in certification is also shared among the members. It is based on participatory approach, shared vision, transparency and trust.

Organization structure of PGS system

National Advisory Committee

↓

PGS India Secretariat (NCOF)

↓

Zonal Councils (1 to 7)

↓

Regional Council

↓

Local Groups

Certified Organic Inputs

The use of manures, organic fertilizers, bio fertilizers, vermi-compost, bio pesticides etc. is very high in Organic Farming compared to conventional farming as organic farmers substitute chemical fertilizers and pesticides with these organic inputs. The demand for these crucial organic inputs is increasing with expansion of area under Organic farming. Therefore, it is most essential to ensure the smooth flow of the certified Organic Inputs in the spread of Organic farming.

Conclusion

Organic farming is a matter of giving back to nature what we take from it. It is safe, inexpensive, profitable and sensible. Customers want certification for the products since small and marginal farmers cannot afford the cost of certification, government and NGO's must provide support for the certification process and motivate the organic growers. Organic agriculture sector still needs a lot of research in the area of pests, disease management and raise with organic solutions with increase in awareness of benefits of Organic products.

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सरसो के प्रमुख कीट एंव एकीकृत कीट प्रबंधन तकनीके

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सरसो के प्रमुख कीट एंव प्रबंधन

तिलहन की फसलों सरसो का भारतवर्ष मे विशेष स्थान है यह रबी ऋतु की फसल है और बडे पैमाने पर इसकी खेती की जाती है सरसो की फसल किसानो को बहुत लोकप्रिय फसल है क्योकि इसमे कम सिंचाई एवं कम लागत मे दूसरी फसलों के अपेक्षा में अधिक लाभ प्राप्त हो रहा है।

सरसो मे बहुपयोगी खाद्य तेल प्राप्त होता है इसके दानो से 30-40 प्रतिशत तेल प्राप्त होता है जो स्वास्थ की दृष्टि से बहुत उपयोगी है।

सरसो मे कई प्रकार के कीट आक्रमण करते है लेकिन 4-5 कीट ही अधिक नुकसान करते है और कीटों का प्रभाव सीधे फसल की उत्पादन पर पडता है इसलिए इनकी पहिचान एंव नियत्रण पाना आवश्यक है।

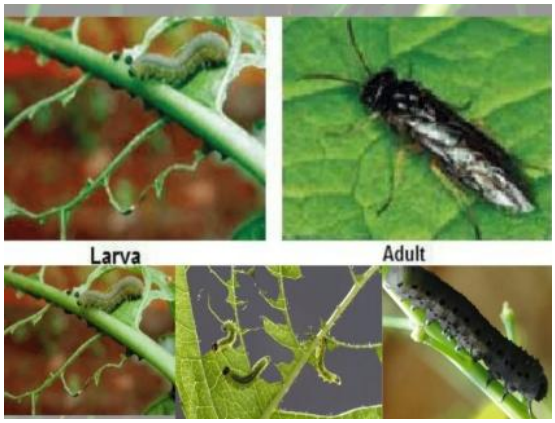
सरसो के प्रमुख कीट

माहू या चेंपा

सरसो की फसल का यह मुख्य कीट है जो हल्के

हरे-पीले रंग का होता है। जिसकी लम्बाई 1.5-3 मि0 मी0 होता है। इस कीट के प्रौढ एंव शिशु पत्तियो के निचली सतह और फूलो की टहनियो पर समूह मे पाये जाते है जो तनो, पत्तियो, फूलो एंव नई फलियो से रस चूसकर उसे कमजोर एंव क्षतिग्रस्त करते है और मधुस्त्राव भी करते है इस मधुस्त्राव पर काले कवक का प्रकोप हो जाता है तथा प्रकाश संश्लेषण की क्रिया बाधित हो जाती है जिसके कारण पौधे अपना भोजन नही बना पाते और वह मर जाते है। इनका प्रकोप दिसम्बर से मार्च तक रहता है!

आरा मक्खी



इस कीडे का धड नांरगी सिर व पैर काले तथा पंखो का रंग धुए जैसा होता है सुण्डियो का रंग गहरा हरा होता है जिनके ऊपर काले धब्बे की तीन कतारे होती है। सुण्डियां पौधों की पत्तियों को काट-काट कर खा जाती है जिससे फसल सूख जाती है इस कीडे का प्रकोप अक्टूबर से नवम्बर मे होता है।

सरसो मे बालो वाली सुण्डी (कावरा)

इस कीट की केवल सूण्डिया की हानि कारक होती है। सूण्डियो के पूरे शरीर मे काले बालदार रोये

पाए जाते है इस सूण्डी का प्रकोप अक्टूबर से दिसम्बर तक तोरिया की फसल मे अधिक होता है। यह समूह मे रहकर पत्तियो को खाकर छलनी कर देती है बाद मे पूरे खेत मे फैलकर फसल को नुकसान पहुचाती है। जिससे पैदावार मे भारी कमी होती है।

सरसो मे चितकबरा कीट

यह कीट भी फसल को बहुत नुकसान पहुचाता है

जो काले रंग का होता है जिस पर लाल पीले नांरगी के धब्बे पाये जाते है इस कीडे के शिशु वा प्रौढ दोनो नुकसान पहुँचाते है यह कीटे फसल की प्रारम्भिक अवस्था मे पत्तियो से रस चूसकर तथा फसल की कटाई के समय फलियो के दानो का रस चूसकर फसल को नष्ट करते है। जिससे पैदावार कम होती है।

सरसो का सुरंग बनाने वाला कीट

यह कीट भूरे रंग का होता है इसका आकार 1.5-2.0 मि0मी0 होता है इसकी सूडियाँ पीले रंग की

होती है यह पौधो मे टेढी-मेढी सुरंग बनाती है और पत्तियो को भी खा जाती है जिससे पौधो मे भोजन बनाने की प्रकृया बधित होती है और जिससे फसल की पैदावार कम हो जाती है।

सरसो के प्रमुख कीट का एकीकृत कीट प्रबंधन

- समय पर बुआई करनी चाहिए 10-20 अक्टूबर तक जिससे माहू का प्रकोप कम हो।
- आरा मक्खी की रोक थाम के लिए सरसो की बुवाई 20 अक्टूबर से पहले करनी चाहिए
- प्रतिरोधी किस्मे की बुआई सही समय करनी चाहिए।
- फसल मे उर्वरक की संतुलित मात्रा हि प्रयोग करनी चाहिए।
- फसल मे होने वाले बीज जनित रोगो की रोकथाम के लिए बीज बोने से पूर्व बीज को ट्राइकोडरमा बिरडी के 4 ग्राम पाउडर प्रति कि0ग्रा0 बीज दर से शोधित करना चाहिए।
- ग्रीष्म ऋतु मे खेत की जुताई करने से अपरिपक्व अवस्था (अण्डे, सूण्डी,कोषस्थ कीट) नष्ट हो जाते है।
- ग्रसित पौधो या टहनियो पत्तो को तोडकर नष्ट कर देना चाहिए।
- मांहू नियत्रण के लिए परभक्षी कीट लेडी बर्ड बीटल, कारसोपरा, मकडी, इत्यादि कीटो का सांणत्र करना चाहिए।

- नीम की खली व नीम के तेल का प्रयोग करना चाहिए।
- आरा मक्खी प्रबधंन के लिए अंकुरण की अवास्था मे ही सिचाई कर देनी चाहिए क्योकि अधिकांश लार्वा पानी मे डूबने के कारण मर जाते है।
- सुबह और शाम के समय आरा मख्खी के लार्वा को एकत्रित कर नष्ट कर देना चाहिए।
- बालों वाली सूण्डी का आश्रय देने वाले वैकल्पिक खरपतवारो को खेत से हटा देना व नष्ट करना चाहिए।

जलवायु परिवर्तन में सूर्य की भूमिका

राजेश कुमार मिश्रा
सूचना प्रौद्योगिकी प्रकोष्ठ
भा.वा.अ.शि.प.-उष्णकटिबंधीय वन अनुसंधान संस्थान
(भारतीय वानिकी अनुसन्धान एवं शिक्षा परिषद्, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार)
जबलपुर (म.प्र.) - 482021

सूर्य पृथ्वी की जलवायु को प्रभावित कर सकता है, लेकिन हाल के दशकों में हमने जो ऊष्णता की प्रवृत्ति देखी है, उसके लिए यह ज़िम्मेदार नहीं है। सूर्य जीवनदाता है; यह हमारे जीवित रहने के लिए ग्रह को पर्याप्त गर्म रखने में मदद करता है। हम जानते हैं कि सूर्य के चारों ओर पृथ्वी की कक्षा में सूक्ष्म परिवर्तन हिमयुग के आने और जाने के लिए जिम्मेदार हैं। लेकिन वर्तमान दशकों में हमने जो ऊष्णता देखी है वह पृथ्वी की कक्षा में बदलाव से प्रभावित है और सौर गतिविधि से नियंत्रित है।

सूर्य ग्लोबल वार्मिंग का कारण नहीं है , वह वायुमंडल के शीर्ष पर पहुंचने वाली सौर ऊर्जा की मात्रा को देखने से पता चलता है। वर्ष 1978 से, वैज्ञानिक उपग्रहों पर सेंसर का उपयोग करके इसका आकलन किया जा रहा है, जो हमें यह बताते हैं कि हमारे ग्रह तक पहुंचने वाली सौर ऊर्जा की मात्रा में कोई बढ़ोतरी नहीं हुई है। यदि सूर्य ग्लोबल वार्मिंग के लिए जिम्मेदार होता, तो हम सतह से ऊपरी वायुमंडल (समताप मंडल) तक वायुमंडल की सभी परतों में वार्मिंग देखने को मिलती। लेकिन वास्तव में वह सतह पर गर्म और समताप मंडल में ठंडा होता है । यह पृथ्वी की सतह के निकट गर्मी रोकने वाली गैसों के संचय के कारण होने वाली गर्मी के अनुरूप है , न कि सूर्य के गर्म होने के कारण।

सूर्य पृथ्वी पर जीवन को शक्ति प्रदान करता है; यह हमारे जीवित रहने के लिए ग्रह को पर्याप्त गर्म रखने में मदद करता है। यह पृथ्वी की जलवायु को भी प्रभावित करता है। हम जानते हैं कि सूर्य के चारों ओर पृथ्वी की कक्षा में सूक्ष्म परिवर्तन पिछले हिमयुग के आने और जाने के लिए उत्तरदायी है। लेकिन पिछले कुछ दशकों में हमने जो गर्मी देखी है, वह इतनी तेज़ है कि इसे पृथ्वी की कक्षा में होने वाले बदलावों से नहीं जोड़ा जा सकता है, और यह इतनी ज़्यादा है कि यह सौर गतिविधि के कारण हो सकता है।

सूर्य सदैव एक ही स्तर की चमक से नहीं चमकता; यह चमकता है और थोड़ा मंद हो जाता है, एक सौर चक्र को पूरा करने में 11 साल लगते हैं। प्रत्येक चक्र के दौरान, सूर्य अपनी गतिविधि और स्वरूप में विभिन्न परिवर्तनों से गुजरता है। सौर विकिरण का स्तर ऊपर या नीचे जाता है, साथ ही सूर्य द्वारा अंतरिक्ष में फेंके जाने वाले पदार्थ की मात्रा और सनस्पॉट और सौर ज्वालाओं के आकार और संख्या में भी वृद्धि होती है। इन परिवर्तनों का अंतरिक्ष, पृथ्वी के वायुमंडल और पृथ्वी की सतह पर विभिन्न प्रकार से प्रभाव पड़ता है।

वर्तमान सौर चक्र (सौर चक्र 25) दिसंबर 2019 में शुरू हुआ और तेजी से इसकी गतिविधि में तेजी आई है। यद्यपि सूर्य 2025 तक चरम स्तर तक नहीं पहुंचेगा, लेकिन यह पहले से ही शुरुआती भविष्यवाणियों से अधिक स्तर पर पहुँच चुका है। नासा का आगामी जियोस्पेस डायनेमिक्स कांस्टेलेशन मिशन, जो वर्तमान में 2027 में लॉन्च होने वाला है, सौर चक्र 26 में मूल्यवान अंतर्दृष्टि प्रदान करेगा।

संयुक्त राष्ट्र के जलवायु परिवर्तन पर अंतर सरकारी पैनल (आईपीसीसी) के अनुसार, वर्तमान वैज्ञानिक मत यह है कि सौर गतिविधि में दीर्घकालिक और अल्पकालिक बदलाव पृथ्वी की जलवायु में बहुत छोटी भूमिका निभाते हैं। मानव-निर्मित ग्रीनहाउस गैसों के बढ़े हुए स्तर से

होने वाली गर्मी वास्तव में सौर गतिविधि में हाल के परिवर्तनों के कारण होने वाले किसी भी प्रभाव से कई गुना अधिक है।

40 से अधिक वर्षों से, उपग्रहों ने सूर्य के ऊर्जा उत्पादन का अवलोकन किया है, जो उस अवधि के दौरान 0.1 प्रतिशत से कम ऊपर या नीचे रहा है। 1750 के बाद से, मानव द्वारा जीवाश्म ईंधन जलाने से उत्पन्न होने वाली ग्रीनहाउस गैसों के कारण होने वाली गर्मी, उसी समय-अंतराल में सूर्य से आने वाली गर्मी से 270 गुना अधिक पाई गई है।

पृथ्वी को प्राप्त होने वाली सौर ऊर्जा की मात्रा सूर्य के प्राकृतिक 11 साल के छोटे उतार-चढ़ाव के चक्र के बाद आई है, जिसमें 1950 के दशक के बाद से कोई शुद्ध वृद्धि परिलक्षित नहीं हुई है । इसी अवधि में, वैश्विक तापमान में उल्लेखनीय वृद्धि हुई है । इसलिए यह बेहद असंभावित है कि पिछली आधी सदी में देखी गई वैश्विक तापमान वृद्धि की प्रवृत्ति का कारण सूर्य है।

स्पष्ट है कि सूर्य वर्तमान में निम्न स्तर की सनस्पॉट गतिविधि का अनुभव कर रहा है। कुछ वैज्ञानिकों का अनुमान है कि यह एक आवधिक सौर घटना की शुरुआत हो सकती है जिसे "ग्रैंड मिनिमम" कहा जाता है, जबकि अन्य का कहना है कि उस स्थिति का समर्थन करने के लिए अपर्याप्त सबूत हैं । एक भव्य न्यूनतम के दौरान, सौर चुंबकत्व कम हो जाता है, सनस्पॉट कभी-कभार दिखाई देते हैं और कम पराबैंगनी विकिरण पृथ्वी तक पहुंचती है। ग्रैंड मिनिमम कई दशकों से लेकर सदियों तक चल सकते हैं। वर्तमान में हुई सबसे बड़ी घटना "लिटिल आइस एज" (13वीं से 19वीं सदी के मध्य) के दौरान हुई: "मॉन्डर मिनिमम", 1645 और 1715 के बीच की एक विस्तारित अवधि, जब कुछ सनस्पॉट परिलक्षित हुए थे।

वर्तमान वर्षों में कई अध्ययनों ने उन प्रभावों पर ध्यान दिया है जो एक और न्यूनतम वैश्विक सतह तापमान का कारण हो सकता है। इन अध्ययनों ने सुझाव दिया है कि एक बड़ा न्यूनतम तापमान ग्रह को 0.3 डिग्री सेल्सियस तक ठंडा कर सकता है, लेकिन यह, सबसे अच्छा, धीमा होगा (लेकिन उलटा नहीं) मानव-जनित ग्लोबल वार्मिंग पृथ्वी तक पहुँचने वाली ऊर्जा में थोड़ी गिरावट होगी, और केवल तीन वर्षों की वर्तमान कार्बन डाइऑक्साइड सांद्रता वृद्धि इसकी भरपाई कर देगी। इसके अलावा, भव्य न्यूनतम मामूली और अस्थायी होगा, इसकेके बाद वैश्विक तापमान तेजी से बढ़ेगा।

कुछ लोगों ने मांडर मिनिमम के अस्थायी शीतलन प्रभाव को सौर गतिविधि में कमी से जोड़ा है, लेकिन यह परिवर्तन ज्वालामुखीय गतिविधि में वृद्धि और महासागर परिसंचरण बदलावों से अधिक प्रभावित था। इसके अतिरिक्त, लंबे समय तक चलने वाला " ग्रैंड सोलर मिनिमम" या "मॉन्डर मिनिमम" भी मानव-जनित वार्मिंग को केवल संक्षिप्त और न्यूनतम रूप से संतुलित करेगा। वैज्ञानिक 20 वीं सदी के मध्य से देखी गई ग्लोबल वार्मिंग की प्रवृत्ति का कारण "ग्रीनहाउस प्रभाव" के मानव विस्तार को मानते हैं - वार्मिंग जो तब उत्पन्न होती है जब वायुमंडल पृथ्वी से अंतरिक्ष की ओर निकलने वाली गर्मी को रोक लेता है।

पृथ्वी पर जीवन सूर्य से आने वाली ऊर्जा पर निर्भर करता है। पृथ्वी के वायुमंडल तक पहुँचने वाली लगभग आधी प्रकाश ऊर्जा हवा और बादलों से होकर सतह पर आती है, जहाँ इसे अवशोषित किया जाता है और अवरक्त ऊष्मा के रूप में विकिरणित किया जाता है। इस ऊष्मा का लगभग 90% ग्रीनहाउस गैसों द्वारा अवशोषित कर लिया जाता है और पुनः विकिरणित हो जाता है, जिससे अंतरिक्ष में ऊष्मा का नुकसान धीमा हो जाता है । पिछली शताब्दी में, कोयले और तेल जैसे जीवाश्म ईंधन के जलने से वायुमंडलीय कार्बन डाइऑक्साइड की सांद्रता में वृद्धि हुई है। यह वृद्धि इसलिए होती है क्योंकि कोयला या तेल जलाने की प्रक्रिया कार्बन को हवा में ऑक्सीजन के साथ मिलाकर कार्बन डाइऑक्साइड बनाती है । कुछ सीमा तक, कृषि, उद्योग और अन्य मानवीय गतिविधियों के लिए भूमि की सफ़ाई से ग्रीनहाउस गैसों की सांद्रता में वृद्धि हुई है।

हमारी आधुनिक सभ्यता जिन औद्योगिक गतिविधियों पर निर्भर है, उन्होंने 1750 के बाद

से वायुमंडलीय कार्बन डाइऑक्साइड के स्तर को लगभग 50% बढ़ा दिया है । यह वृद्धि मानवीय गतिविधियों के कारण है, क्योंकि वैज्ञानिक वायुमंडल में एक विशिष्ट समस्थानिक फिंगरप्रिंट देख सकते हैं । अपनी छठी मूल्यांकन रिपोर्ट में, दुनिया भर के देशों के वैज्ञानिक विशेषज्ञों से बने जलवायु परिवर्तन पर अंतर सरकारी पैनल ने निष्कर्ष निकाला कि यह स्पष्ट है कि औद्योगिक युग में वातावरण में कार्बन डाइऑक्साइड, मीथेन और नाइट्रस ऑक्साइड की वृद्धि का परिणाम है मानवीय गतिविधियाँ और मानव प्रभाव वायुमंडल, महासागर, क्रायोस्फीयर और जीवमंडल में देखे गए कई परिवर्तनों का प्रमुख चालक है।

चूंकि 1970 के दशक में व्यवस्थित वैज्ञानिक मूल्यांकन शुरू हुआ, जलवायु प्रणाली के गर्म होने पर मानव गतिविधि का प्रभाव सिद्धांत से स्थापित तथ्य तक विकसित हुआ है। साक्ष्य से पता चलता है कि वर्तमान ग्लोबल वार्मिंग को सौर विकिरण द्वारा समझाया नहीं जा सकता है । पृथ्वी को सूर्य से प्राप्त होने वाली ऊर्जा में परिवर्तन को मापने के लिए वैज्ञानिक कुल सौर विकिरण (टीएसआई) नामक एक मीट्रिक का उपयोग करते हैं । टीएसआई में सूर्य की सतह से 11 साल का सौर चक्र और सौर ज्वालाएं/तूफान शामिल हैं । अध्ययनों से पता चलता है कि सौर परिवर्तनशीलता ने पिछले जलवायु परिवर्तनों में महत्वपूर्ण भूमिका निभाई है । उदाहरण के लिए, बढ़ी हुई ज्वालामुखी गतिविधि के साथ सौर गतिविधि में कमी ने छोटे हिमयुग को शुरू करने में मदद की ।

संदर्भ ग्रंथ

आईपीसीसी छठी मूल्यांकन रिपोर्ट, डब्ल्यूजी, नीति निर्माताओं के लिए सारांश, खंड ए, जलवायु की वर्तमान स्थिति

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