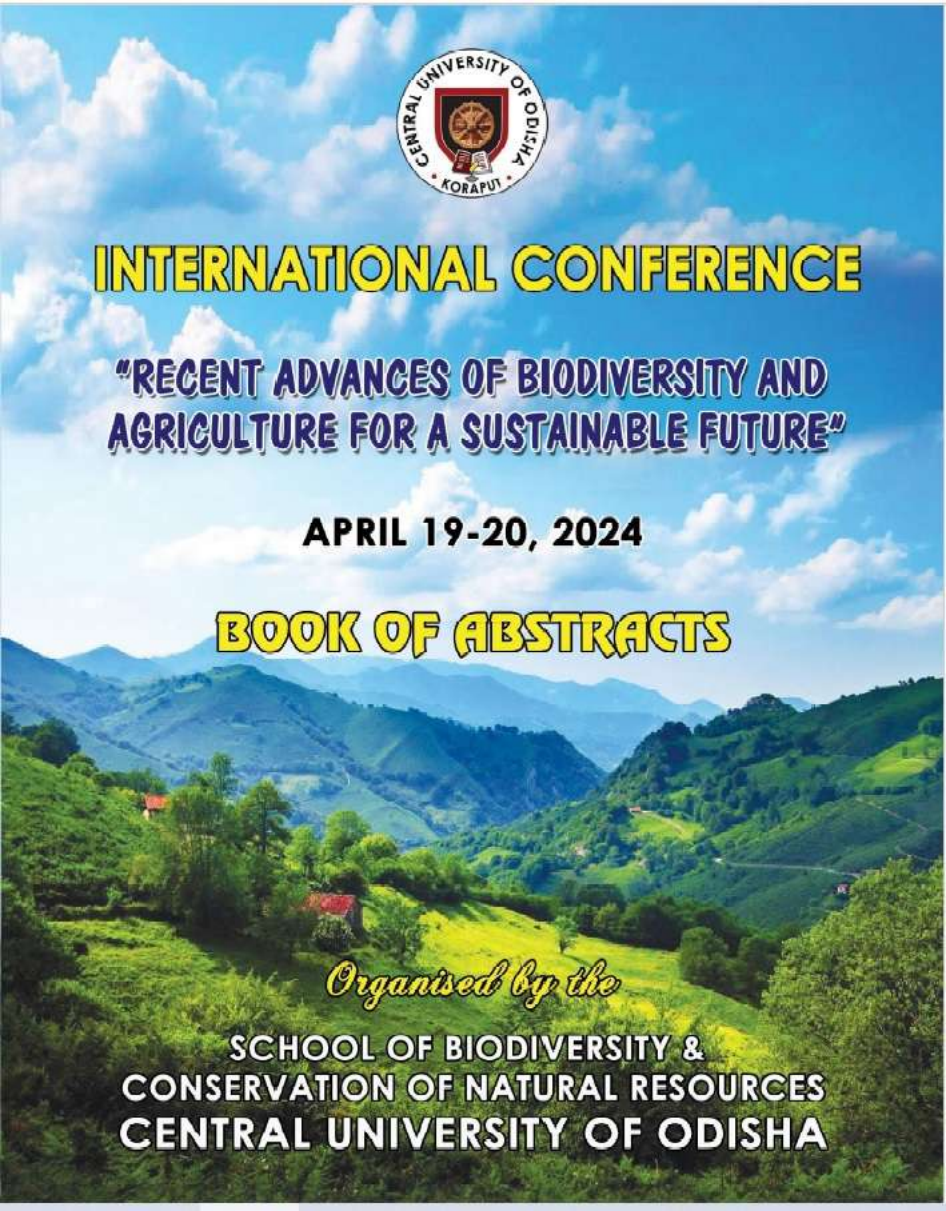
INTERNATIONAL CONFERENCE

"RECENT ADVANCES OF BIODIVERSITY AND AGRICULTURE FOR A SUSTAINABLE FUTURE"

APRIL 19-20, 2024

BOOK OF ABSTRACTS



Organised by the

SCHOOL OF BIODIVERSITY &
CONSERVATION OF NATURAL RESOURCES
CENTRAL UNIVERSITY OF ODISHA

International Conference
"RECENT ADVANCES OF BIODIVERSITY AND AGRICULTURE FOR A SUSTAINABLE FUTURE"

April 19-20, 2024

Organised by

School of Biodiversity & Conservation of Natural Resources
Central University of Odisha

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Vice Chancellor, CUO

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International Conference

"RECENT ADVANCES OF BIODIVERSITY AND AGRICULTURE FOR A SUSTAINABLE FUTURE"

April 19-20, 2024

Editorial Board

Prof. S.K. Palita

Dr. Debabrata Panda

Dr. Kakoli Banerjee

Organised by

School of Biodiversity & Conservation of Natural Resources

CENTRAL UNIVERSITY OF ODISHA

ରଘୁବର ଦାସ
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Governor, Odisha

ରାଜ ଭବନ
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राज भवन
भुबनेश्वर-७५१००८
RAJ BHAVAN
BHUBANESWAR-751008

April 12, 2024

MESSAGE

I am glad to know that the Department of Biodiversity & Conservation of Natural Resources, Central University of Odisha (CUO), Koraput is organizing an International Conference on "**Recent Advances of Biodiversity and Agriculture for a Sustainable Future**" on April 19-20, 2024.

Biodiversity is the source of the plants and animals that form the basis of agriculture. However, loss of Earth's biodiversity has put in jeopardy the sustainability of ecosystem services and agriculture. Therefore, conservation and sustainable use of biodiversity is essential for the future of agriculture and humanity.

The International Conference with participation of eminent speakers from academia and industry world over along with scientists, researchers, policymakers and consultants in the field of Biodiversity and Agriculture will not only amplify the importance of safeguarding biodiversity for agriculture but it would provide a comprehensive framework for collective action to halt the destruction of biodiversity and help in promotion of agriculture for sustainable future. CUO deserves appreciation for organising this international conference.

I wish the Conference all success.

(Raghubar Das)

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ପ୍ରଦୀପ ଜେନା, ଭା. ପ୍ର. ସେ.
ମୁଖ୍ୟ ଶାସନ ସଚିବ, ଓଡିଶା
PRADEEP JENA, IAS
CHIEF SECRETARY, ODISHA

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ପତ୍ର ସଂଖ୍ୟା / Letter No.:
ତାରିଖ/Date: 12 04 2024

MESSAGE

It gives me immense pleasure to know that 'Department of Biodiversity and Conservation of Natural Resources, Central University of Odisha(CUO), Koraput' is organizing an International Conference on **"Recent Advances of Biodiversity and Agriculture for a Sustainable Future"** on 19th and 20th April 2024.

Biodiversity in agricultural and associated landscapes provides ecosystem services essential to agriculture. Its maintenance is crucial for the production of food and other agricultural goods and the benefits these provide to humanity, including food security, nutrition and livelihoods. More knowledge and awareness is needed of the multiple goods and services provided by the different levels of agricultural biodiversity, such as relationship between diversity, resilience and production in agro ecosystems.

Koraput is a land of ecological diversity with a rich assembly of unique flora and fauna. Well known for its rich human cultural diversity, this is an agriculturally important region that has contributed to agriculture in India.

Established by the Central Universities Parliament under the Central Universities Act, 2009 (No.25 of 2009), the Central University of Odisha has created opportunities for availability of quality higher education to the students not only in the KBK (Koraput, Balangir and Kalahandi) region of Odisha, but also created opportunities for study and research for students from all corners of the country in an eco-friendly environment.

I hope, the conference going to be organised with participation of Scientists, Researchers, Policymakers, Consultants, Academicians and Eminent Speakers from across the country and abroad, will create an opportunity to discuss various issues related to biodiversity and agriculture and its sustainable solutions towards a healthier society.

I congratulate the fraternity of Central University of Odisha at Koraput along with organizers of the programme and all those who are participating in this global event and wish grand success for this International Conference.

(Pradeep Jena)

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Office of the Chief Secretary, Odisha, GA & PG Department, Lok Seva Bhavan, Bhubaneswar-751001

Prof. Chakradhar Tripathi
Vice-Chancellor
Central University of Odisha
Koraput-763004

Dared 12 April 2024

MESSAGE

I am pleased to know that the Department of Biodiversity & Conservation of Natural Resources, Central University of Odisha is organising an International Conference on **"Recent Advances of Biodiversity and Agriculture for a Sustainable Future"** during the 19th and 20th April 2024. The Conference aims to deliberate on various issues of biodiversity and agriculture and their sustainable solutions towards for a healthy globe. The conference is going to witness multiple eminent speakers from academia and research institutes from all over the world and create awareness for conserving biodiversity and plant genetic resources towards a viable future.

I convey my heartiest congratulation to the Department of Biodiversity & Conservation of Natural Resources for organising such an important event with a valuable theme.

I wish this International Conference a great success

12-04-'24

(Prof. Chakradhar Tripathi)

Prof. (Dr) Narasingha Charan Panda
Registrar (I/c)

Central University of Odisha,
Koraput

Dared 12 April 2024

MESSAGE

I am glad to know that the Department of Biodiversity & Conservation of Natural Resources, Central University of Odisha is organizing an International Conference on **"Recent Advances of Biodiversity and Agriculture for a Sustainable Future"** during the 19th and 20th April 2024. I would like to convey my thanks to all the delegates and participants from across the country in India and abroad. This conference seeks to deliberate novel research initiatives in biodiversity and agriculture worldwide, fostering networking and partnerships among scientists to collectively explore new avenues.

I extend my warmest congratulations to the organizing committee and the Department of Biodiversity & Conservation of Natural Resources for organizing such a significant conference on an important topic

My best wishes for the grand success of the International Conference

(Narasingha Charan Panda)

Prof. Sharat Kumar Palita

CHAIRMAN
ICRABASF-2024
Professor
Department of Biodiversity &
Conservation of Natural Resources
Central University of Odisha

Dared 12 April 2024

From the Desk of the Chairman

We are at a time when challenges of Climate Change are looming large on our natural ecosystems. Therefore while achieving Sustainable Development Goals (SDGs) by 2030, there is a necessity of systematic planning on the part of conservationists for the conservation of habitats and their pristine fauna and flora. While conservation planning and attention are required for various ecosystems in India, Koraput, a pristine land with rich biodiversity and agriculture in the Eastern Ghats of India requires special attention. The tribal and indigenous communities of Koraput have been preserving the rich biodiversity for millennia and they are also responsible for the origin of rice in this region. Not only rice, tribals also hold the key to all forgotten food like millets, small millets, and tuber crops, etc. which are climate-resilient crops with promise for future food security in the era of climate change.

The ongoing International Conference on “Recent Advances on Biodiversity and Agriculture for a Sustainable Future” provides a unique opportunity for academicians, scientists, conservationists, administrators, and people who matter in this domain for a fruitful dialogue and way forward for sustainable living.

We are thankful to our Hon’ble Vice Chancellor as an inspiring force behind organising the International Conference. Hope, the deliberations will be fruitful and its outcomes will help us and our future generations to steer forward with all positivity towards making the Earth a greener one.

(Sharat Kumar Palita)

Dr. Debabrata Panda

Convener-cum-Organising Secretary
ICRABASF-2024
Assistant Professor
Department of Biodiversity & Conservation of Natural Resources
Central University of Odisha

12 April 2024

From the Convener's Desk

Most of the countries around the globe suffer from a high prevalence of food scarcity and malnutrition. There is a strong call to end hunger and malnutrition by 2030, especially in the second SDG2 by the General Assembly of the United Nations in 2015. In recent times conservation of Biodiversity and Agriculture has been in high priority focus of research and in the National agenda for mitigating food and nutrition security in the face of climate change. Recently, Koraput has been declared by FAO as a global agricultural heritage site. The last five decades have witnessed a rapid decline in the genetic resources of various crops and a depletion of forest species (flora and fauna) in the region and it has negatively affected the life and livelihood of the people in general and the indigenous communities in particular. Thus, this conference aims to explore novel research initiatives in biodiversity and agriculture across the globe to facilitate networking and partnerships between scientists and discuss the way forward.

I feel honoured to organise the International Conference on "*Recent Advances of Biodiversity and Agriculture for a Sustainable Future*" during 19-20 April 2024.

I express profound thanks to all the Guest of Honours, invited speakers, delegates, and participants across the globe for their efforts to attend the conference. I am thankful to all the members of the Steering Committee, Organising Committee and staff of the Department and University for their invaluable assistance in making this conference a reality.

We are grateful to our Hon'ble Vice-Chancellor, Prof. Chakradhar Tripathi for his constant support, guidance, and blessings to conduct such an event of an international level like ICRABASF-2024 at the Central University of Odisha. Let us make this conference a great success.

D Panda

(Debabrata Panda)

Dr. Kakoli Banarjee

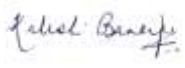
Co-Convener
ICRABASF-2024
Assistant Professor
Department of Biodiversity &
Conservation of Natural Resources
Central University of Odisha

12 April 2024

From the Co-Convener's Desk

As per the United Nations Sustainable Development Goal 13, climate change is in the peak of discussion since last two decades. It was also brought into focus by our Hon'ble Prime Minister Shri Narendra Modi in the G-20 Summit which was headed by India. Climate crisis is supposed to take a lead role with the global temperatures rising to 1.5 ºC above pre-industrial *era* and all the member countries have pledged to reduce emissions and cut the temperature below 1.5 ºC by 2050. It is being documented by scientists that 2010-2019 was the warmest decade and between 2010-2020, the world was more vulnerable to natural disasters like floods, droughts, storms etc. Recently it has been documented that 2023 was the year of highest temperature which underscored its alarming immediacy. Much of its causes were due to the natural causes like, aerosol regulation, Hunga Tonga-Hunga Ha-apai volcanic eruption in 2022 and the solar cycle. The extreme weather events that were seen in 2023 in US and around the globe are proofs that climate crisis is not some far-off possibility.

According to UNFCCC global climate finance reached an annual average of $803 billion in 2019-2023 (almost ~12% increase compared to the prior years). While large scale changes are necessary in reducing greenhouse gas emissions through transition of fossil fuels to bioenergy, investments in alternate energy sources, shifts in industrial practices and everyday action matters too. Choosing plant-based food over meat, using public transportation, reducing energy consumption, may lead to biodiversity conservation, collectively addressing the climate crisis to a sustainable future.



(Kakoli Banerjee)

International Conference on

"RECENT ADVANCES OF BIODIVERSITY AND AGRICULTURE FOR A SUSTAINABLE FUTURE"

April 19-20, 2024

PROGRAM SCHEDULE Day 1: 19th April 2024	
9:00 AM to 9: 30 AM	**Breakfast**
9:30 AM to 10: 00 AM	**Registration**
10:00 AM to 11: 30 AM	**INAGURATION**
11: 30 AM to 11: 45 AM	**Exhibition & Millet Food festival**
11: 45 AM to 12: 00 PM	**Tea**
Session-1 (Technical Session- 1) 12: 00 PM to 01:15 (Keynote Address)	
Chair Person	**Prof. S. P. Adhikary** Former Vice Chancellor, F. M. University, Balasore
Keynote Speaker (12: 00 PM to 12:45 PM)	**Prof. Saroj Kanta Barik** Professor, Dept. of Botany, NEHU, Shillong Former Director, CSIR-NBRI, Lucknow
Invited Lecture – 1 (12: 40 PM to 01:00 PM)	**Dr. Balogun Shamsudeen Tomiwa** Principal Research Scientist, Cocoa Research Institute of Nigeria (CRIN), Ibadan, Nigeria
Invited Lecture – 2 (1: 00 PM to 01:15 PM)	**Dr. M. Vetriventhan** Senior Scientist (Genetic Resources), International Crops Research Institute for the Semi-Arid Tropics, Hyderabad
01:15 PM to 2.30 PM	**LUNCH**
Technical Session-2 Theme-I: Agrobiodiversity for Food and Nutritional Security 2: 30 PM to 04:15	
Chair Person	**Prof. Amarendra N. Mishra** Former Vice Chancellor, Khalikote cluster University, Khalikote, Odisha
Invited Lecture – 1 (2: 30 PM to 2: 45 PM)	**Dr. Bhaskar Chandra Patra** Former Director, ICAR–National Rice Research Institute, Cuttack

Invited Lecture – 2 (2: 45PM to 3:00 PM)	**Dr. Nguemnang Mabou Lile Christère** Faculty of Science, University of Yaoundé I, Cameroon
Invited Lecture – 3 (3:00 PM to 3:15 PM)	**Dr. Manas Ranjan Sahoo** Head, Central Tuber Crop Research Institute, Tiruvantapuram, Kerala
Invited Lecture – 4 (3:15 PM to 3:30 PM)	**Dr. Akinsanmi Oluwatosin FOWOWE** Faculty, University of Ibadan, Ibadan, Nigeria
Invited Lecture – 5 (3:30 PM to 3:45 PM)	**Dr. D. Ramajayam** Head & Principal scientist at ICAR-IISWC, Research Centre, Koraput
Invited Lecture – 6 (3:45 PM to 4:00 PM)	**Dr. Ajaya Biswal** Research Scientist, University of Georgia, USA
4:00 PM to 4:15 PM	**TEA BREAK**
Technical Session-3 Theme-II: Biodiversity and Conservation 04:15 PM to 04:06:00 PM	
Chair Person	**Prof. M. K. Satapathy** Former Professor of Botany, NCERT-RIE, Bhubaneswar
Invited Lecture – 1 (4: 15 PM to 4: 30 PM)	**Dr. Mukund D. Behera** Associate Professor, CORAL, IIT-Kharagpur, West Bengal
Invited Lecture – 2 (4: 30 PM to 4: 45 PM)	**Dr. Pratap Chandra Panda** Former Principal Scientist at Regional Plant Resource Centre and Member Secretary of Odisha Biodiversity Board, Bhubaneswar
Invited Lecture – 3 (4:45 PM to 5:00 PM)	**Prof. Pradipta Kumar Mohapatra** Professor of Botany, Ravenshaw University, Cuttack, Odisha
Invited Lecture – 4 (5:00 PM to 5:15 PM)	**Dr. Nabin K. Dhal** Principal Scientist and Head, Dept. of Environmental Sustainability, CSIR-IMMT, Bhubaneswar
Invited Lecture – 5 (5:15 PM to 5:30 PM)	**Prof Jogeswar Panigrahi** P.G Department of Bio-Technology, Berhampur University, Berhampur

Invited Lecture – 6 (5:30 PM to 5:45 PM)	**Gunanidhi Sahoo** Department of Zoology, Utkal University, Bhubaneswar - 751004, India
6:00 PM to 7:30 PM :	**CULTURAL FUNCTION**
7:30 PM to 8:00 PM	**DINNER**
Day 2: 20th April 2024	
9:00 AM to 10: 00 AM	**Breakfast**
10:00 AM to 12: 30 AM	**POSTER PRESENTATION**
Technical Session-4 **Theme-III: Biodiversity, Agriculture and Threat of Climate Change** **10: 00 AM to 11: 30 AM**	
Chair Person	**Prof. Vibhas. Chandra Jha** Former Vice Chancellor, T.M. Bhagalpur University, Bhagalpur
Invited Lecture – 1 (10: 00 AM to 10: 15 AM)	**Prof. Sushil Kumar Shahi** Department of Botany Guru Ghasidas Vishwavidyalaya
Invited Lecture – 2 (10: 15 AM to 10: 30 AM)	**Dr. B. Anjan Kumar Prusty** Department of Env Science Berhampur University
Invited Lecture – 3 (10: 30 AM to 10: 45 AM)	**Prof. Ekamber Kariali** Professor & Head, School of life Sciences, Sambalpur University, Sambalpur
Invited Lecture – 4 (10: 45AM to 11:00 AM)	**Dr. Sangram K. Lenka** Associate Professor, Gujarat Biotechnological University, Gandhi Nagar
Invited Lecture – 5 (11:00 AM to 11:15 AM)	**Prof. Chandra Sekhar Gahan** Professor- Dept. of Biotechnology, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh
Invited Lecture – 6 (11:15AM to 11:30 AM)	**Dr. Binod Sahu** **Department of Life Science National Institute of Technology Rourkela Rourkela-769008, Odisha, India**
Invited Lecture – 7 (11:30AM to 11:45 AM)	**Dr. Kartik C. Lenka** **Scientist, MSSRF, Jeypore**
11:45 AM to 12:00 PM	**TEA BREAK**

Technical Session-5 Theme-IV: Conservation and Sustainable Solutions 12: 00 PM to 01: 30	
Chair Person	**Dr. Pratap Chandra Panda** Former Principal Scientist at Regional Plant Resource Centre and Member Secretary of Odisha Biodiversity Board, Bhubaneswar
Invited Lecture – 1 (12: 00 PM to 12: 15)	**Dr. Peter Doerner** Academic Director, Institute of Molecular Plant Sciences, University of Edinburgh, Edinburgh EH9 3BF, Scotland
Invited Lecture – 2 (12: 15PM to 12: 30)	**Prof. Soumendra Kumar Naik** Professor of Botany, Ravenshaw University, Cuttack
Invited Lecture – 3 (12: 30 PM to 12: 45)	**Sujogya Kumar Panda** Department of Biology, KU Leuven, Leuven-3000, Belgium
Invited Lecture – 4 (12: 45PM to 01:00)	**Dr. Arun Kumar Rath** Lecturer in Botany, SJCET, Bhubaneswar
Invited Lecture – 5 (01:00 PM to 01:15)	**Dr. Biswaranjan Paital** CBSH, OUAT
Invited Lecture – 5 (01:15 PM to 01:30PM)	**Dr. Asutosh Kumar** University of Groningen, Netherland
1:30 PM to 2:30 PM	**LUNCH**
2:30 PM to 3:00 PM	**Discussion on Collaboration and Networking & Way Forward**
3:00 PM to 4:00PM	**VALEDICTORY**
4:00 PM	**Tea & Departure**

Background Note for the Conference……

Koraput (18º 14' to 19º 14' N latitude and 82º 05' to 83º 25' E longitude) is one of the tribal-dominated districts of Odisha in the Eastern Ghats of India. Situated in the northern Eastern Ghats of India, Koraput is unique due to its topographical and ecological diversity with great variation in altitude (80-1,672 m). The forest type in the region is tropical moist deciduous and tropical dry deciduous type. The topography of the area is undulating with discontinuous mountains interspersed with rivers, water reservoirs, and several waterfalls, thus providing a diversity of habitats for a variety of life forms. The Koraput region of Odisha is an important eco-region of the Eastern Ghats of India. The district is predominantly inhabited by most of the primitive tribes *viz*. Paroja, Bhumia, Gadaba, Bhatra, Durua, and Kandha etc. constitute 54.45% of the total population.

Biodiversity Richness (Floral and Faunal)

Koraput district is known for its rich variety of plants and animals. It hosts 450 vascular plant species (including angiosperms, pteridophytes, and gymnosperms), 25 orchid species (both epiphytic and terrestrial), 10 bryophyte species (mosses, hornworts, and liverworts), 12 fungal species, and eight lichen species. Two plant species are new to the Eastern Ghats, and 35 bryophytes are first reported in the state. Two fungi species are notable as well. Salvia elegans and *Limnanthimum parviflora* found on Mali Parbat hill are new discoveries for the Eastern Ghats in India and are new to Odisha's flora. *Habenaria grandifloriformis*, *Emilia zeylanica, and Gynuura lycopersicifolia* are endemic to Deomali hills and not found elsewhere in the state. *Coleus barbatus*, a common medicinal plant, and *Piperomia quadrifolia* were spotted on the Deomali hilltop. Panchpatmali hills have 160 plant species, including eight rare, vulnerable, and dependent species.

The Gupteswar Forest, recently named a “Biodiversity Heritage Site” by the Odisha government, is a significant hub of plant and animal diversity. Its plant life includes 182 tree species, 76 shrub species, 177 herb species, 69 climber species, and 14 orchid species. Additionally, the area has 17 fern species, 20 bryophyte species, 15 lichen species, 44 macrofungi species, and one gymnosperm species.

Koraput's sacred groves house 94 sacred plant species, spanning 63 genera and 43 families, and contribute to the unique ecological landscape of the area. Four new species—*Rotheca serrata* (L.), *Exacum trinervium* (L.), *Cyperus fuscus* L., and *Utricularia graminifolia*—and one new angiosperm variety have been added to the district's flora and to the state of Odisha.

Koraput is known for its rich faunal biodiversity, with researchers from the Central University of Odisha (CUO) documenting eight micro-chiropteran bat species from the Gupteswar limestone caves, including two IUCN Near Threatened species: *Hipposideros galleritus* and *Rhinolophus rouxii*. The CUO team also

recorded the presence of the Mugger or Marsh Crocodile (*Crocodylus palustris* Lesson, 1831) along the Saberi River of the Godavari River system. In Gupteswar Forest, they identified 45 herpetofauna species from 4 orders and 16 families, showcasing the region's diverse reptile and amphibian population.

CUO researchers identified 269 avian species solely in the Koraput district, confirming the presence of Black Baza (*Aviceda leuphotes*) in the Gupteswar forests and documenting the first record of the Vulnerable Green Munia (*Amandava formosa*) with a breeding population in Koraput.

In the Koraput region, researchers have successfully documented 81 spider species from 51 genera and 19 families across six distinct sacred groves, including the first record of the Lynx Spider (*Oxyopes sertatus*) from the Kantabausuni Sacred Grove. There is published information on 148 butterfly species from different parts of Koraput, including the Nymphalidae butterfly Tamil Treebrown (*Lethe drypetis todara* Moore, 1881) recorded from Deomali Hills, extending its range from southern to central India for the first time in nearly 129 years. Additionally, researchers documented 30 moth species from 27 genera and seven families in Gupteswar PRF.

Koraput has seen many new faunal discoveries recently. A new caecilian amphibian species, Gegenophis orientalis, was found in Deomali, marking the first terestomatan caecilian from the Eastern Ghats. CUO researchers discovered a new loach species, *Garra laishrami*, from the Kolab River at Ghatguda. Furthermore, 17 earthworm species have been added to Koraput's faunal diversity, including two new Megascolex species: Megascolex quadripapillatus from Rani Duduma Forest and *Megascolex jeyporeghatiensis* from Jeypore Ghati forest.

Agrobiodiversity

In 2012, Koraput region was recognized as one of the Globally Important Agricultural Heritage Systems (GIAHS) by the Food and Agriculture Organization of the United Nations (FAO). Known for its rich plant diversity, Koraput is considered a centre of biodiversity for many crops and forest species. The tribal communities depend on farming and harvesting forest products for their livelihood, using the area's plant diversity for food, fodder, medicine, timber, fuel, and agricultural tools. The region has approximately 2,500 species of flowering plants, including around four percent endemism, represented by 79 angiosperm and one gymnosperm species.

Rice is the main crop in the region, both in terms of land coverage and production. Other crops grown include maize, finger millet (Eleusine coracana), green gram (*Vigna radiata*), black gram (*Vigna mungo*), mustard (*Brassica juncea*), sesame (*Sesamum orientale*), and groundnut (*Arachis hypogaea*). In the hills, tribal people also cultivate minor millets such as little millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*), as well as niger (*Guizotia abyssinica*), pigeon pea (*Cajanus cajan*), and horse gram (*Dolichos biflorus*).

Koraput is home to a large number of indigenous rice varieties and is considered a secondary centre of origin for Asian cultivated rice, specifically the Aus ecotype. Between 1955 and 1959, the Central Rice Research Institute (CRRI), Cuttack collected 1,745 germplasm accessions of cultivated rice from the region. Then, in 1995-1996, the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, collected 318 accessions from the region.

Some indigenous rice landraces like Machhakanta, Haladichudi, Para Dhan, Muktabali, Sapuri, and Umuriachudi offer high-quality grains with superior cooking, nutritive, and milling properties. Various aromatic rice landraces such as Kalajeera, Gangabali, Kuyerkuling, Deulabhoga, Lactimachi, Sapuri, Dudhamani, Muktabali, and Nadiarasa possess excellent aroma and desirable grain qualities.

Genotypic variation in seed quality traits was found among these landraces, with the Kalajeera variety showing the highest protein, iron, zinc, and antioxidant levels. Physiological analysis revealed that three landraces—Haldichudi, Kalajeera, and Machhakanta—exhibited better photosynthesis and higher water use efficiency under drought than the tolerant check variety N22. These landraces also demonstrated a high level of tolerance to multiple stresses such as salinity and flooding.

After rice, Koraput is renowned for its minor millets, which are traditionally grown and consumed by subsistence tribal farmers in the region. Various tribal communities cultivate several millet species on lower hill slopes under multiple cropping systems, with a range of durations and grains in diverse sizes, shapes, and colors.

The tribal farmers grow indigenous millet varieties, particularly Mandia (*Eleusine coracana*), black and white Suan (*Panicum sumatrense*), and black, white, and red Kangu (*Setaria italica*). Traditional finger millet genotypes such as Bhalu, Ladu, Telgu, and Bada exhibit superior panicle traits and grain yield comparable to improved varieties. Telgu, Bada, and Dushera were noted for their enhanced nutritional composition and energy, while Mami mandia was exceptionally rich in flavonoids and antioxidant capacity.

Based on drought tolerance screening, six local finger millet genotypes—Ladu, Lala, Bati, Biri, Tumuka, and Bhalu—demonstrated superior drought tolerance compared to the improved varieties Bhairabi, Chillika, Arjuna (developed by OUAT, Bhubaneswar), and GPU 28 (developed from GKVK, Bangalore). These varieties require less water and maintain better photosynthesis and growth under water-deficit conditions.

These nutrient-rich and climate-resilient ragi varieties offer future food, nutrition, and livelihood security for tribal people in Koraput.

A number of wild plants used by tribal populations contributed significantly to their livelihood and food security. A total of 156 plant species belonging to 105 genera and 71 families have been documented as wild edible plants in Koraput.

There are 8 wild yam species are very popular and have been used as food by the tribal people of Koraput. These are *Dioscorea oppositi*folia L., *D. hamiltonii* Hook.f., *D. bulbifera* L., *D. pubera* Blume., *D. pentaphylla* L., *D. wallichii* Hook.f., *D. glabra* Roxb. and *D. hispida* Dennst. These plants are important constituents of biodiversity and their exploitation have become a valuable livelihood strategy and fall-back option for rural households during periods of nutritional stress.

Threats to Biodiversity and Agriculture

The last five decades have witnessed large-scale land use land cover (LULC) changes that resulted in a rapid decline in the genetic diversity of various crops and a depletion of forest species (flora and fauna) in the region. The loss of biodiversity and agro-bioresources have negatively affected the life and livelihood of the people in general and the indigenous communities in particular.

The Way Forward

We are at a time when challenges of Climate Change are looming large on our natural ecosystems. Therefore while achieving Sustainable Development Goals (SDGs) by 2030, there is a necessity of systematic planning on the part of conservationists for the conservation of habitats and their pristine fauna and flora. While conservation planning and attention are required for various ecosystems in India, Koraput, a pristine land with rich biodiversity and agriculture in the Eastern Ghats of India requires special attention. The ongoing International Conference on "Recent Advances on Biodiversity and Agriculture for a Sustainable Future" provides a unique opportunity for academicians, scientists, conservationists, administrators, and people who matter in this domain for a fruitful dialogue and way forward for sustainable living.

CONTENTS

KEYNOTE ADDRESS

BIODIVERSITY AND AGRICULTURE RESEARCH IN INDIA FOR SUSTAINABLE DEVELOPMENT *ADVANCES AND FUTURE AGENDA*

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India's progress in agriculture that began 11,000 years before the present has been phenomenal, particularly during the past 75 years i.e. since independence. The farmers have transformed India from a food-starved nation to a food-exporting country. The cutting-edge research led by 113 institutions of ICAR, duly supported by Agriculture and other Universities, and several institutions of CSIR and DBT have been central to this transformation. The food grain production, which was 51 million tons (Mt) in 1950-51 increased to over 314 Mt in 2022. Today India is the largest producer of milk, pulses, and jute, the second largest producer of rice, wheat, cotton, fruits, and vegetables, and one of the leading producers of spices, fish, poultry, livestock, and plantation crops in the world. Despite several inherent problems that the Indian agriculture sector faces, the country could achieve this spectacular progress due to the concerted efforts of Indian scientists by developing need-based technologies and their effective dissemination through a network of technology extension institutions/tools such as 1.2 billion mobile connectivity, about 3.5 lakh rural common service centres and 730 KVKs spread across 806 districts of the country, besides the farmers' outreach machinery of the governments of 28 states and 8 UTs. The journey against such complex problems as small landholdings and farmland fragmentation, dependency on rain-fed cultivation, continuously declining soil health, limited farm mechanization, and marketing bottlenecks has never been easy, and these issues continue to pose challenges to scientists and policymakers even today. The emerging neo-global problems related to climate change such as weather uncertainties, increasing temperature, erratic rainfall, and the appearance of novel virulent pests and pathogens are compounding the above problems. Anthropogenic factors such as loss of agro-diversity, desertification, and rapid land use and land cover changes at the landscape scale continue to seriously affect the economy of the nation in general, and the lives of 126 million small and marginal farmers in particular, who own about 74.4 million ha of land on an average holding of 0.6 ha each (10th Agriculture Census 2015-16, 2018).

Some of the national priorities set before the agriculture sector are, enhancing farmer's income (200%), reducing fertilizer (25%) and water uses (20%),

increasing the use of renewable energy (50%), reducing greenhouse gas emission intensity (45%) and rehabilitating degraded land of 26 million ha (Mha) (Mohapatra *et al.* 2022).

The blending of validated rich traditional knowledge systems (TKS) of the Indian farming community with modern emerging technologies might provide a sustainable solution to the above-stated problems. For addressing human health and malnutrition, even one health issue, agriculture can play a key role. For example, to address the malnutrition problem, large-scale fortification of crops using molecular breeding and genome editing approaches holds great promise for the future. Giving due consideration to the landholding pattern and socio-economic conditions of our farmers, crop diversification, domestication, AI-Sensor-based precision farming, development and mainstreaming of climate-smart crop varieties, post-harvest value addition, and development of viable low-cost technologies for sustainable land management based on deep scientific understanding with application of TKS, wherever applicable, should be the future strategy for emerging agriculture technologies in India.

BSI, in the forefront of plant diversity research, has completed its glorious 135 years (in 2024) of dedicated service to the nation. It led plant exploration in India, discovered new species, described > 21600 angiosperm species, conducted several Revisionary and Monographic studies, completed the Flora of India project, and resolved nomenclature issues for several taxa. We have maintained the largest herbarium of the nation and conserved several threatened plants and *ex-situ* conservation in Botanic Gardens. Yet we have many unfinished tasks in the domain of biodiversity taxonomic research. Some of these are, Accelerating floristic survey in under-explored areas, IUCN protocol-based threat classification with quantitative population data, Resolving taxonomic ambiguity/delimitation of taxa in Indian Flora for the Global list of accepted species, One India Digital Herbarium, and Unravelling evolutionary trend among the taxa (Species complex). Similarly, India's achievements in animal diversity research led by ZSI, established in 1916, and duly supported by the university system and other institutions is laudable. In addition to taxonomic research, biodiversity being an inter-disciplinary subject, we need to understand and predict the factors and trends of biodiversity loss and ecosystem services. For conservation of biodiversity, principles of ecosystem and genetic approaches need to be integrated at field level to obtain the desired conservation results. Microbial diversity, with highest economic potential has been least studied and researched in India. With the advent of tolls such as metagenomics, we are now able to fasten the process of inventory of microbial communities across the niches opening up new opportunities to discover useful microbes, genes and biomolecules for their application in pharmaceutical, agricultural, environmental and several other industrial applications. We need to harness innovative biodiversity-based

research at all levels viz., molecular, genetic, ecological and cultural for converting our rich biodiversity to bioresources and ultimately contributing to India's bio-economy. India is set to achieve $150 billion Bio-Economy by 2025, which stood at $137.24 billion in 2022 (29% growth), with a target of 300 billion USD by 2030. The biodiversity to bioeconomy research has to be inherently interdisciplinary, bringing together the power and diversity of biology with insights and principles from engineering, computing, geological, mathematical, physical, social, behavioural, and economics sciences. The agenda must include fundamental research that can be translated readily into bioeconomy solutions while advancing biological sciences. This basic research expands our fundamental understanding of living systems from the molecular and to the ecosystem and biome scale. This includes advances in genomics and genomic tool development, systems and synthetic biology, biomechanics and bioinspired design, physiological and ecological foundations of ecosystem services and food security, continental scale ecological measurement and prediction, ecology and evolution of infectious disease, biology of infection, and biodiversity. Incorporation of biodiversity into the 'sustainable and circular' bioeconomy is often assumed and incidental, and possible trade-offs with biodiversity are not yet sufficiently considered. This must be taken care of in future research agenda.

Besides meeting its future challenges to feed its 1.6 billion expected population by 2050, India being a signatory and responsible member of the United Nations and other global organizations, it has several international commitments to fulfil such as Panchamrit and C neutrality (UNFCCC), land degradation neutrality (UNCCD), biodiversity conservation (UNCBD), regional development (SAARC) and Sustainable Development Goals (UN). All these commitments have inter-sectoral responsibilities including Agriculture and Biodiversity. For example, Panchamrit is a five-part pledge made by India at CCC COP26 Glasgow in 2021 that includes: Non-fossil fuel energy capacity: 500 GW by 2030, Renewable energy: 50% of energy requirements by 2030, Carbon emissions: 1 billion tonnes reduced by 2030, Economy carbon intensity: Less than 45% by 2030, and Net Zero carbon emitter by 2070.

In his keynote address, the speaker intends to present a few case studies exemplifying the country's achievements in these two key sectors that contribute immensely to achieve many of the 17 SDGs. He will also discuss future cutting-edge research areas where India needs to focus and invest to achieve the country's bioeconomy targets.

LEVERAGING TRADITIONAL PRACTICES AND CONTEMPORARY BIOTECHNOLOGY FOR SUSTAINABLE RESILIENCE IN A RAPIDLY CHANGING CLIMATE

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The impact of climate change driven by growing greenhouse gas accumulation in the planet's atmosphere is being increasingly and catastrophically felt around the globe. However, the largest burden of impact is carried by the populations that have contributed least to emissions, the people that live in the global South. The changes presently occurring fundamentally and existentially affect their livelihood. In many areas of the global South, the livelihood of a large proportion of the majority rural population, is dependent on subsistence or basic commercial agriculture for local markets.

One of the most pernicious and persistent but erroneous ideas in association with subsistence agriculture and the basic transition forms to commercial agriculture for local markets is they have been and still are essentially static. In truth, subsistence farmers have been keen innovators for the last 10 millennia as such innovation was essential for survival. Their contributions are immeasurable, particularly in two areas, selection of well adapted varieties and agricultural management techniques. As we go through an epoch of particularly rapid change, it is paramount that we exploit this bedrock of knowledge and experience and enrich it with key modern innovations to ensure sustainable resilience.

This contribution will focus on indigenous management methods from around the world and how these can be enhanced and enriched with modern biotechnology. Besides the local culture of land ownership, the factor that most affects crop management is the interaction of soil type, climatic zone, and ecological complexity. In many parts of the tropics, the climate (with intense, if seasonal rainfall) has led to leaching and depletion of essential soil minerals. While complex ensembles of plants have evolved to thrive when undisturbed in such environments, clearing and cultivation can lead to short cycles of productivity and "shifting cultivation" where new areas are cleared and cultivated until they, too, loose fertility. Where these practices were not common, innovative farmers recognised the fundamental importance of soil health and fertility and developed approached to preserve and enhance these.

Recent innovations have led to the combination of ecological and soil health-focussed approaches that enhance resilience and sustainability. Common to all of these is that they fundamentally recognise that food production occurs in an 'agro-ecological' space that is most resilient when interventions are minimised, multiple

crops are grown together and maintenance and durable enhancement of soil health and fertility is given priority. When combined with 'robust' germplasm, productivity, yield, as well as One Health benefits increase significantly.

Which mixed cropping systems are optimal, which are best restricted to annuals or bi-annuals or extend to perennials including trees, depends strongly on the agro-climatic zone and the availability of positively-allelopathic ensembles and varieties.

We will review the leverage that altered management systems together with optimal crop varieties provide to generate exciting new opportunities for sustainable resilience and productivity.

ROLE REVERSAL OF GREENHOUSE ASSOCIATED GASES TO HUMAN ADVANTAGE: NITRIC OXIDE AS ONE OF THE PROBABLE CANDIDATES

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Greenhouse gases such as Carbon dioxide, Methane, Nitrous oxide, Ozone and compounds of Fluorine. trap heat in the atmosphere. Nitrogen oxides are an integral part of the Earth's system and are constantly exchanged between the atmosphere and ecosystems. Nitric oxide (NO) although not a greenhouse gas, as such, but is associated with the dynamics of Nitrous oxide and Ozone. Nitric oxide (NO) is a reactive gas that influences ozone dynamics and changes in the oxidizing capacity of the atmosphere. Rapid industrialisation and combustion of fossil fuels is the major sources of NO in the atmosphere. NO is produced and consumed in soil by biotic and abiotic processes. Recently nitric oxide

is reported as a signalling molecule in plants regulating various metabolic pathways and ameliorate climatic stress. In the present study, the effect of nitric oxide on photosynthetic performance of plants under stress conditions is illustrated. There have been several attempts through technology interventions to reduce stress and improve crop performance. However, in this study, the possibility of increasing plant productivity by role reversal of atmospheric pollutant NO in adverse climatic conditions is elucidated. Such a role of NO can improve plant productivity under adverse climatic conditions and can be of use for human advantage.

DIVERSITY OF PLANT BIORESOURCES IN ODISHA AND THEIR BIOPROSPECTING FOR SUSTAINABLE AGRICULTURE

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Everyone love plants, be it flowering or non-flowering. All know that they are dependent on plants for basic needs like food, shelter and medicine since the dawn of the civilization. *Homo sapiens* left their nomadic life and became civilised leading a community life by domestication of plants about 10,000 years ago. However, scientific way of studying plants is not very old, say it started from Linnaeus. First botanical study was confined to naming of plants, documentation of diversity and finding out their effective uses. But after understanding of cellular way of life, and the double helix soon after second world war, study of plant science expanded, and when we were students in seventies, nearly forty years ago, we were taught taxonomy and identification of cryptogams and phenerogams, cell biology, genetics and heredity, physiology and biochemistry, anatomy and embryology, flowering and hormones, ecology and utilization of plants. With the advent of molecular biology, PCR techniques and sequencing together with intensive use of informatics from late eighties, research in the subject expanded in interdisciplinary mode. But without knowing plants, their identification, biodiversity in different ecosystems and interaction in the environment if used as experimental material in Genomics, Metabolomics, Biotechnology or Bioinformatics, the results cannot be authenticated. Present day students and researchers think one plant can be identified accurately through their gene sequencing, and their utilization can be precisely understood through proteomics, and publish in good referred journals with high impact factor. The situation is such that given a little DNA sample one can find out its phylogeny through its sequenced product but shown the same plant in nature, hardly can be identified. Because of this sophistication technology use, young are attracted to use these tools and techniques primarily and all other analysis are secondary for them. Proper identification of any plant used in research or in Industry for product preparation is most important to validate the output, for which understanding the traditional procedures in plant sciences is required together with the most advanced methods of genomics, proteomics and informatics. For the purpose students need to be motivated to join exploration tours knowing plants in the nature and studying them in the laboratory for bioprospecting and entrepreneurship which is quite relevant to Central University of Odisha where a unique Department "Biodiversity and conservation of natural resources" is existing since its inception

almost 15 years ago. It is also proper as the region, Nandapur-Jeypore-Jagdalpur tract is recognised as one of the centre for origin of rice where many of the wild germplasm/varieties of rice still occur. In addition, the local inhabitants use several tuber crops and millets as their staple food besides forest produce: mango, jack fruit, jamun, mahua etc, and diversity of all these crops is immense.

The geography of Odisha state is unique with 10 agro-climatic regions, diversity of flora and fauna in its eastern ghat region with a biosphere reserve (Similipal), two Ramsar sites (Chilika lake and Bhitarkanika mangroves), several estuaries, lagoons and wetlands in its 460 km coastline, three biodiversity hot spots identified by the state (Mandasuru, Gandhamardan and Mahendragiri) is an ideal region of India for research on diversity of plant bioresources to find out the potential of many unknown as well as known species for technology development in agricultural sector (for rice, millet, tuber crops, plantation crops, fish, bovine farming, and also on biofertilizers and biopesticides) and in the area of environmental sustainability (biofuel, bioremediation of degraded soil, biodiversity assessment of rare and endangered species) including those conserved in sacred groves since ages.

With mechanization and use of agro-chemicals the quality of agriculture ecosystems has changed immensely. Unprecedented increase of agrochemicals like N, P and residual pesticides have caused immeasurable loss of biodiversity and adversely affected soil-water health. Thus, for sustainable productivity use of biofertilizers, biopesticides, bio-stimulants and other organic inputs, as supplements is advocated for almost all crops. This is of much significance for rural/tribal communities living in hilly areas, because for long they continued with traditional agriculture practises but lately, agrochemical use has entered and adversely affecting the soil health due to biomagnification in food chain. Hence, it is important to popularize use of biofertilizers like BGA (cyanobacteria), *Rhizobium, Azospirillum, Azotobacter* for cereals and pulses, bio-stimulants for vegetable and plantation crops, biopesticides and plant-based pesticides for sustainable maintenance of soil health as well as water quality. It is crucial to focus on organic produce for a healthy living. It is recommended that a Pilot scale demonstration of these organic inputs at the village level, their popularization and involvement of the youth in the remote areas for its production, and supply for agriculture use is necessary to be taken up. Motivation for its promotion and use at the village level may be visualized as income generation activity for the young. This would empower them to undertake traditional practices that would provide them nutritious food and help in maintaining biodiversity and sustainable productivity.

MILLETS GENETIC RESOURCES FOR BREEDING CLIMATE RESILIENT AND NUTRIENTS DENSE CULTIVARS

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Plant genetic resources hold the key to unlocking untapped potential in terms of increased productivity, improved nutrition, and enhanced climate resilience for ensuring food security. Millets are the potential crops which can drive drylands towards climate resilience and sustainability because of higher productivity with minimal input, adapting to diverse ecologies and the grains are more nutritious than the major cereals. Globally over 479,795 accessions of sorghum and millets are considered *ex-situ* in genebank of which majority of them are sorghum (259,595), pearl millet (73,578), finger millet (43,862), foxtail millet (46,368) and proso millet (29,865) while other small millets are represented with very low number of germplasms. The ICRISAT Genebank conserves about 80,000 accessions of the diverse global collection of sorghum (42869), pearl millet (25537), and six small millets namely finger millet (7513), foxtail millet (1542), proso millet (849), barnyard millet (749), kodo millet (665) and little millet (473). These germplasm are conserved as active collection (4°C and 20% Relative Humidity) and base collection (-20°C), and distributed over 786,000 seed samples to researchers in 119 countries globally. Extensive evaluation of germplasm and diversity subsets, such as core and mini-core collection, resulted in the identification of trait-specific sources for breeding climate-resilient and nutrient-dense crops. The key trait-specific sources identified in sorghum include drought, low-temperature stress tolerance, photoperiod and temperature insensitivity, grain nutrients, fodder quality, and several insect pests and diseases resistance; in pearl millet for early maturity, grain nutrients, fodder yield and quality, drought, salinity and heat stress tolerance, and resistance to downy mildew, rust and blast; finger millet and foxtail millet for drought and salinity tolerance, resistance to blast and high grain nutrients; and proso millet, kodo millet, little millet and barnyard millet for yield, and grain nutrients. Diversity subsets and trait-specific sources are available in the ICRISAT (https://genebank.icrisat.org/) and Genesys-PGR (https://www.genesys-pgr.org/) databases. ICRISAT is working towards large-scale high-throughput phenotypic and genomic characterization and trait discovery to support breeding climate-resilient nutrient-dense cultivars in millets for increasing productivity and resilience in the drylands. Researchers can obtain seed samples of millets accessions from the ICRISAT genebank following the Standard Material Transfer Agreement.

Z- FARMING IN THE CONTEXT OF FOOD SECURITY AND ENVIRONMENTAL SUSTAINABILITY

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The continuous and unabated migration of people from rural to Urban areas in search of Job, education and working environment has made the cities overcrowded and unsustainable. The world population presently, at about 8,0 billion is projected to pass 9,0 billion mark at 2050 (UNO, 2004). Further, it is predicted that half of the world population presently living in cities likely to increase to more than 60 percent and 70 percent in 2030 and 2050 respectively putting a lots of stress on agricultural land being diverted for developmental purpose. Further cities presently consume more than half of the world resources, two-third of the energy and account for 70 percent of the global co_2 emissions (UNFCC, 2020). Sustainable solutions for food water, energy and transport of food or waste are needed as an integrated approach to city's climate change adaptation. Urban agriculture is currently considered as one of the solutions as it plays a significant role in greening the city, productive reuse of urban wastes and reduction of energy foot print besides improving urban climate. The United Nations Development Programme (UNEP) in 1997 defined Urban Agriculture as an industry that produces, processes, and markets food largely in response to the daily demand of consumers within a town or city or metropolis on land dispersed throughout the Urban and sub-urban areas. But in many cities, open space is scarce and limited. In densely built up areas where space is a limiting factor, low space or no space technologies provide tremendous opportunities for space confined growing of plants.

Z Farming (Zero acreage farming includes all types of Urban agriculture characterized by the non-use of farm land or open space thereby differentiating building related form of Urban agriculture from those in parks, gardens and waste lands. Integration of food production in to building includes development of roof top garden, vertical farming (edible green walls), rooftop greenhouse, gardens in the balcony, indoor farms etc. Thus Z Farming includes all types of urban farming carried out at or in the building (integration of food production in to the Building). Z farming tries to use home produced organic wastes, waste water and dry leaves from plants. It is a complementary practice to traditional agriculture.

Keywords: Z Farming, Urban Agriculture, Integration of Food Production, Energy Foot Print

CONSERVATION OF AGRO-BIODIVERSITY FOR A SUSTAINABLE FUTURE

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About 7000 plant species have been domesticated and cultivated by humans over the millennia for food, fodder and feed. Nature has evolved an extraordinary intra-specific genetic diversity in crop plants and their wild relatives. These invaluable plant resources form the basis of all crop varieties that are bred to produce more, withstand stresses and yield quality output. Today, our nutrition world over is supplied by a mere 30 species because they provide 95% of our dietary energy or protein. Plant genetic diversity is vulnerable to genetic erosion causing the loss of individual alleles/genes found in locally adaptable landraces. According to FAO, replacement of local varieties by modern varieties resulting in reduction of cultivars is the main cause of genetic erosion. This is aggravated by the emergence of new pests, weeds and diseases, environmental degradation, urbanization and land clearing. Therefore, it has long been realized that we conserve all the diversity with their origin and characteristics. The modern intensive agriculture calls for uniformity and consequently has a narrow genetic base. In contrast, traditional agriculture had large numbers of diverse landraces. Thus, the plant genetic resources collected and maintained as *ex situ* conservation at regional, national and international gene banks are considered as hope for future food security at global level. These global collections met the need of breeding programs that ushered green revolution in many developing countries including India in late 1960s. Among the world major rice gene banks, International Rice Research Institute (IRRI) has conserved 140,000 diverse rice accessions collected from 120 countries, China has several rice germplasm collections but the collection at Beijing has over 50,000 accessions. The Japanese national rice collection contains about 26,000 accessions. The USDA-ARS rice collection has 17,279 accessions from 110 countries. Not-withstanding, because of its geography, diverse ecosystems and heritage of agricultural richness in India, the country is immensely rich in rice genetic resources and has 1,18,012 accessions (as on Feb, 2024) conserved in the National Gene bank of NBPGR at -180C and with 3-4% RH. The duplicate set of the base collections need to be conserved at the Svalbard Global Seed Vault as safety back-up in case of large-scale loss of crop diversity. Svalbard Global Seed Vault (SGSV) commissioned at Arctic Island of Svalbard near Norway in North Pole in 2008 conserves about 0.8 million germplasm. It is managed by Norway's Department of Agriculture and the Global Crop Diversity Trust (GCDT) under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and supported by Bill & Melinda Gates Foundation. Recently, India has started depositing the materials since April, 2014 as the 59th Nation.

It has been estimated that even 5% of rice germplasm conserved in different gene banks have not been utilized at global level whereas in India it is hardly 3%. Identifying trait-specific genetically diverse parents i.e., salt tolerance, cold tolerance, drought tolerance, early/late heading, low chilling, tolerance/resistance to particular pests/diseases, adaptability to water logged habitats, tillering capacity, root system, leafiness, etc., apart from quality characteristics are the primary need of the plant breeder for trait enhancement. So, identification of new diverse sources will help in better utilization of germplasm in the breeding programs, aimed at producing agronomical superior cultivars with broad genetic base. Realizing the importance of genetic diversity, Jeypore tract of Odisha, the Pokkali region (Palakkad area) of Kerala and Apatani valley of Arunachal Pradesh should be protected as on farm *in situ* conservation sites. The need for both *in situ* on farm and *ex situ* conservation is now felt as the paddy cultivation in the country is largely affected by extreme natural calamities after rapid climate change, through an erratic monsoon. Earlier the biggest challenge was flood, but subsequently other factors like salinity after frequent cyclones and sea water surge, temperature rise and drought like situation in many parts of the country have put the challenge before the researchers to incorporate these genetic factors in the plant.

Keywords: Ex situ Conservation, Genetic Diversity, Genetic Erosion

REMOTE SENSING OF BIODIVERSITY AND CLIMATE SUSTAINABILITY

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The urgency and complexity of safeguarding and halting decline in biodiversity (SDG 15.5) requires comprehensive assessments of biodiversity and its changes that are required for successful action. Meeting the SDGs and the targets of the Convention on Biological Diversity requires a suite of monitoring strategies for the acquisition of high quality data and a thorough understanding of current and emerging pressures acting on species and ecosystems. A large variety of products derived from various satellite sensors are available to assess key natural systems, environmental conditions, and extremes affecting the land surface in a contiguous spatial and temporal fashion. These products thereby capture the environmental processes that underlie the distribution of species and of biodiversity, including land use and cover, forest cover, vegetation structure , vegetation productivity and phenology. Remote sensing data are increasingly recommended for and applied to biodiversity monitoring and conservation. Such data are used notably in the monitoring of essential biodiversity variables (EBVs) and the adoption of systematic observation requirements is steadily improving.

Keywords: Comprehensive Assessment, Biodiversity, Distribution of Species, Essential Biodiversity Variables

BIODIVERSITY CONSERVATION OF ODISHA FOR SUSTAINABLE DEVELOPMENT

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In recent times sustainable management of natural resources has become the need of our survival. Biodiversity conservation is given the most significant priority through Convention on Biological Diversity (CBD). Extensive and intensive field surveys have been conducted in different forest pockets of Odisha by the survey team of IMMT, Bhubaneswar with a view to access the floristic wealth of different districts. The diversified topography and variable climate of the state have given rise to a rich and variety flora. The present paper will highlight floristic enumeration of Eastern Ghats of Odisha along with few case studies. In recent times, indiscriminate human exploitation of natural resources poses the greatest threat to the ecosystems. Many valuable species have reduced to an alarming number. Dominant species should be given priority for immediate conservation to restore the loss of Biodiversity. Extensive ethnobotanical exploration is required to establish herbal crude drug centre creating ample scope for earning revenue. Biotic interference should be checked through regular awareness programme. Furthermore, environmental education, and skill development training Program is required to empower the local communities in biodiversity conservation efforts. By adopting holistic approaches that integrate conservation with socio-economic development, Odisha can achieve a harmonious balance between human needs and environmental preservation, thereby fostering a more sustainable future.

PLANT CELL WALL POLYSACCHARIDES – A PATHWAY TO PLANT-BASED FUELS AND PRODUCTS FOR A SUSTAINABLE BIO-ECONOMY

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Progress towards a sustainable global economy requires continued improvement of biomass production for carbon-based fuels, chemicals and bio-based products. The bulk of plant biomass, a sustainable source of polysaccharides, is plant cell walls. Plant cell walls are a complex polymeric matrix of lignin, cellulose, hemicellulose, pectin, and glycoproteins that provide a carbon-rich resource for by-products such as pulp, paper, bioplastics, and other biomaterials. However, the structural complexity of cell walls impedes the economic production of biofuels from lignocellulosic feedstock. Understanding plant cell wall polysaccharide structural complexity, interactions between the polymers, and functionality of the cell wall polymers is necessary to engineer crop plants with enhanced properties. Biomass modification strategies through genetic engineering and genome editing are essential to achieve this goal. To date, my work has demonstrated that genetic modification of several genes in the pectin and xylan (hemicellulose) metabolic pathway, improves plant growth, biomass yield and ethanol yield in bioenergy feedstocks. In my presentation, I will discuss the above mentioned findings and strategies for generating coproduction of high-value by-products that can be recovered in biorefineries for a sustainable bio-based economy.

Keywords: Polysaccharides, Complex Polymeric Matrix of Lignin, Rich Resource for By-Products, Structural Complexity

PIGMENT FLUORESCENCE AS AN EFFICIENT MEASURE FOR CROP PRODUCTION POTENTIAL

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Crop plant production is determined by the soil health, nutrient level and soil microbial processes. Commercialization of agriculture and high nutrient input for augmentation of yield has resulted in ascending inorganic and descending organic input into the agro ecosystems. Additionally, the use of pesticides and other xenobiotic (additives, hormones, elicitors, etc.) have resulted in unhealthy agro ecosystem conditions, warranting a change in the approach for restoration and continuation of sustainability. The organic farming and integrated nutrient management have emerged as the suitable alternatives for better soil health and continued production. Studies in our laboratory have shown that the plant performances are determined by the soil quality and soil bound practices. Field with continuous organic cultivation practices have better plant performance which is reflection in the JIP fluorescence transients and fluorescence yield. The soil microbial processes and metabolic processes are significantly correlated with the plant performances in terms of light absorption, electron transport and photosynthetic activity. Similarly, integrated nutrient management improved the plant growth and productivity than of the crops grown on pure organic or pure inorganic practices. The contributions of micronutrients and bio fertilizers on plant production were also reflected in the plant performance and prolonged vitality.

Keywords: Plant Performance, Unhealthy Agro Ecosystem Condition, Nutrient Management, Microbial Process

TISSUE CULTURE MEDIATED PLANT REGENERATION PROTOCOLS OF SOME THREATENED MEDICINAL PLANTS

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Conservation of plants in general and medicinal plants in particular has become an utmost necessity for saving the planet and the people. Medicinal Plants are under stress due to various factors like overexploitation, habitat loss, climate change, pollution, invasive species, lack of awareness etc. As per the Conservation Assessment and Management Prioritisation (CAMP) Workshop held in the year 2007 in Regional Plant Resource Centre (RPRC), Bhubaneswar using IUCN Red List categories and criteria, 41 species of medicinal plants of Odisha state have been enlisted as conservation concern species. *Hedychium coronarium* (Vulnerable), *Blepharispermum subsessile* (Endangered), and *Symplocos racemosa* (Critically Endangered) are to name a few. Conventional propagation methods of these plants have their own limitations. *In vitro* propagation through plant tissue culture offers a promising solution to challenges associated with traditional propagation methods. Under such circumstances, we have developed tissue culture mediated protocols for regeneration of complete plantlets of *Hedychium coronarium*, *Blepharispermum subsessile* and *Symplocos racemosa* using various techniques like axillary shoot proliferation by node/ cotyledonary node/ shoot tip, direct adventitious shoot organogenesis and callus mediated shoot organogenesis. We also have documented separate protocols for production of synthetic seeds by encapsulating axenic nodal segments using sodium alginate and CaCl2 for some of these species, which enhances the potential for large-scale plant propagation, short-term storage and germplasm transfer. Ensuring the biochemical and genetic stability of regenerants in some of these protocols guarantee quality and reliability of propagated plants. These plant regeneration protocols not only provide a sustainable means of producing planting materials but also hold promise for reintroducing these valuable yet threatened plant species into their natural habitats. Apart from that, they offer consistent quality raw materials for pharmaceutical purposes without disrupting natural populations. These works will help us to contribute towards the Goal-15 (Life on Land) of the 2030 Agenda for Sustainable Development.

ENHANCING ECOSYSTEM SERVICES FOR CLIMATE RESILIENCE: HARNESSING THE POTENTIAL OF BIOLOGICAL CONTROL IN AGROECOSYSTEMS

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As global agriculture faces unprecedented challenges from climate change, there is an urgent need to develop resilient and sustainable practices to ensure food security and environmental stability. This paper focuses on the critical role of biological control in enhancing ecosystem services and bolstering climate resilience within agro ecosystems.

Biological control, a sustainable pest management approach, utilizes natural enemies such as predators, parasitoids, and pathogens to regulate pest populations. Unlike chemical pesticides, biological control operates within the framework of natural processes, minimizing environmental risks while promoting biodiversity and ecological balance. In the context of climate change, biological control offers a flexible and adaptive strategy to mitigate the impacts of shifting environmental conditions on pest dynamics. By harnessing the potential of natural enemies, agricultural stakeholders can reduce reliance on chemical inputs, promote soil health, and enhance ecosystem resilience.

This abstract explores innovative strategies for harnessing biological control to enhance ecosystem services and climate resilience in agriculture. It discusses the importance of habitat diversification, conservation of natural enemies, and collaboration between farmers, researchers, and policymakers.

In conclusion, the integration of biological control into agro ecosystems is essential for enhancing ecosystem services, fostering climate resilience, and ensuring the long-term sustainability of global food production systems. Embracing biological control initiatives is paramount for building resilient agricultural systems capable of adapting to the challenges of a changing climate.

Keywords: Global agriculture, Sustainable Pest Management, Agro Ecosystems, Long-Term Sustainability

PROTECTIVE POTENTIAL OF ESSENTIAL OILS AND THEIR COMBINATION IN CONTROLLING POST-HARVEST ROT OF *DIOSCOREA* SPP IN NGORO

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Yam (*Dioscorea* spp.) is one of the most important dietary sources of energy produced and is an essential income source for many people in sub-Saharan Africa, notably in Cameroon. However, post-harvest rot due to microbes is the primary factor limiting the postharvest life and, thus, the availability of this staple throughout the year. Rather than chemical fungicides that have shown drawbacks to man and the environment, plant-based biofungicides have been advocated. This study was therefore performed to evaluate the potential effects of two essential oils (EO) from *Cymbopogon citratus* and *Syzygium aromaticum* and their combination against microbial isolates causing white yam rot in the Ngoro sub-Division, Cameroon. Pathogenic tests showed fungi isolates to be the most aggressive microorganisms among the isolates, and their complete characterization identified as *Aspergillus niger* ATCC16404. The inhibitory effect of tested EOs showed that the most active EO was from *Cymbopogon citratus*, exhibiting complete inhibition of mycelial growth and spore germination at a minimal inhibitory concentration (MIC) of 0.312 mg/ml and 0.625 mg/ml, respectively. The combination of these EOs showed a synergistic effect over the tested activity parameters. The results obtained from studying the combined EOs of *Cymbopogon citratus* and *Syzygium aromaticum* indicate the potential of this combination for further development as a natural alternative to chemical fungicides. Further, *in vivo* studies confirm the efficacy of this combination and its suitability as a replacement for chemical sanitizers with a natural bio-control alternative to increase the safety and extend the storage time of post-harvested yam.

Keywords : Yam, Replacement for chemical sanitizers, Dietary source of energy

HARNESSING THE GENETIC POTENTIAL OF TARO DIVERSITIES FOR CLIMATE RESILIENCE IN THE NORTHEASTERN HILL REGION OF INDIA

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Taro (*Colocasia esculenta* L. Schott) is reported to have originated in the northeast hill region of India, particularly in the Indo-Burma Region. It is an ancient crop cultivated since time immemorial. The plant as a whole (leaf, pseudo-stem, and cormels) is used as a vegetable among the 166 tribal populations of the region. It is considered one of the most important traditional food crops among the tribal community of Northeastern India. Taro leaf is also used as a folk medicine for several diseases. Despite being ranked fourteenth among the vegetable crops grown worldwide, taro is often considered an orphan crop and neglected by researchers. The untapped taro genetic diversities in this fragile agroecosystem need attention to develop climate resilience varieties. Biotic stresses, notably taro leaf blight (TLB), caused by *Phytophthora colocasiae* Raciborsky, resulted in yield loss to the tune of 50%. Similarly, drought and salinity are two growth-limiting factors that affect up to 90% of yield loss to total crop failure. Using morpho-physiological-biochemical and biomolecular markers, we have characterized 101 diversified genotypes collected from the northeast region and other parts of India for TLB, drought, and salinity. Taro genotypes Duradim, and RCMC-5 showed resistance to TLB with low disease incidence, whereas IGCOL-4 and DP-89 showed tolerance to drought, and Sonajuli performed well under salinity. The promising genotypes were barcoded using DNA barcode genes. Taro hybrids were obtained by hand emasculation of promising taro genotypes. The 71 hybrid progenies were evaluated for biotic and abiotic stress tolerance. The hybrid progenies, R5MK and

R5JH showed resistance to TLB with higher accumulation of antioxidative enzymes *viz.,* SOD, GPX, APX and PPO. Molecular characterization of hybrid progenies along with their parental lines was performed using 25 SSR markers, of which, reliable polymorphism was observed in 15 markers. The stress-tolerant plants may be recommended for cultivation under harsh biotic and abiotic stress conditions. The results of the present study would encourage the development of resilience taro varieties from wide untapped genetic resources of NEH region of India.

Keywords: Traditional Food Crop, Yield Loss, Hybrid Progeny, Biomolecular Markers

CHEMICAL COMPOSITION AND FIBRE CHARACTERISTICS OF *HILDERGADIA BARTERI*

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Despite the vast diversity of plant species (wood and non-wood) globally, only a fraction is utilized, indicating untapped potential in lesser-used wood species like *Hildegardia barteri.* With cellulose fiber primarily sourced from wood for use in pulp and paper production, the increasing demand for paper coupled with other uses for wood has resulted in a decline in its supply from natural forests. Consequently, there's a pressing need to explore new and underutilized sources of cellulose fibres. This study aimed at evaluating its chemical composition and fiber morphological characteristics along and across the length of the tree. The research aligns with the broader goal of diversifying raw material sources for pulp and paper manufacturing, conservation, and Sustainable Solutions, thereby reducing reliance on major commercial species that are prone to overexploitation and mitigating environmental concerns associated with their deforestation. *Hildegardia barteri* was found to have a specific gravity of 0.25 with an average green moisture content of 221%. Its chemical composition of lignin, cellulose, hemicellulose, hot and cold water solubility, and ash content is 11.74%, 31.39%,26.30%, 19.50%, 16.81%, and 3.20%, respectively. The average fiber length, fiber diameter, and lumen width are 2.08mm, 23.97µm, and 13.70µm, respectively. The results of *Hildegardia barteri* chemical composition, fiber

morphological characteristics, its availability as well as its fast-growing property, and ability to thrive in disturbed vegetation are desirable qualities for conservation, sustainability and use in pulp and paper manufacturing.

Keywords: *Hildegardia barteri,* Paper Manufacturing, Desirable Quality For Conservation

RECENT ADVANCES IN SUSTAINABLE CULTIVATION OF COCOA IN NIGERIA: AN EFFORT BY THE COCOA RESEARCH INSTITUTE OF NIGERIA

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This paper depicts recent progress in sustainable cocoa farming practices in Nigeria. Cocoa Research Institute of Nigeria's (CRIN) research areas involve developing disease-resistant, high-yielding cocoa varieties, managing soil and water resources, controlling pests and diseases, and evaluating the social and economic impacts. Notably, CRIN has released eight new cocoa (Tc 1-8) varieties that resist major diseases and offer higher yields. This directly addresses the global cocoa yield losses of around 30% (as reported by the FAO) and tackles specific Nigerian challenges like black pod disease and brown cocoa mirid damage. Additionally, CRIN promotes environmentally friendly practices like agroforestry and intercropping, which are crucial to combat the high annual tree mortality rate (estimated at 10%) plaguing Nigerian cocoa production. These advancements have significant socio-economic benefits. Faster-maturing varieties (18-month flowering cycle) can improve farmer livelihoods and attract younger generations to cocoa farming. Moreover, sustainable practices open doors for new markets for ethically sourced cocoa. By highlighting CRIN's pivotal role and pinpointing areas

for future research, this review emphasizes the importance of ongoing innovation for a thriving and sustainable cocoa sector in Nigeria's agricultural economy.

Key words: Sustainable Cocoa Cultivation, Crop Improvement, High-Yielding Varieties, Disease Resistance, Soil & Water Management, Agroforestry, Pest & Disease Control, Socio-economic Impact

OUTLOOK ON *BARANAAJA*: A CLIMATE RESILIENT MIXED CROPPING SYSTEM OF THE CENTRAL HIMALAYA

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The traditional farmers of Central Himalayan region have evolved unique mixed cropping system called the *Baranaaja* (meaning twelve crops). This cropping system can be described as a "simultaneous system" in which crops, legumes, oil seeds, cereals and pseudo cereals are grown in mixture and the interactions are both spatial and temporal. This system can effectively manage the challenges arising out of vagaries of climate through its dynamic attributes. It is a complex production system interlinking through crops, livestock and forests. A wide combination of crops are grown in terraced slopes under two major cropping season "Kharif"and "Rabi". There is a unique crop calendar (*Fasal Chakra*) that has evolved out of labour limitations, conflicting demands for inputs, availability of desirable crops or genotypes and market requirements. The characteristics like no tillage, choice of crops and cropping sequence across space and time is highly efficient in utilization of soil water and nutrients. The ecological and economical efficiency, yield and energetic and product quality has been scientifically validated and described by the author in the light of "*Conservation Agriculture*" being practiced in other parts of the world. Majority of crops grown like millets (foxtail millet, barnyard millet, finger millet, pearl millet, buckwheat, amaranth, cow pea, different grams like horse grams, black gram etc) are drought tolerant and grows easily in less fertile soil and resistant to pests and diseases and therefore are climate resilient crops. *Baranaaja* reflects the idea that diversity is prosperity.
However the cropping system is still subsistence type. Changes in political and economic policy to promote traditional technology and contemporary science can help change the present imbalance between food available and the size of the human population. Strategies that lead to sustained exploitation of biodiversity need to be promoted. It would be of great advantage to discover whether physiological measures such as the water- and nutrient-extraction potential of

plants could be used to predict their competitive ability when grown together. Crop diversification can also fulfil the nutritional requirements of humans and animals and deliver benefits in terms of soil maintenance, disease, pest and weed control and more efficient employment of labour through reduced seasonality. This system has supported the masses for a long time and can also support the growing population in future with the aid of proper scientific inputs based on present needs. Indigenous knowledge based on our long and rich tradition in agriculture should be drawn on to help in the generation of wealth and employment. Local people can continue to play a significant role as stewards of agro-biodiversity conservation. A reward system (based on financial and other criteria) should be created for this biologically important service. Thus the policies on agro-biodiversity of the central Himalayan region need to be strengthened and reoriented so as to provide a strong impetus for agricultural diversification that will lead to the conservation of biodiversity and increased incomes for farmers and help in mitigating climate change.

FROM REDISCOVERY TO RECOVERY: THE CONSERVATION STORY OF A THREATENED PLANT SPECIES

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Globally, the wild plant resources are under increasing threat and human beings have been responsible for accelerating the rate of extinction many-fold than nature's own process of elimination and modification. The best place to conserve plant biodiversity is in the wild, where a large number of viable populations of species can persist in their natural habitats by interacting with each other and also with the ecosystem. Apart from habitat conservation, reinforcement of the declining populations through reintroduction is essential to establish self-sustaining vegetation and to ensure long-term survival of threatened plants. To achieve this, one needs to understand the composition and structure of extant populations, their genetic diversity and regeneration potential; identify causal factors of rarity; standardise appropriate propagation methods and reintroduce genetically similar plantlets in natural or near-natural habitats for enrichment of population and species' gene pool.

Lasiococca comberi Haines (Euphorbiaceae) is a threatened tree species of Eastern Ghats of India. First described by H. H. Haines from forests of Odisha in 1920, the species was later reported from few other states of Eastern India, China and Indo-China region. The species was rediscovered from its type locality after a gap of 65 years having two small populations. Through exhaustive field inventory in Eastern Ghats of India, a total no. of 4,236 individuals including 851 mature plants, 443 saplings and 2,942 seedlings have been located. Seven new populations have been discovered from unknown localities by predicting new sister populations through Ecological Niche Modelling (ENM) using MaxEnt tool. ENM proved useful for generating predictive distribution map of the species. With a view to identify population (s) with maximum genetic variability, molecular markers like RAPD, matK and AFLP were used. A viable population from Aranga RF (Khurda) with maximum Nei's Genetic Diversity (H), Shannon Information Index (I) and percentage of polymorphic loci (PPB) was identified to serve as source materials for bioprospecting, propagation and other conservation actions.

As a part bioprospecting of the species, the physico-chemical characteristics and fatty acid composition of *L. comberi* seeds were analysed. The seed oil content was as high as 41.5% and linolenic (65.3%), oleic (13.8%), linoleic (7.1%), palmitic (5.3%) and stearic (3.1%) acids were the major fatty acids. Thus, the seed oil can be used as a rich and commercial source of omega-3 fatty acid. Other physicochemical characteristics of the seed oil also suggested that it is likely to have application in cosmetic and food industries.

With a view to raise large-scale planting stocks for reintroduction programme, very efficient and cost-effective propagation techniques through seed germination, rooting of stem cuttings and air-layering have been standardized for the first time. The seeds of *L. comberi* germinated just after 8th day of sowing and continued till 20th day with 46% seed germination. However, after 22nd day, the seeds lost their viability completely. Treating air-layers with 5000 mg/l IBA gave best results for production of large-sized ready-to-plant planting materials. Further, the defoliated stem cuttings rooted best in a treatment of 2000 mg/l IBA. About 6,000 plants have been propagated, hardened and acclimatized under nursery conditions. About 4,000 nos. of 2-year-old *L. comberi* plants have been reintroduced in sites previously identified through ENM in Khurda and Phulbani Forest Divisions and their survival and growth performance are being regularly monitored. The flowering and fruiting in plants of three reintroduced populations in Khurda Forest Division of Odisha and their natural regeneration in terms of flowering and fruiting, profuse seed setting, seed dispersal, germination and seedling establishment on forest floors have been encouraging and demonstrated reintroduction success ensuring long-term survival of this threatened plant species.

Keywords: *Lasiococca comberi*, Ecological Niche Modelling, Viable Populations

OVIPOSITION SITE SELECTION IN ANURAN AMPHIBIANS: CONSTRAINTS AND COMPROMISES

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The reproductive success of most species is determined by their choice of oviposition sites. Therefore, the key habitat and microhabitat features that reliably predict whether given waterbodies are used as oviposition sites in anuran amphibians were characterized in this study. Data was collected in 256 water bodies (128 water bodies with 297 breeding points and 128 non-breeding aquatic bodies) in eastern India (states of Bihar, Jharkhand, West Bengal, and Odisha) over five successive breeding seasons (2018–2022). The microhabitat parameters: pH, water depth, air temperature, water temperature, relative air humidity, canopy cover, aquatic organic matter, water colour, turbidity and submerged vegetation were examined using multivariate statistical methods. Paired logistic regression models were designed and the akaike Information Criterion was used to assess the strength of the relationships between microhabitat variables and oviposition sites.

The findings suggest that *D. melanostictus* prefers slightly acidic spawning areas with lower water depth and temperature, as well as moderately developed submerged vegetation. Ephemeral pools and temporary ponds recorded single clutches on most occasions whereas multiple clutches were observed in permanent ponds. The highest number of egg clutches was recorded in September, 2020 (52 clutches, high rainfall, $p > 0.05$). Rainfall and egg laying were positively correlated ($r = 0.94$). The clutch distribution was highest at 0.5 ft and lowest at 1.6 ft. Most species avoid laying their eggs near predators. 45% of females avoid laying eggs near predators, 30% prefer to oviposit near anuran predators and 25% near non-anuran predators. Breeding behaviour sometimes varied depending on developmental stage or density of predators. *D. melanostictus* tadpoles have been known to consume their own eggs and live tadpoles. Tadpoles showed no avoidance behaviour to dragonfly naiad predators late in the breeding season which they did earlier. Besides, 49% of females did not share their breeding habitats with members of other species whereas 31% and 20% shared with sympatric species and non-sympatric species, respectively. Toads sometimes lay eggs near larger conspecifics but show no preference if the conspecific is similar in size to their own tadpoles. Preserving hydrologic processes that create these habitats and protecting high-use breeding areas could benefit D. melanostictus habitat management. Basic data like this is essential for predicting impacts on population abundance and ecological health.

Keywords: Asian common toad (*Duttaphrynus melanostictus*), Breeding Ecology, Conservation Plan, Conspecifics, Microhabitat Selection, Predator

LEVERAGING PLANT BIOFORTIFICATION AND MICROALGAE-BASED NUTRACEUTICALS FOR BIODIVERSITY CONSERVATION AND LIVELIHOOD ENHANCEMENT AMONG INDIGENOUS COMMUNITIES

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In the quest to address pressing issues of malnutrition and lifestyle diseases while fostering biodiversity conservation and livelihood enhancement among indigenous communities, our research amalgamates cutting-edge methodologies in plant biofortification and microalgae-based nutraceutical development. By harnessing translational research involving molecular biotechnology techniques alongside state-of-the-art molecular tools, including CRISPR-based genome editing, we aim to fortify crops with essential bioactive metabolites and enhance the nutritional content of microalgae-derived supplements.

Central to our approach is the strategic deployment of CRISPR-Cas9 based genome editing techniques and chloroplast synthetic biology to engineer crops for improved climate resilience, nutrition, enhanced yield potential, and heightened tolerance to abiotic stressors such as drought, salinity, and extreme temperatures. By precisely targeting key genes associated with stress response pathways, we can introduce beneficial genetic modifications that confer plants with the capacity to thrive under adverse environmental conditions, thereby ensuring food security and livelihood stability for vulnerable communities.

Furthermore, our research examines the utilization of biopolymeric methyl jasmonate-loaded chitosan nanoparticles (MJ-CNPs) and empty CNPs as innovative nanocarriers for targeted nutrient delivery in plants. Through the strategic encapsulation of methyl jasmonate, a potent inducer of phenolic and flavonoid biosynthesis, within chitosan nanoparticles, we aim to prolong the activity of key enzymes involved in secondary metabolite synthesis. This approach not only enhances the nutritional quality of crops but also can minimize environmental impacts associated with traditional agronomic practices.

In parallel, our investigation extends to the optimization of microalgae growth and metabolite productivity through the manipulation of environmental stimuli, including flashing light schedules. By modulating light regimes, we seek to maximize the accumulation of valuable metabolites, such as omega-3 fatty acids and antioxidants, in microalgae biomass, thereby enhancing the efficacy of microalgae-based nutraceutical supplements.

Moreover, our research has potential for improving the socio-economic dimensions of biodiversity conservation and rural livelihood enhancement.

Through community engagement and capacity-building initiatives, we can empower indigenous communities to actively participate in sustainable agricultural practices, including the cultivation of biofortified crops and microalgae farming. By integrating traditional ecological knowledge with modern biotechnological approaches, we strive to create holistic solutions that promote both human well-being and environmental stewardship.

In conclusion, our interdisciplinary research endeavours epitomize a holistic approach to addressing complex global challenges at the intersection of nutrition and biodiversity conservation. By leveraging advanced methodologies in plant biotechnology and microalgae cultivation, we aspire to catalyse transformative change, ensuring a sustainable and equitable future.

ETHYLENE SENSITIVITY DOMINATES THE EXPRESSION OF PANICLE BRANCHING AND SPIKELET MERISTEM GENES TO THE DETRIMENT OF GRAIN FILLING IN CONTRASTING RIL RICE GENOTYPES

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In order to increase the yield potential of rice crops, breeders increased the spikelet's numbers without much increase in the panicle length. As a result, more numbers of spikelets were accommodated within the limited space available in the boot present inside the flag leaf sheath enclosure leading to reduction in inter-spikelet distance, space available for growth of individual spikelets and severe increase in competitions among the spikelets for space and nutrients for their growth and development. Increase in the spikelet number within the panicle is also responsible for change in the panicle architecture from lax to compact type due to increase in the secondary branching and compact type panicled type rice produced more ethylene resulting into vulnerability towards grain filling and also poor grain growth leading to higher percentage of grain sterility and significant yield loss to the farmers. Though numerous spikelets are formed within the rice panicle inside the flag leaf sheath enclosure during the ontogenetic stage of development and each spikelet is competent to develop a good quality grain, spikelets located on the basal part of the panicle produces grains of poor quality unsuitable for human consumption. Panicle-wise grain-filling of individual spikelets in a panicle is typically location-specific in rice; apical spikelets dominate over their basal counterparts where flowering occurs first in the former and almost seven days thereafter in the latter.

This pattern of grain filling often changes with panicle architecture among cultivars, but the underlying mechanisms are largely unknown. The cylinder-shaped panicles introduced more recently, though suited for high grain yield, exhibit several instances of poor grain filling. In the present work, panicle branching and spikelet apical meristem gene expressions in the ontogeny stage and their influence on spikelet survival and grain filling at the post-anthesis stage were elucidated in two types of rice Recombinant Inbreed Lines (RIL) having similar spikelet density with identical lengths in their panicles, such as SR-157 (low-sterile) and SR-159 (high-sterile) and their parents NPT-V12 (low-sterile) and SPS-1-6-1 (high-sterile). Between cultivars, SR-157 versus SR-159, and spikelets located apically versus basally, grain filling was more vulnerable in the latter than the former owing to greater evolution and perception of ethylene at anthesis. The expression of ethylene receptors and downstream signal transducer genes was quite higher in the high sterile genotypes compared to low sterile genotypes and also higher expression in the basal spikelets than that of apical spikelets. Present scenario of climate change causing abiotic stresses like temperature increase and incidence of higher solar radiation might have been exacerbated the problem of ethylene production in the rice panicle to the detriment of grain filling. On the other hand, combined genome analyses revealed that branching genes like *DEP2*, *SPL-14, PTR,* and *FZP* over-expressed in rice cultivars with more secondary branching having high spikelet numbers in the high-sterile cultivar SR-159 compared to low-sterile cultivar SR-157 during the ontogeny stage of development. But this over-expression of panicle branching and spikelet meristem genes had no matching improvement in grain-setting in the post-anthesis period. Grain starch synthesis was higher, and expression of ethylene receptors and signal transducer genes was lower in the low- compared to high-sterile cultivars.

Thus, the quantum of grain set in the post-anthesis stage determining actual panicle yield was not dependent on the expression of genetic factors in the pre-anthesis stage defining potential grain yield. It was concluded that the default expression of ethylene synthesis and transducer genes at anthesis caused spikelet degeneration and this ethylene sensitivity at anthesis dominates the expression of panicle branching and spikelet meristem genes during pre-anthesis stage resulting into poor grain yield due to failure of achieving the yield advantage of high spikelet number in the sterile genotype SR-159 compared to SR-157. Hence, the genomic studies involving ethylene production and action must be an inalienable part of any constructive contribution for manipulation of higher yield potential in rice.

NUTRITIONAL DIVERSITY IN THE EDIBLE PORTION OF FRUITS AND FLOWERS (BLOSSOM) OF COMMERCIALLY CULTIVATED BANANAS IN INDIA

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There are over 93 distinct species and over 162 validly published taxa of Musaceae (includes all the three genera viz. 9 under *Ensete*, 152 under *Musa* and only one under *Musella*) around the world, out of which 27 distinct species or 34 taxa in two genera (2 under *Ensete*& 32 under *Musa*) are reported in India. There are approximately 1,200 banana cultivars grown worldwide, with India alone cultivating more than 120 of them. Globally, bananas, including plantains and cooking bananas are cultivated in 11.72 million hectares, resulting in a combined production of 162.95 million metric tons and a productivity of 13.90 tons per hectare. India holds the distinction of being the world's largest banana producer, with a production of 33.73 million metric tons from 0.92 million hectares and with a productivity of 36.67 tons per hectare.

In this study, we analysed the fresh fruit pulp sample of 450 bunches belongs to 121 commercially cultivated banana cultivars of India to quantify nine different mineral contents using ICP-OES. The ANOVA revealed highly significant cultivar differences for all the minerals with below 10-fold variability for K & Mg to more than 100-fold for Na and Ca; Iron and Zn recorded 35- & 45-fold variability, respectively. Only positively skewed distribution was alone observed for all the minerals i.e. majority of the banana cultivars have low magnitude for their fruit pulp mineral contents. The descending order of mean fruit pulp mineral content (mg/Kg) was K (626.1) > Ca (548.4) > Mg (321.9) > Na (196.3) > Fe (7.9) > Mn (4.6) > B (3.5) > P (3.2).

Similarly, analysis of edible parts of banana blossom (male flower bud) sample of 108 flower buds belongs to 36 banana cultivars revealed significant differences for all the minerals analysed on dry weight basis using ICP-OES. Of all macro-elements estimated, K content was found to be highest in the edible part of flower buds. Significantly highest K content of 7935.95 mg/ Kg was recorded in 'Srisailam' while the lowest K was detected in 'Rasthali' (856.90 mg/Kg) with a mean of 2526.11 mg/Kg and a CV of 70.7%, representing a range of 9.3-fold estimated in this study. In this study, calcium is the second most abundant mineral found in banana flower buds after K. Values for Ca content ranged from 217.05 to 1883.26 mg/Kg with an average of 890.52 mg/Kg. Magnesium concentrations in the blossom ranged from 98.2 to 1005.3 mg/Kg, representing a range of 10.2-fold with a general mean of 447.89 mg/Kg and CV of 50.7%. Values for P content

ranged from 51.32 to 873.88 mg/Kg with a general mean of 422.54 mg/Kg and a high CV of 60.7%. The S concentration in the flower bud ranged substantially from 97.12 to 980.25 mg/Kg, representing a 10.1-fold range with a general mean of 396.87 mg/Kg. The Na concentration recorded for the 36-banana germplasm ranged from 22.14 to 61.01 mg/Kg with a mean of 38.81 mg/Kg, representing a range of 2.8-fold with a low CV of 24.0%. The B concentration in the edible part of the blossom ranged substantially from 0.05 to 0.55 mg/Kg with a general mean of 0.25 mg/Kg. Iron values for 36 banana cultivars ranged from 14.68 to 62.56 mg/Kg with an average of 29.23 mg/Kg. therefore, the descending order of mean mineral content in the edible portions of banana blossom (mg/Kg) was K (2526) > Ca (891) > P (423) > Mg (403) > Na (39) > Fe (29) > B (0.25). Significant positive correlation was observed for all minerals with highest correlation value of 0.677 between Mg & Zn followed by >0.5 between Mg-Ca, Mg-Fe, Mg-Na and Mg-Mn. Both principal component analysis and cluster analysis failed to group the banana cultivars according to their ploidy/genome/subgroups. Further, the association among banana cultivars in close proximity (Biplot) reveals the involvement of only few ancestral species during their evolution with narrow genetic bases followed by uncontrolled spread of suckers through vegetative propagation.

Consumption of 100 g of banana pulp is shown to contribute fairly to the Indian adults' (men and women with sedentary/moderate/heavy physical activity) daily requirement in the ascending order of Mn (11.6%) > Ca (9.1%) > Mg (9.5% & 10.4%) > Fe (4.6% & 3.7%) > Zn (2.1%&2.5%) > K (1.7% & 1.9%) > Na (0.9% & 1.0%) and > P (0.1%), according to the revised RDA(Recommended dietary allowances)/AI (Adequate intake) values notified for Indians by the ICMR.

Keywords: Musaceae, Musa, Musella, India, Banana Cultivars, Correlation, Principal Component Analysis, Cluster Analysis

IDENTIFICATION OF SCOT MARKER LINKED TO BRUCHID (*Callosobruchus chinensis*) RESISTANCE IN PIGEONPEA AND ITS *IN SILICO* MODELLING AND BINDING INTERACTION AGAINST *C. CHINENSIS* GUT AMYLASE

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Pigeonpea is an important legume crop across the semi-arid tropics, and its yield is constrained with post-harvest loss due to bruchids (*Callosobruchus chinensis* and *C. maculatus*). The genetic linkage analysis using interspecific F_2 and BC_1F_1 populations [derived from a cross *Cajanus cajan* (L.) Huth ('ICP-28') × *C. cajanifolius* (acc. ICPW-31)] identified a SCoT marker ($SCoT04_{675}$) linked to bruchid resistance locus CcBr1 at a distance of 3.8 cM (0.038 Rf). The resistance specific fragment $SCoT4_{675}$ was converted into a sequence characterized amplified region (SCAR) marker, $CcBr1ST04_{693}$. BLAST analysis with pigeon-pea genome sequence (Version 2.0) also confirmed the occurrence of homologous locus in CcLG11, which contains Lectin-Legume-LecRK-Arcelin-ConA domain. The predicted marker protein also showed nearly 96% homology with seed Lectin β-chain of *C. cajanus* (XM_20384170). Further, the in-silico modelling and the protein–protein interaction between $CcBr1ST04_{693}$ and lectin β-chain against gut amylase (larval and adult) of *C. chinensis* was studied to assess the inhibitory mechanism. Molecular docking, molecular dynamics simulation and MM-PBSA based free energy calculation have been performed to understand the binding mechanism of these candidate proteins to gut amylases. The rigid flexible docking analysis also predicted the stable protein binding affinity, effectiveness, and inhibitory consistency. The RMSD, RMSF, and RoG analysis showed stable conformation sampling for both the $CcBr1ST04_{693}$ and lectin β-chain simulations with the adult and larval α-amylases, respectively. MM-PBSA based binding interaction study shows $CcBr1ST04_{693}$ protein has a higher potential to inhibit larval α-amylase and adult α-amylase than that of lectin β-chain. Overall, this study reported on putative candidate gene/ marker linked to bruchid resistance in pigeon pea which can be used as genetic handle in marker-assisted introgression of the genomic fragment conferring bruchid resistance and screening of breeding lines in pigeon pea.

SUSTAINABLE CIRCULAR ECONOMY APPROACH FOR MICROBIAL MEDIATED METAL RECOVERY FROM ELECTRONIC WASTE

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Electronic waste (e-waste) poses a pressing environmental challenge worldwide due to its complex composition, rapid proliferation, and hazardous components. As the consumption of electronic devices continues to escalate, there is a need for sustainable recycling practices. Sustainable recycling of e-waste has become imperative to mitigate environmental pollution, conserve resources, and promote circular economy principles. As depleting ores of metals is a problem, recycling e-waste is a way to replenish economically essential metals, e.g., some base and precious metals. Traditional methods like pyrometallurgy and hydrometallurgy often carry a high environmental burden due to their reliance on energy-intensive processes and harsh chemicals. In contrast, the paper focuses on biohydrometallurgy, a technique utilizing naturally occurring microorganisms, primarily iron-oxidizing bacteria, to dissolve and extract valuable metals from e-waste. Biohydrometallurgical processes operate at near-ambient temperatures, require minimal chemical input, and generate fewer toxic byproducts than conventional methods. In this process, microbial consortia, or specific microorganisms such as *Acidithiobacillus ferroxidans*, *Leptospirillum ferriphilum*, and *Acidithiobacillus thiooxidans,* use reduced sulphur and ferrous as energy sources and oxidize them into sulphate and ferric ion. This ferric iron oxidizes metal present in e-waste, releasing metals into the solution. This natural process offers advantages such as reduced energy consumption, minimal environmental impact, and selective metal recovery.

The review details future research paths in sustainable e-waste recycling, emphasizing new technologies and research progress. It looks at eco-friendly methods for metal recycling from e-waste, aiming to reduce environmental harm and boost resource recovery. This involves improvements in bioleaching and creating closed-loop systems for metal circular economy. Adopting these sustainable methods can turn e-waste management into a valuable resource recovery system, reducing environmental harm and securing vital metals for the future.

Keywords: Sustainable solution, Circular economy, Bioleaching, E-waste recycling, Metal recovery.

BIODIVERSITY AT THE CROSSROADS OF THE MILLENNIUM: IMPLICATIONS OF ENVIRONMENTAL PERTURBATIONS ON BIODIVERSITY IN 21ST CENTURY

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The planet earth is under pressure from various stresses now than ever before, as evidenced by increased ecological footprints across the globe. This has not only resulted in ever decreasing biocapacity of earth but also ever-shortened earth-overshoot days. This, is apparently, an outcome of resource (over)consumption patterns, and the lifestyle of denizens, irrespective of nations. This results in an inevitable impact on the biodiversity (biological resources) thereby declining ecosystem goods and services as rendered by various ecosystems. Till date more than 157,100 species have been assessed for the IUCN Red List, of which more than 44,000 species are threatened with extinction. The changing status of many of the assessed species are ascribed to complete absence/reduction in the main threats, or conservation measures (e.g., reintroduction, habitat protection or restoration, legal protection, harvest management, etc.) have successfully improved the status of the species enough to move it into a lower category of threat. In some cases, the main threats have continued unabated, have increased, or new threats have developed causing the status of the species to deteriorate enough to move it into a higher category of threat. Although, the sixth mass extinction process and impact are being debated in almost all the scientific forums, the fate of biodiversity on the crossroads of development and environmental management (protection) needs a rigorous deliberation.

In view of these specifics, my talk would focus on impact of different environmental (anthropogenic) stresses on biodiversity in general, and earth's natural resource base in particular. The talk would cover an array of habitats such as wetlands (in natural areas and urban landscapes), ecologically sensitive habitats such as coastal sand dunes, sea turtle nesting sites (both sporadic and mass nesting), biologically active mudflats, coastal bird nesting areas and maritime environments. The talk would cover mismanagement of solid waste, plastic menace, marine debris, chemical release into environment, to name a few proxies. Further, the deliberation would include birds and sea turtles as model organisms. Undoubtedly, the talk would include few aspects on the ecological response of birds to the temporal shifts in human disturbances (due to anthropause as witnessed during COVID-19 pandemic), as insights for devising species recovery plans in various landscapes/regions.

Keywords: Anthropause, Biocapacity, Earth Overshoot Days, Marine Debris, Wetlands

CLIMATE CHANGE, FOOD CULTURES AND FUTURES IN DILEMMA: AN EXAMINATION OF DIDAYI ADIVASI FOOD PRACTICES

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In past one decade the question of climate change and rising number of hungry people around the world has taken for front in most of the academic debates and discussions. Given the rising need to feed the growing population of the world, priorities for many governments and international agencies have shifted towards it. However, the major dilemma is how to grow ecologically yet enough food to provide healthy, nutritious and affordable food for all. One of the major questions also include on what to grow? For example, in last half a decade the state of Odisha has launched an ambitious project to promote Millets that are traditionally grown in the southern region of the State. Where on the one hand the state is focused on cereal to provide the masses with food, the communities at the local level have their own ways to meet their food requirement. In most of the cases it is not limited to growing food. Gathering of food from the forest or the local environment is one of the most important ways remain food sufficient. This presentation will focus on one such communities called Didayi who have developed a complex system of cultivation, gather and hunting to remain food sufficient. In the recent past the community has lost a lot of its genetic diversity through the loss of seeds due to twin reasons of market and state policies. The aspiration for a modern life and its *niti niyam* (norms and rules) stand in direct conflict of the *niti niyam* of the Didayi's way of living. This paper will point on how the outside culture of the mainstream world has changed the food, and interaction of migrant members with their ow community and in the process how the system that that has sustained the community for century is being altered and a new unsustainable system is entering in the fibric of the community. Lastly, this presentation will highlight the need for an integrated approach from communities and state. A collaboration between both might create a meaningful plan to sustain and in fact help better these traditional practices. It might also create an outlook towards diverse cultural food with dignity and recognize the need for diverse meaning of food.

Keywords: Climate Change, State Policy, Odisha Millets Mission, Traditional food systems, Didayi Adivasi

DIVERSITY AND CONSERVATION OF MUD CRAB *Scylla serrata* UNDER VARIED ECOLOGICAL SALT CHALLENGE STATES

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Salinity is one of the important factors for regulating the habitat and biodiversity especially in marshy and salty areas. It influences the homeostasis organism that leads to their survival, or escaping from the ecosystem to a suitable salinity zone. The mud crab *Scylla serrata* is ecologically and commercially highly important. In its larval stages, it contributes to a major portion of zooplanktons that indirectly stabilize the ecosystem, and the bioturbation structure it creates, helps in seed trapping and increasing the mangrove population. Knowing its stenohaline range and production shall have implications for its culture. Antioxidant defences such as antioxidant enzymes (superoxide dismutase, catalase, glutathione peroxidase and glutathione reductase and small antioxidant molecules such as ascorbic acid and free non-protein sulfhydryl (GSH), oxidative stress status in tissues was evaluated by measuring lipid peroxidation, protein carbonylation and H_2O_2 levels, DNA unwinding was also tested as a genotoxic marker. Effects of different salinities on O_2 consumption, CO_2 release and NH_3 excretion of both male and female crabs were determined in*S. serrata in vitro* and also sampled from Chilika lagoon as a function of salinity. Oxidative stress markers are used to evaluate the effects of any external or internal troubles in animals and can be used for their conservation. Results indicate that increase in salinity caused decrease in O_2 consumption and CO_2 release and increase in NH_3 excretion by both male and female crabs. High salinity is found to induce oxidative stress in crabs irrespective of tissues. However, high salinity does not have any effect on DNA unwinding levels in tissues of crabs. Results of the experiment suggest that high salinity causes hypoxia in mitochondria of mud crabs. At hypoxic conditions, the increased activities of electron transport chain enzymes were found to be coupled with decreased oxidative phosphorylation in gill mitochondria of the crabs. On the other hand, the hypoxic condition at high salinity was accompanied with increased H_2O_2 production resulting in oxidative stress in mitochondria of crabs. In conclusion, results of the present study suggest that high salinity induces oxidative stress in mud crabs by enhancing reactive oxygen species generation in tissues. Nevertheless, salinity does not induce genotoxicity in mud crabs (*Scylla serrata).* The data suggest that medium salinity is recommended for better growth of the crab species and is useful for the conservation of mud crabs in general.

Keywords: Electron Transport Chain, Mud Crab Conservation, Redox Modulation, Salinity, Active Oxygen Metabolism.

NATURAL COMPOUNDS AS ANTAGONISTS AGAINST HIV-1 PROTEASE: EXPLORING THE THERAPEUTIC POTENTIALS FOR HIV INFECTIONS

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Acquired Immune Deficiency Syndrome (AIDS) is caused by infection of the Human Immunodeficiency Virus (HIV) and HIV-1 protease (HIV^{Pro}) acts as the most promising drug target commonly used against AIDS. HIV attacks the body's immune cells and dismantles their function. About 2 million people die every year from HIV infections and related complicacies as reported by the World Health Organization. Hence, there is an urgent need of redoubling our efforts to control HIV / AIDS as the virus undergoes resistant against antiretroviral drugs by accumulating mutations. Designing a perfect anti-HIV drug without the drug resistance is quite difficult. Mitigation is a challenging problem due to the non-availability of praiseworthy treatments. Screening synthetic chemicals against HIV targets has failed to find HIV antivirals. The present investigation looks at medications that act as antagonists against HIV^{Pro}, a potential therapeutic target. Due to the richness and greatest diversity of plants, the ongoing analysis aims at exploring phytocompounds as antagonistic to HIV-1 focusing on the specific HIV^{Pro} target, an aspartic protease that cuts the Gag-Pol polyprotein into separate proteins crucial for viral reproduction, through multi-faceted *in silico* methods.

The current study involves five medicinal plants (*Areca catechu, Terminalia arjuna, Saraca indica, Syzygium cumini, and Cassia fistula*) having reported anti-HIV-pr activity. Initially, a virtual library of more than 116 phytocompounds was prepared from previously published reports of plants with anti-HIV properties, which were then virtually screened and shortlisted against the WT, and I50V mutant of HIV^{Pro}. The five top-most compounds were viewed as Epicatechin, Epigallocatechol, D-Catechin, Afrormosin and Afzelechin showing docking scores of −9.1, −9.1, −8.7, -8.2, -8.8 kcal/mol for WT, −7.9, −7.8, −7.5, -7.5, -7.2 kcal/mol for the I50V mutant protease, respectively. 100 ns long MD simulations and MM-GBSA based free energy calculations were performed on the HIV^{Pro} complexes to witness the relative binding affinity of the compounds and favourable molecular interactions network. The results of the study are intriguing in the context of computer-aided screening and the binding affinities of the phytocompounds,

proposing Epigallocatechol (GAL) and D-Catechin (CAT) as potent bioactive antivirals for the development of phytocompound-based anti-HIV agent.

Further, in a separate study, to thoroughly investigate the mechanism of HIV^{Pro} drug resistance, molecular dynamics (MD) studies and free energy calculations were accomplished on the WT and four significant resistance mutants (V82F, I84V, I50V, and V82F/I84V) of HIV^{Pro} complexed with bioactive fungal compounds: Ganomycin-I (GN-I) & Ellagic acid (ELA). The protein's overall structure was determined through the evaluation of the MD trajectories. To determine precise binding free energies, we utilized an MM/GBSA method based on molecular mechanics. In this study, we found that compared to WT and single mutants, the double mutant (V82F/I84V) exhibited less flexibility and less curling of the flap tips. Largely, this study led to the identification of prospective hit compounds like GN-I with favourable pharmacokinetic properties not only for both WT and single-mutants but also for the double mutant like V82F/I84V, which may lead to the discovery of robust new drugs against HIV-pr. The current study's findings may provide light on the mechanism of mutational effect, leading to the development of more potent and effective HIV^{Pro} inhibitors in the future. This study is significant in defining the ideal therapeutic candidate against HIV infections.

Keywords: HIV, AIDs, Phytocompound, Free Energy Calculation

Botanical extracts against spoilage bacteria from non-food product's: Importance for a Sustainable future

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Microbial contamination of non-food products is unavoidable since most industrial production cannot guarantee completely sterile end products. Therefore, biocides are added to postpone spoilage. In the last decade, legislation and social acceptance of chemicals have changed tremendously, leading to a growing interest in botanical extracts as alternatives. Here, we identified the bacterial contaminants from 16 expired non-food products, both by a culturing method and a metagenomic approach. We confirmed Pseudomonadaceae and/or Enterobacteriaceae members as common spoilage organisms of non-food products, but also identified additional spoilage bacteria. Next, we evaluated >500 botanical extracts for antibacterial activity against a panel of 11 challenge strains. Finally, their antibacterial activity was evaluated against *Escherichia coli* and *Staphylococcus aureus* in paint and a detergent product matrix, showing their potential as more sustainable alternatives to synthetic chemical biocides. Most of the botanical extracts tested showed antibacterial activity against Gram-positive, but far fewer against Gram-negative spoilage species. The activity profiles against the panel of spoilage bacteria were highly diverse, with broad as well as narrow spectra. Active extracts were most commonly prepared with ethanol, followed by acetone and water. Most active extracts originate from leaves, followed by bark, fruits and whole plants. Antibacterial activity was found in most of the 76 plant families tested, but Anacardiaceae, Meliaceae and Myrtaceae showed the highest frequency of high antibacterial activity. The product matrix within the paint and detergent product strongly influenced the antibacterial activity of the three selected botanical extracts against *E. coli* and *S. aureus.* But the activity in paint was comparable to a commonly used isothiazolinone chemical preservative, suggesting the feasibility of using plant extracts as preservative biocides. More product challenge tests under real-life conditions and large-scale production of plant extracts will be needed to further explore their potential as preservatives to combat spoilage bacteria in non-food products.

Keywords: Biocide; Crop Protectants; Metagenomics; MIC; Product Matrix

Importin alpha 2 provides nonhost resistance against rice sheath blight

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There is neither resistant rice cultivar nor any control measure against *Rhizoctonia solani* AG-1 IA (*RS*), causal of sheath blight and a major threat to global rice production. Rice is a host and Arabidopsis is a nonhost with underlying nonhost resistance (NHR) gene which is largely untested. Using approaches of forward genetics and tools, cytology, and molecular biology, we identified homozygous mutants in Arabidopsis, mapped the NHR gene, and functionally characterized it in response to *RS. Rss1* was mapped on Ch 4 between *JAERI18* and *Ch4_9.18* (844.6 Kb) and identified *IMPORTIN ALPHA 2* as the candidate *RSS1* gene. We found that breach of immunity in *rss1* by *RS* activates defence responses whereas photosynthetic pigment biosynthesis and developmental processes are negatively regulated. In addition, a gradual decrease in *PR1* by 3 dpi revealed that *RSS1* positively regulated early SA-mediated resistance. Whereas increased expression of *PDF1.2* by 3 dpi supported switching to necrotrophy, SA-mediated defence in Col-0 leading to immune response. Enhanced expression of *ATG8a* in rss1 supported autophagic cell death. *IMPA2, IMPA1*, and *RAN1* function together to provide NHR against *RS*. These findings demonstrate that *IMPA2* provides NHR against *RS* in Col-0 that evoke SA-mediated early immunity with boulevard for potential biotechnological application.

Keywords: RSS1 Gene, Arabidopsis, Autophagic Cell Death, Defence Responses

ETHNOBOTANICAL DIVERSITY STUDY IN RICE-BASED CROPPING SYSTEM: AN INCOME GENERATION OPPORTUNITY FOR SMALL AND MARGINAL FARMERS

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Rice is rich in genetic diversity, with thousands of varieties are grown throughout the world. Rice cultivation is the principal activity and source of income for about 100 million households in Asia and Africa. Rice is grown under diverse cultural conditions and over wide geographical range. Rice is usually grown in either rainfed or irrigated conditions which promotes the growth of many weeds with medicinal values. Anthropogenic disturbances and cultural operations seemed to govern the overall ecology of medicinal flora in rice field. Rice based cropping system with domesticated medicinal plant *Ocimum sanctum* enhances the soil status as well yield of rice crop. To increase the profitability of rice farmers, possibilities of growing medicinal crops in rice-based cropping system is being evaluated at village Dandi (Balasore district, Odisha, India) in farmers' field during 2020-2022 based on the survey conducted in the years 2018 and 2019. From the survey it was observed that many general herbs growing in different rice ecosystems possess good medicinal values, which can be cultivated in rice based copping system as cash crop and raw materials for Agro-medico industries.

In irrigated fields in sequence of early rice, medicinal crops like *Bacopa monnieri* (Brahmi), *Wedelia chinensis* (Bhrungaraj), *Sphaeranthus indicus* (Bhuinkadamba), Kalakeshadura (*Eclipta prostrata*), *Centella asiatica* (Thalkudi), and *Trachyspermum ammi* (Juani) were found commercially viable crops in sandy loam upland soil, when cultivated during December to March. Except *Bacopa monnieri*, others were given limited irrigation i.e. 2-3 times. *Bacopa monnieri* gave net return of Rs.1.25 lakh/ha followed by *Wedelia chinensis* of Rs. 0.85 lakh/ha, *Sphaeranthus indicus* of Rs. 0.70 lakh/ha, *Eclipta prostrata* of Rs. 0.35 lakh/ha, *Centella asiatica* of Rs. 0.32 lakh/ha and *Trachyspermum ammi* Rs. 0.21 lakh/ha and their cost benefit ratios were found to be 1:6, 1:4.86, 1:4.5, 1:3.3, 1:2.9, and 1:2.8, respectively. In 2018-19, first four medicinal crop in rainfed lowland field gave less yield after late rice (Var. Panidhan) during March to June due to standing water and occasional submergence.

Hunger and disease are two vital problems for human survival. So 'Let food be thy medicine' is the Devine theory. About 99%, rice eco-friendly medicinal plants are edible in form of leafy vegetables, salads, curry, chutney, pickles, oil extracts, spices, aromatics, etc. for better nutrition, digestion, absorption, assimilation,

sustainability of life and disease free life. There is need for public awareness to use these natural medicines for disease free life and for better socio-economic development of rice farmers. The rice-ecofriendly medicinal plants can be utilized for isolation of natural phytochemicals like alkaloids, glycosides, vitamins, enzymes, saponins, hydrocarbons like glucose, steroids, resins and preparation of botanicals, pesticides, preservatives, bactericidal, mosquito repellents, contraceptive materials, etc. Generally, the medicinal plants are being collected from forest and waste lands, which are reducing day by day and inviting biodiversity loss. Moreover, cost of collection is increasing with adulteration and non-availability of many herbal materials. Further, continuous cultivation of irrigated rice will cause a great water loss which may invite water scarcity in near future. These medicinal crops are considered as basic raw materials for agro-medico-industries and also commonly used in preparation of mother tincture, hair oil, memory tonic etc. in commercially branded ayurvedic and homeopathic medicines. Cultivating medicinal crops in rice-based cropping system will improve the socio-economic condition of small and marginal farmers with setting up of agro-medico-industries in villages to change the economic scenario of rural India in general and Odisha in particular.

Keywords: Rice, Medicinal Crop, Cropping System, Agro-Medico

COMMUNITY PARTICIPATORY AGRO-BIODIVERSITY CONSERVATION MEASURES; STRENGTHENING COMMUNITY RESILIENCE ON CLIMATE CHANGE

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Agrobiodiversity is the part of biodiversity directly concerned with agriculture and food production that depends on human actions, both positive and negative. Agro-biodiversity comprises of all the components of biological diversity relevant to agriculture. The participatory approaches help to generate information on conservation and use of plant genetic resources within the communities. These approaches would establish linkages between various stakeholders and developing indigenous knowledge of local plant genetic resources. The participatory methodology the community in assessing climate resilient crop diversity at local level and also it helps to identify the limits of adaptation strategies. In this specific context, the Koraput biodiversity and unique agriculture system focusses on participatory agro biodiversity conservation as a methodology, conservation of agro biodiversity through participatory approach, like mixed farming technique, Knowledge transfer from generation to generation, germplasm, i,e seed, planting material exchange for promoting access to seed etc. this will enhance the (PVS) participatory varietal selection, germplasm pass from generation to generation etc.

Local and indigenous communities in biodiversity-rich countries have been closely linked to their natural environments for millennia. Often, they have intimate knowledge about their habitats and wild plant species, including wild relatives. This may include knowledge of their sustainable management. In many instances, this intimacy has been disrupted by conventional conservation approaches (United Nations, 2009). The latter part of the 20th century has witnessed a reassessment of some of these approaches to biodiversity conservation, with a growing recognition of the need to enhance the role of local and indigenous communities in the management of their environments and resources. The participatory approaches will generate many challenges for scientists who may be used to working with conventional, quantitative research approaches. Most natural scientists are usually not experienced with behavioural aspects of human management include in attitudes, skills and collective / individual behaviours considered necessary for participatory approaches. To ensure an effective participatory process, it is good practice to seek out those social (and natural) scientists in your organization or others with extensive skills and experience in using participatory methods and tools, and facilitating participatory approaches with local and indigenous communities. This four cell analysis method to assess on farm diversity status. It is a rapid assessment technique to assess the amount and distribution of crop diversity within farming

communities. It is also a method to identify common, unique and rare species or varieties and helps to find reasons for their current status.

Participatory conservation is essentially an approach bridging farmer(indigenous) knowledge and formal (scientific) theory for conservation, sustainable use and benefit sharing. Over time, farmers have learnt the techniques of conserving their genetic resources based on practical knowledge of pollinating systems, flowering time, tillering capacity, biomass accumulation, disease and pest incidence, seed size and maturity. The community seed bank is promising and reliable option for on-farm conservation of local crop diversity Farmers are vulnerable to natural disasters such as drought and floods which also speedily erode plant genetic resources, foundation for agro-biodiversity. In a community seed bank, local crop germplasms are collected along with important information and associated knowledge, stored, regenerated or multiplied as required and distributed to fulfil the seed demands of farmers for their diverse agro-ecology. It is a livelihood strategy and contributes to on-farm management of locally important genetic resources. The participatory approaches help the communities for the better access to the suitable diversity for further development. By adopting the participatory agro-biodiversity systems, farmers may have better opportunities to use the genetic diversity as a tool while facing the environmental variation and socioeconomic uncertainties. This technique would provide information on climate resilient crop diversities within a locality which may further disseminate the knowledge to neighbouring communities. This approach may also help for identification of climate resilient crops for future crop breeding programs by the researchers, conservationists to support the breeders, seed producers in future. This unique practice of the Koraput community bring a glory for our nation in 2012 as a GIAHS site (Global Important Agriculture Heritage System) by Food and Agriculture Organization of the United Nations.

Keywords: Participatory Approach, Genetic Resource, Indigenous Community

Theme-I Agrobiodiversity For Food and Nutritional Security

A SHORT PRELIMINARY STUDY ON CURRENT FARMING SITUATION OF TRIBAL LANDSCAPE IN POTTANGI, KORAPUT

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The undivided Koraput Landscape is surrounded by 53.74% of total tribal population of India thus it can be a Tribal Landscape. The location itself favours the ultimate climate for various Farming techniques but the intervention of globalisation into the ancient tribal culture changes both the tradition and culture. The literature says before Independence the tribals used to be living in mountains far from the cities, after the green revolution people wants to get benefited, they chose to interevent their farming culture and move towards marketized place. The present preliminary study was conducted in march 2024 to identify the current farming situation in the Pottangi block of Koraput. Pottangi has three elevation zone starting from 500 to 1600m from sea-level and dominated by Kondha, Paroja and Dora tribals. Three Gram panchayat (Gangarajpur, Deopottangi and Kotia) and nearly 15 villages were taken according to three elevation zone. Focal Group Discussion was done in every Gram Panchayat and a general farming questionnaire survey was conducted. The Result is that the Deopottangi GP have water scarcity has it located near to market and in lower elevation of Pottangi, but in three places dug wells are set by ICAR for Irrigation purpose where different types vegetable crops are grown and they use different type of fertilizers, hybrid seed (more productivity) and pesticides. But in high elevation like Kotia GP there is evidence of Shifting cultivation and there is no water Scarcity, the people perform organic farming as they use the traditional methods for cultivation and according to the village peoples there is no use of fertilizer. Intercropping is seen in all places of lowland but in high elevation (Kotia GP) there is single cropping pattern is seen. In Deopottangi, 74% villages depend on the irrigation for the cultivation and observed that 80% of lands are fallow land closed to market due to water scarcity mainly in dongar lands.

Keywords: Landscape, Tribal, Koraput, Farming

WILD EDIBLE FRUITS: NUTRITIONAL SECURITY FOR TRIBAL PEOPLE OF KORAPUT

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Wild edible fruits used as indigenous food and contribute significantly to nutritional security of several tribal people of Koraput. Present study evaluated the proximate compositions, vitamins, phenol, flavonoid and antioxidant capacity in 16 different wild edible fruits used by tribal people from Koraput. The protein, carbohydrates and fat content in the wild fruits are varied from 5.54% to 19.51% and 25.54% to 66.52%and 0.7% to 8.11%, respectively. The wild fruits are rich in energy content which varied from 156.51 to 352.47 kcal$100g^{-1}$. The energy content was highest in *Semecarpus anacardium* followed by *Aegle marmelos* and *Averrhoa carambola.* The phenol, flavonoid and antioxidant capacity of the wild fruits were varied from 12.07 to 64.8mg 100 g^{-1}dry weight, 1.07 to 6.25 µg $100g^{-1}$ dry weight and 10.98 to 97.56%, respectively. Results revealed that some wild fruits such as *Bauhinia vahlii, Semecarpus anacardium* and *Aegle marmelos* recoded high protein, carbohydrate and exceptional rich in total energy content indicated its nutritional superiority than other fruits. In addition, exceptional rich in antioxidants and vitamin C were recorded in *Spondias pinnata*, *Psidium guajava* and *Terminalia chebula* than the other species can be promoted as a source of natural antioxidants. These underutilized wild fruits might be popularized for different products as a good alternative source of food to alleviate hunger and malnutrition.

Keywords: Antioxidant capacity; Flavonoid; Proximate composition; Wild fruits; Vitamins

If agriculture goes wrong, nothing else will have a chance to go right.

Bharatratna M. S. Swaminathan

ESTIMATION OF SOIL QUALITY INDEX AS INFLUENCED BY INORGANIC AND ORGANIC FERTILIZATION IN DIFFERENT RICE-BASED CROPPING SYSTEMS OF SUB-HUMID TROPICAL INCEPTISOLS

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Cropping system intensification with provision of integrated nutrient management holds immense potential in enhancing soil quality and sustaining environmental stability. A field experiment was conducted with three rice-based cropping systems (rice-mustard-jute; rice-wheat-maize+greengram; rice-lentil-sesame) and four nutrient management practices (NPK fertilizers and biogas slurry or BGS in various combinations) in sub-humid tropical Inceptisols under the new alluvial zone of West Bengal to evaluate the influence of inorganic-organic fertilization on soil quality. The experiment was laid out in strip-plot design and replicated thrice. Regardless of cropping systems, system rice equivalent yield varied from 5.87 t ha^{-1} in the plots treated with 100% N through BGS to 7.78 t ha^{-1} with 100% NPK fertilizers. However, higher sustainable yield index was obtained with substitution of NPK fertilizers by BGS. Soil samples were analysed for physical, chemical and biological indicators after seven crop cycles and the soil quality index was calculated by following principal component analysis and multiple regression analysis-based minimum data set selection. The best attainment of SQI was found in the rice-lentil-sesame system (3.32), followed by the rice-wheat-maize+greengram (3.27) cropping system with integrated nutrient sources. A greater value of SQI in the integrated treatments suggested that partial substitution of chemical fertilizers with biogas slurry has an advantage over lone fertilizer treatments. Among all the indicators under study, four soil parameters, namely, available nitrogen, available boron, available sulphur and dehydrogenase activity were screened as key indicators.

Keywords: Rice-based Cropping System; Biogas Slurry (BGS); System Productivity; Sustainable Yield Index; Soil Quality Index (SQI); Quality Indicators

PRECISION FARMING: EFFECT OF ORGANIC MANURE WITH DOSES OF NPK ON SINDHU RICE VARIETY

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There is an imbalance and excessive use of chemical fertilizers in rice cultivation to increase yield, which is leading to a catastrophe in soil fertility, productivity, microbes &worsening the global environment. Due to which organic farming is gaining recognition as a promising means to offer healthier rice& to ensure environmental sustainability. But various studies have shown that organic crops yielded lower yields on an average in good years but higher yields during drought years. There are a few limitations with organic farming such as lack of convenience, more time consuming, lack of chemical alternatives and no GM crops. So a recent advancement in organic farming method is precision farming for better productivity, by using doses of chemical fertilizers (NPK) with organic manure. To demonstrate it, an experiment was conducted in the premises of U.N. Auto College, in which five plots were prepared and supplemented with organic manure (cow dung, vermicompost, azolla, jaggery and curd). To these plots seeds of pulses or mustard were added for nitrogen supplementation(mulching) into which Sindhu rice planlets were planted and allowed to grow for 40days.Then the plot 1 was supplemented with 100% NPK (control), plot 2 with 90% NPK and 10% organic manure, plot 3 with 80% NPK and 20% organic manure, plot 4 with 70% NPK and 30% organic manure and plot 5 with 50% NPK and 50% organic manure. The morphological and biochemical analysis after 15days showed that plot 2 (90%NPK & 10%Organic manure) and 3(80%NPK & 20%Organic manure) showed better growth and development of panicle than plot 1 with 100% NPK and other plots also showed comparatively better productivity.

Keywords: Precision Farming, Azolla, Vermicompost, Jaggery, Sustainability, Mulching

NUTRITIONAL AND CLIMATE RESILIENCE TRAITS OF LOCAL NIGER ACCESSIONS FROM KORAPUT REGION OF EASTERN GHATS OF INDIA

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Niger [*Guizotia abyssinica* (L.f.) Cass.] is an economically important edible oilseed crop cultivated in different parts of India and Ethiopia for nearly 5000 years. India contributes 3% of the country's total production of oilseeds, making it the leading producer and exporter of Niger. Present study evaluated the genetic diversity of nutritional and climate resilience traits of 30 indigenous Niger accessions originating from Eastern Ghats of India, and compare them with three improved varieties of the locality. Based on the findings, some indigenous Niger accessions such as Mangardora, Ganjeipadar and Kolabnagar had exceptionally rich in fat, protein and energy contents and are nutritionally superior compared to improved variety of the locality. Exceptional rich in flavonoid, antioxidant capacity and vitamin C was recorded in Manahar, Badapada and Mahadeiput. Based on drought tolerance screening, three Niger accessions such as Dayanidhiguda, Manahar and Sungar recorded a higher drought tolerant index than that of tolerant check variety Deomali and showed more adaptive response to drought. Further, nutrition rich Niger accessions may be valuable for mass consumption and indicating ample opportunities for future breeding programs aimed at enhancing their quality. Additionally, these accessions show considerable promise in the food industry for producing valuable functional foods.

Keywords: Antioxidant, Anti-Nutrition, Drought Stress Niger, Oil Crops

PLANT STRESS ANALYSIS USING MACHINE LEARNING, A SPECIAL REFERENCE TO BRINJAL PLANT

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Stress is a defensive state of an organism resulting deviation of its optimal developmental condition. Environmental challenges destabilize fundamental biological functions in plants. Plant stress is one of the most significant factors affecting plant health and food production. Plant phenotyping involves measuring and studying plant features such as growth, development and responses to environmental stimuli and pathogens. Early detection and accurate diagnosis are essential to manage and prevent plant stress effectively. Due to availability of high resonant images and more enhanced image capturing techniques it became even easier for study and analysis of different diseases at an early stage by identifying and classifying its minute features taken from the images. This study explores the application of image processing and machine learning techniques for the early detection of diseases in Brinjal leaves. Leveraging advancements in image processing, convolutional neural networks (CNNs) are employed to analyse visual cues and patterns in brinjal leaf images, facilitating the swift identification and classification of diseases. By integrating machine learning algorithms, particularly CNN models, this research aims to enhance the accuracy and efficiency of disease detection, enabling proactive measures to mitigate potential crop losses. Through the utilization of cutting-edge technologies, such as deep learning and image processing, this study seeks to revolutionize disease management in brinjal crops, offering a promising avenue for early intervention and sustainable agriculture practices.

Keywords: Plant Stress. Environmental Challenges, Brinjal Leaf, Machine Learning, Sustainable Agriculture

"The health of our planet depends on the health of its ecosystems, and sustainable agriculture is key to maintaining that health."

Jules Pretty

EXPLORING THE TRADE-OFF BETWEEN PHOTOSYNTHESIS AND PHOTOASSIMILATE PARTITIONING ACROSS THE CULTIVATED AND WILD RELATIVES OF RICE

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Photosynthesis and photoassimilate partitioning are two interconnected physiological processes determining overall plant performance, yield and biomass. A leaf is the prime site for carbon fixation, hence, different developmental, photochemical, and biochemical traits of a leaf affect photosynthesis. Photoassimilate partitioning, in the form of sucrose, depends on the source and sink strength, phloem loading and unloading, and activity of sucrose transporters. In the present study, wild rice species showed a higher net leaf photosynthesis rate (P_N) compared to cultivated rice. Higher photosynthesis in the wild rice species was found to be associated with different leaf developmental traits, specifically mesophyll cell size and lobbing, and vein dimensions. Further, fitting A/Ci curves followed by experimental validation showed that the leaf photosynthesis in cultivated rice varieties was limited by biochemical attributes, such as Rubisco activity and electron transport rate, compared to wild rice species. Consistent with higher photosynthesis, the wild relatives accumulated high NSCs in leaves. ^{14}C levelled sucrose loading experiment, quantification of sucrose in phloem sap, and expression analysis of *SWEET* genes encoding sucrose transporters suggested efficient phloem loading in the leaves of wild species. However, sucrose transport to the grains of the wild species was not adequate, likely due to abnormal vascular bundles as well as reduced expression of some key *SWEET*s and *SUT*s at the panicle base. Interestingly, a large portion of sucrose in the wild relatives of rice stem was converted to structural carbohydrates such as cellulose and hemicellulose likely due to higher cleavage activity of OsSUS and higher expression of cellulose synthase. Low starch accumulation in wild relatives of rice, thus partially seem to be responsible for its poor yield.

Keywords: Photosynthesis, Carbon Fixation, Photoassimilate Partitioning, Rice

INVESTIGATION OF ANTIBACTERIAL ACTIVITY OF PHYCO-FABRICATED IRON OXIDE NANOPARTICLES SYNTHESIZED USING *Chlorella vulgaris*

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Green technology provides efficient solutions for converting biological systems to green approaches through nanomaterial synthesis and thus preventing any associated toxicity. Green synthesis involves the use living entities such as plants, bacteria, and microbes etc. to synthesize metallic nanoparticles (NPs) for pharmaceutical and biomedical applications in an eco-friendly and comparatively economical manner. Nanotechnology is a promising technology with a wide range of pharmaceutical applications in the modern world because it provides a higher surface area (SA) to volume (Vol) ratio. Compared to chemically synthesized NPs, algal-based NPs have recently received increasing attention from researchers worldwide to treat and inhibit infections caused by microbial pathogens resistant to antibiotics. Algae produce various bioactive compounds such aschlorophyll, phycobilins, phenolics, flavonoids, glucosides, tannins, and saponins that can be used as therapeutic agents. In this investigation, iron oxide (FeO) NPs were synthesized using a green biosynthetic method by reduction of ferric chloride solution using the cell extract of the *Chlorella vulgaris* (BUACC04).The structural uniformity and functional properties of the FeO NPs were investigated by X-ray diffraction, Fourier Transforms Infrared Spectroscopy (FT-IR), and Scanning Electron Microscopy (SEM). The average particle diameter as determined by SEM was found to be 17 - 43 nm. X-ray diffraction (XRD) showed that the nanoparticles are crystalline with a spherical shape. FeONPs also exhibited the antibacterial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Escherichia coli*.

Keywords: Green Synthesis, *Chlorella vulgaris,* Nanoparticle, Pharmaceutical

DIVERSITY OF WEEDS FOR HUMAN FOOD- A CONQUEST FOR CHEAPER MINERAL SOURCES

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A weed is an unwanted plant growing in a place where some other plants are also growing or no other plant has grown at all. The plants growing in a wrong place i.e. in agriculture fields are often referred to as weeds. They proliferated quickly and aggressively. In many parts of India, wild edible plants and weeds are frequently used in everyday meals. Wild weedy edible plants are essential for tribal cultures' survival as a source of food and as a source of money like lumber and other resources. With a goal of closing the knowledge gap in traditional wisdom regarding the usefulness of wild plants and unlocking the resources' hidden potential for appropriate use, assessment of nutrition and exploitation. The poor families used these weeds abundantly during the season and also they dried them for off season use. The nutritional studies show these weeds are rich in protein, Ca, P, Mg, Mn, Cu, and Zn content more than domesticated green vegetables. Thorough investigation indicated that these plant species are used to cure diseases like diarrhoea, dysentery, gonorrhoea, rheumatism, headache fever, ulcer, cough, jaundice, blood purification and boils, etc. The conclusion of the study is that edible weeds can be proved to be good sources of nutrients for human consumption. Further work is needed on the chemical composition of all weeds used as human diet.

"Sustainable agriculture is not just about growing crops, it's about caring for the soil, the water, the air, and all the living things that depend on them."

Vandana Shiva

ANTAGONISTIC ACTIVITY OF 2,4-DIACETYLPHLOROGLUCINOL ISOLATED FROM *Pseudomonas aeruginosa* OD13: A POTENT ALTERNATIVE FOR MANAGEMENT OF *Ralstonia solanacearum*

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2,4-Diacetylphloroglucinol (DAPG) is a highly significant polyketide metabolite produced by different strains of Fluorescent Pseudomonads (FPs) and plays a major role in controlling broad spectrum of plant diseases. These diseases include bacterial wilt, caused by *Ralstonia solanacearum*, which leads to substantial yield losses in tomato crops ranging from 0 to 90%. In this study, the antibiotic compound DAPG isolated from *Pseudomonas aeruginosa* OD13 exhibited promising results in combating bacterial wilt caused by *Ralstonia solanacearum*, particularly in tomato plants. At a concentration of 50 µg/ml, DAPG exhibited significant antibacterial activity with a zone of inhibition 13.75 mm against *R. solanacearum*. The application of DAPG via foliar spray demonstrated its potential as a biocontrol agent, showcasing a 30.00% disease incidence rate and an impressive biocontrol efficacy of 67.36%. Moreover, beyond its antibacterial properties, DAPG positively influenced plant growth. It enhanced the germination rate by 75% and stimulated the development of both shoots and roots in the tomato plants. These findings suggest that DAPG derived from *Pseudomonas* possesses dual benefits: effective antibacterial action against *R. solanacearum* and the ability to promote plant growth. Consequently, it emerges as a promising solution for addressing the challenges associated with biocontrol agents' viability. Moreover, the study indicates that DAPG could potentially serve as a safer and more efficient alternative in combating bacterial wilt in tomato plants, showcasing its potential as a viable option for agricultural applications.

Keywords: 2,4-DAPG, Bacterial Wilt, Tomato Plant, Biocontrol Agent

CONSERVATION GENETICS STUDY OF NALIA ECORACE OF TASAR SILK WORM *Antheraea mylitta* DRURY FOUND IN ODISHA

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Tasar culture or the culture of Tasar silkworm *Antheraea mylitta* Drury provides livelihood to poor tribal people and also earns foreign exchange for our state and country. In the past few decades, there is substantial deterioration of natural habitats due to many anthropogenic activities. This has resulted in large decline in wild tasar cocoon production. Lepidopterans are accepted as ecological indicators of ecosystem health and it is apprehended that through anthropogenic and climatic factors this precious genetic resource, which took millions of years to evolve, may face the threat of extinction in near future if adequate conservation measures are not taken. Since the genetic resource are the wealth of the nation and also they harbour many genes and alleles developed through centuries by the process of natural selection. Through appropriate conservation and sustainable utilization plans, these genetic resources can be exploited in a better way for human welfare. At International and National level there is no report on conservation genetics of the Nalia ecorace of tropical tasar silkworm. *A. mylitta* Drury which is now being used as a commercial source of Tasar silk in Odisha after the Modal ecorace. Keeping this in view, this paper was designed to study the Nalia tasar silkworm ecorace/genetic resource available in Odisha and ascertain the extent of variability in existing populations with respect to ecological niches through morphological and genetic characterization and ascertain the status of this highly commercially important ecorace in conservation view point

Keywords: *Antheraea mylitta*, Nalia Ecorace, Genetic Resource, Conservation Genetics

EXPLORING THE VARIABILITY IN THE ANDROGENIC RESPONSE OF A X R AND B X R LINES: A COMPARATIVE STUDY FOR DOUBLED HAPLOID DEVELOPMENT

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In the present study, we have undertaken a comparative analysis of the androgenesis efficiency between A x R and B x R progeny within the context of a three-line hybrid rice system. In a three-line hybrid system, A x R leads to heterosis resulting in the production of hybrid rice while B x R crosses envisioned to develop superior maintainer or restorer lines. Yet, the development of doubled haploids (DHs) in *indica* rice hybrids using the combination of B lines (maintainer lines) and R lines (restorer lines) has not been exploited significantly. We aimed towards the generation of DHs from both B × R lines and their corresponding A × R counterparts. These results hold promise for the utilization of DHs in the generation of new diverse parental lines within a short period. Among the various combinations of media tested, the combination of N6 medium supplemented with 2,4-D (2.0 mg/L) and BAP (0.5 mg/L) after 7 days of cold pre-treatment and MS medium supplemented with NAA (0.5 mg/L), BAP (2.0 mg/L), and Kn (1.0 mg/L)was identified as the most effective and optimal for callus induction and shoot regeneration, respectively. The cross-A x R showed both, the highest callus induction frequency (47.63%) and the highest green shoot regeneration frequency (80.34%) while the addition of proline (5mg/L) to MS media in B x R cross, doubled its green regeneration frequency (35.5% to 70.1%). The present study validates, for the first time, a comparative assessment of an efficient anther culture technique utilizing F_1 hybrids derived from crosses between (A x R) and (B x R) genotypes. Additionally, it examines the influence of cytoplasmic sterility factors on androgenesis.

Keywords: A x R, B x R, Doubled Haploids, Shoot Regeneration, Callus Induction

DECIPHERING THE MOLECULAR DIVERSITY AND POPULATION STRUCTURE OF *Sarocladium oryzae* USING HYPER VARIABLE SSR MARKERS

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Rice sheath rot, caused by the fungus *Sarocladium oryzae*, has recently emerged as a significant rice disease. This pathogen displays substantial variability in the field, and the availability of limited information hampers the development of effective strategies to manage this disease. A total of 87 *Sarocladium* isolates had been isolated from different rice-growing regions of Odisha which were confirmed at the molecular level by sequencing ITS region. The amplification of ITS1/ITS4 yielded a uniform 550 bp band across all isolates. Subsequently, these bands were extracted and sequenced, and the resulting sequences were compared with previously deposited sequences of *S. oryzae* in the GenBank database. The sequences exhibited a homology of 98-100%, confirming their identity as belonging to *S. oryzae* and the generated sequences have been submitted to the NCBI GenBank. Phylogenetic analysis of the *S. oryzae* ITS sequences were carried out revealing three distinct clusters. In the present study, hyper-variable Simple Sequence Repeats (Hv-SSR) markers were utilized for the first time to examine the genetic diversity of the pathogen. Gene diversity ranged from 0.409 to 0.641, while the major allele frequency varied from 0.448 to 0.736. The Polymorphic Information Content (PIC) values ranged from 0.325 to 0.569, with an average of 0.457. Pathogenicity for *S. oryzae* isolates was assessed, SR13 recorded the maximum PDI of 92.58%. Based on pathogenicity results, the *S.oryzae* isolates were grouped as highly virulent (9), virulent (20), moderately virulent (42) and less virulent isolates (16). The findings of this study can be used to develop more effective strategies for disease control and enhance resistance to rice sheath rot through the development of new resistant varieties using marker-assisted breeding.

Keywords: *Sarocladium oryzae,* SSR markers, *In silico* analysis, Molecular Diversity, Pathogenecity

ENHANCING GROWTH AND QUALITY OF MD-2 PINEAPPLE FRUITS THROUGH PLANT GROWTH REGULATORS

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An investigation was undertaken to assess the influence of plant growth regulators (PGRs) on the growth and quality characteristics of MD-2 pineapple fruits. The study was conducted (2020-21) at the Central Horticultural Experiment Station in Bhubaneswar, India. Employing a randomized complete block design with three replications, each comprising 25 plants, the experiment aimed to elucidate the effects of naphthalene acetic acid (NAA), gibberellic acid (GA), and brassinosteroid (BR) treatments administered at the flower initiation stage, with water serving as the control. After fruit ripening, detailed analyses were performed on various growth and quality parameters.

The findings showcased substantial improvements in both yield and quality attributes of pineapple fruits following the application of naphthalene acetic acid (NAA) and gibberellic acid (GA). Particularly noteworthy was the effectiveness of NAA at a concentration of 200 mgL^{-1} (T3), which significantly enhanced parameters such as absolute growth rate (2.65 g day^{-1}), fruit weight (1.58 kg), and fruit-to-crown ratio (6.38). Moreover, this treatment demonstrated superior fruit quality, evidenced by increased levels of soluble solids (17.67 °Brix), soluble solids to acid ratio (19.49), reducing sugar (3.54%), and total sugar content (12.38%). Additionally, it led to increased pulp content (73.89%), pulp-to-peel ratio (3.49), and juice content (54.50%).

In conclusion, the application of NAA at a concentration of 200 mgL-1 significantly improved fruit growth parameters and enhanced various quality attributes of pineapple fruits. These findings highlight the potential of NAA as a promising tool for improving the yield and quality of MD-2 pineapple fruits.

Keywords: MD-2 Pineapple Fruits, Naphthalene Acetic Acid, Gibberellic Acid, Yield

MULTIPLE MARKERS BASED HPLC-DAD CHEMICAL FINGERPRINTING AND QUANTITATIVE ANALYSIS OF *Cinnamomum tamala* COLLECTED FROM WESTERN HIMALAYAN REGION FOR QUALITY ASSESSMENT AND CHECKING OF ADULTERATION

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Cinnamomum tamala (Lauraceae), is an economically important plant having numerous applications in medicine, food and cosmetic industries. The demand for its leaf and bark is increasing day by day, which leads to large-scale species admixture and adulteration in the global market. The present investigation is designed for developing a validated HPLC-DAD (High-performance liquid chromatography coupled with diode array detection) method and multiple markers-based chemical fingerprints for quality evaluation of *C. tamala* leaf extracts. Twenty-eight (28)leaf samples of *C. tamala* collected from its native habitat in Western Himalayan region of India covering states/UT of Himachal Pradesh, Uttarakhand and Jammu & Kashmiris were selected for the study and five bioactive compounds, *viz*., coumarin, cinnamyl alcohol, cinnamic acid, cinnamaldehyde and cinnamyl acetate were identified and quantified. The chromatographic separation was achieved on Shimadzu Shimpak C18 column with a gradient elution of mobile phase using acetonitrile and 0.1 percent phosphate buffer and the chromatograms were obtained at a wavelength of 265 nm. The content of target compounds such as coumarin, cinnamyl alcohol, cinnamic acid, cinnamaldehyde and cinnamyl acetate varied in the range of 0-1.09, 0-0.05, 0.07-0.51, 0.39-1.27 and 0-0.27percent, respectively. In the chemical fingerprint of *C. tamala* leaves, a total of 13 peaks were assigned as common peaks. The results of the study revealed that the HPLC method now developed combining chemical fingerprint with quantification of analytes could serve as a useful tool for quality evaluation of herbal raw materials of *C. tamala* and a valuable reference for further study.

Keywords: HPLC, Chemical Fingerprint, Quality Control, Herbal Products, *Cinnamomum Tamala,* Medicinal Plant

pH-RESPONSIVE COLORIMETRIC LABEL UTILIZING IMMOBILIZED ANTHOCYANINS ON STARCH-BASED FILM FOR FRESHNESS MONITORING OF PACKAGED FOOD

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Starch are the edible biopolymer and its utilization in the food packaging application has been explored in these days. A novel edible colorimetric label has been developed for determining the freshness level of perishable food items. The label comprises anthocyanins extracted from flowers such as *Butea monosperma* and *Bombax ceiba*, immobilized onto an edible film composed of starch with polyvinyl alcohol (PVA). The influence of anthocyanin on colour response was investigated, alongside FTIR analysis, thickness, water content, mechanical properties, antioxidant activity, and water vapor permeation through the films. Various freshness parameters including pH, weight loss, texture, and sensory evaluation also were characterized. Results demonstrated that the colorimetric label exhibited a dark orangish-red to dark red hue when prawn and chicken meat were fresh, transitioning to light purple for fresh mushrooms, and ultimately turning green when the sample was no longer fresh. The addition of more starch resulted in increased tensile strength, contact angle, and water vapor permeability (WVP) of the films, while elongation at break and water content decreased. FTIR analysis indicated interactions between starch and the PVA matrix, suggesting potential changes in film properties due to these interactions. The incorporation of anthocyanins led to a significant enhancement in the antioxidant properties of the PVA films. The total volatile alkaline nitrogen and pH value of the food mimics were monitored after 4 days of refrigeration. This edible label effectively distinguishes fresh food samples from spoilage, thus making it suitable for integration into packaged meat products as a freshness indicator.

Keywords: Food Packaging Film, Biopolymer, pH Indicator, Anthocyanin, Intelligent Packaging

ECONOMIC, NUTRITIONAL SECURITY AND AGRO-DIVERSIFICATION APPROACHES OF UNDEREXPLOITED CROPS FOR TRIBAL PEOPLE IN INDIA

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The world's population is expected to reach nine billion by 2050. Simultaneously India is one of the most populous countries of the world and accounts for about one fifth of the world's population. Therefore agriculture is under tremendous pressure to produce more food, animal feed, and biofuel on the finite land resources of the planet, specifically the tribal people of India suffer more from acute malnutrition, variety of nutrient-deficiency illnesses as well as livelihood insecurity. Only by effectively utilising the nutritional and therapeutic qualities of underexploited horticultural crops will meet the future demand. Moreover cheap, readily available, and in-season fruits and vegetables help to maintain population health and nutritional security more effectively than expensive and out-of-season produce. India has wide diversity of underutilized minor horticultural crops such as *Taro*, Yam bean, Tamarillo, Chow chow, Under-utilized leafy vegetables Alligator weed, Spiny amaranth, Creeping wood sorrel (Amrul) and fruits like karonda, Himalayan silver berry, mulberry, egg fruit and rose apple. However there is a lack of strategic development and appropriate policies therefore through the agro-diversification approaches like incorporation of these crops into existing agricultural system, subsidies, promotion and sensitization programmes on unexplored plant species would contribute towards the nutritional security, dietary and culinary diversification, health and income generation of tribal people.

Keywords: Agro-diversification, Underexploited Horticultural Crops, Tribal Nutritional Security

FINGER MILLET LANDRACES FROM KORAPUT: POTENTIAL FOR TRIBAL FOOD AND NUTRITION SECURITY

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Finger millet (*Eleusine coracana* (L.) Gaertn) is a nutrient-rich valuable crop generally grown and consumed by subsistence farmers in Asia and Africa. Koraput valley of Eastern Ghats of India is one of the agro-biodiversity hot spots in India and home to huge number of traditional finger millets. The traditional varieties grown by the farmers are likely to be lost shortly if measures are not taken to protect the valuable genetic resources. Based on drought tolerance Screening, six finger millet genotypes (*Ladu*, *Lala*, *Bati*, *Biri*, *Tumuka* and *Bhalu*) showed superior drought tolerance response compared to the tolerant check genotypes. These genotypes are identified as drought-tolerant genotypes of this region suited for cultivation in drought prone areas and can be used in future finger millet breeding programs for drought tolerance. Based on the nutritional evaluation, indigenous finger millet genotypes like Bhalu, Ladu, Telgu and Bada are identified for better panicle traits and grain yield at par with the improved varieties. Further, enhanced level of nutritional compositions and energy was recorded in Telgu, Bada and Dushera, whereas exceptional rich in flavonoid and antioxidant capacity was recorded in Mami. These genotypes indicated its nutritional superiority than other and might be reliable food and nutritional security crops for tribal people of the locality.

Keywords: Antioxidants; Grain Yield. Traditional Finger Millet. Panicle Architecture

NUTRITIONAL VALUE OF SOME WILD EDIBLE PLANTS USED BY TRIBALS OF ODISHA

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Tribal people have developed a profound knowledge of the local flora, particularly the nutritional value of numerous wild food plants because they frequently reside in remote and biologically varied areas. The tribal people live near the natural

world and have a longstanding custom of using wild plants and their byproducts, such as fruits, shoots, leaves, tubers, and other plant parts, as nourishment. In many rural parts of the world, these wild edible plants have been crucial in improving the nutritional and food security of impoverished populations and their general health. To address the dietary needs of tribal communities, this study examines the value of wild edible plants, emphasizing their significance in promoting sustainable lifestyles and ensuring food security. The study reveals the wide range of edible wild plants used for sustenance, shedding light on the extensive traditional knowledge passed down through the ages within tribal groups. These plants' essential macro and micronutrients complement conventional food crops nutritionally. To learn more about how wild edible plants can improve general health and fight hunger in tribal cultures, researchers are examining the nutritional makeup of these plants. In addition, research is conducted to ascertain the long-term sustainability of gathering wild edible plants. The study evaluates the resilience and potential for regeneration of wild plant species while accounting for aspects like ecosystem health and biodiversity preservation. Research is being done to support community-based conservation initiatives and sustainable harvesting methods to guarantee the availability of these priceless resources for future generations.

Keywords: Biodiversity, Nutrition, Tribal, Traditional, Wild edible

GROWTH AND YIELD OF CROPS UNDER SOME AGROFORESTRY SYSTEMS

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Agroforestry systems integrating fast growing timber species and pulse crops are remunerative. An experiment was carried out at JNKVV University Jabalpur, Madhya Pradesh in 2021-2022 and 2022-2023 integrating *Gmelina arborea* with arhar, cowpea and greengram. *G. arborea* trees were 6-year and 7-year old, respectively in both the years of experimentation and planted at 8.0 m x 2.5 m spacing. Height of tree in year 1 ranged from 4.02 to 4.72 m and in year 2 it was 5.04-5.84 m. In both the years, *G. arborea* with Greengram (T_3) registered maximum values. DBH at 6 year old varied from 7.22 to 9.02 cm with highest value under T_3 and in the 7 year similar trend was obtained and it varied from 8.34 to 10.54 cm. In 6-year age, the total biomass of tree was maximum (179.80 q/ha) under T_3, whereas the sole tree (T_4) produced the lowest amount (141.50 q/ha). In 7-year age, the total biomass production of tree varied from 165.33 to 191.71

q/ha under different systems. Regarding growth of crop plants, with 6-year trees height values ranged from 48.3 to 104.7cm. Arhar sole (T_5) registered the maximum value whereas Greengram with tree (T_3) registered the lowest value. In 1st year of study it was observed that arhar in open (T_5) condition exhibited highest quantity of grain yield (9.04 q/ha) and greengram with tree (T_3) registered the lowest quantity (7.02 q/ha). In 2nd year of experimentation similar finding was obtained, but the values with tree (T_1, T_2, T_3) were slightly lesser than their corresponding values of previous year. It ranged from 6.94 to 9.26 q/ha.

Keywords: Agroforestry, *Gmelina arborea*, Arhar, Cowpea, Greengram, DBH

IMPROVED AGRONOMIC PRACTICES TO ENHANCE THE PRODUCTIVITY OF TRADITIONAL FINGER MILLET VARIETIES (*Eleusine coracana* l. Gaertn): EXPERIENCES FROM EASTERN GHATS OF KORAPUT DISTRICT, ODISHA

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Low productivity and poor market realization are the major constraints faced by millet farmers across India. This necessitates identification of best practices to raise productivity and income from millets. This article illustrates the improved farming methods adopted in finger millet cultivation for enhancing productivity of three finger millet landraces. The demonstrations were carried out during Kharif seasons in three villages namely Machhara, Podheiguda and Chapper, in Koraput district, Odisha, India during 2018-19. Demonstrations on traditional finger millet verities were carried out by the millet farmers with the objective to enhance the productivity through improved farming practices. The improved method applied in transplanting of seedlings with right spacing and proper weed management. Demonstrations were recorded biometric parameters, organized farmers' exposure visit, yield and expenditure analysis in comparison with farmers' practices. It is observed from the biometric data that the improved method resulted in higher yield in case of Bada mandia(1640kg/ha), Bati mandia(1470kg/ha) and Kurma bati(560kg/ha)compared to the yield of these varieties under farmers' practices i.e. Bada mandia (880kg/ha), Bati mandia(910kg/ha) and Kurma bati(910kg/ha). The improved practices provided higher gross return and net return with a higher benefit-cost ratio against farmers' practices.

Keywords: Finger millet (*Eleusine coracana* l. Gaertn**)**, Crop Cutting, Demonstrations, Biometric And Conservation

MEETING THE CHALLENGE OF FOOD SECURITY: SEARCHING FOOD RESOURCES IN THE WILDERNESS

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Food is the first among the hierarchical needs of human beings. A sufficient balanced diet is the most important contribution for human health and well-being. All countries in the world have been striving to be self-sufficient in food production. India with only 3% of the world's arable land feeds 17% of the world population. However with decline in area under cultivation because of urbanization and industrialization, the production in India has failed to keep up with population growth and consequently per capita availability has come down to less than 400 gms per day over the last two decades. Though India is one of the largest producers of the food grains in the world, it has nearly 300 million people who sleep without two square meals a day. Several strategies such as the breeding process, dietary diversification, pharmaceutical preparations, bio-fortification etc. are being pursued to meet the dietary need. However, one of the easiest ways is to search for the potential sources in the nature. A number of wild plants rich in nutrients are traditionally used by rural and tribal people make important contributions to food basket ensuring food security along with livelihood for major communities around the world.

A study carried out to assess the diversity and consumption pattern of wild plants as food by tribal communities of Koraput districts of Odisha in a systematic manner, documented 112 wild plant species distributed in 86 genera spread over 51 families. The plant species recorded include 26 trees, 03 shrubs, 68 herbs and 15 climbers/creepers. Out of 112 plant species recorded, 83 are used as green leafy vegetables and others as edible fruits, tubers, seeds etc. either as raw or cooked form. The plants used widely as leafy vegetables include *Achyranthes aspera, Alternanthera sessilis, Centella asiatica, Bauhinia purpurea, Emilia sonchifolia, Hibiscus sabdariffa, Mitracarpus hirtus* etc. Similarly plants such as, *Dioscorea, Madhuca longifolia, Coccinia grandis, Ficus hispida,* etc. are important for consumption of their edible parts like tuber, flower, fruit etc. In addition to their dietary uses, many plants species do have medicinal values as well.The study tries to provide baseline data which could be useful for prioritization of conservation, besides sustainable use and management of the resources keeping the regional food security in view.

Keywords: Food security, Wild food plants, Tribal Communities, Leafy Vegetables

HARNESSING THE POTENTIAL OF WILD BRINJAL RELATIVES FOR CLIMATE RESILIENCE

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Brinjal (*Solanum melongena* L.) and its wild relatives have an unprecedented demand across the globe. India is the principal source of brinjal genetic resources. India is the second-largest producer of eggplants after China, accounting for global production of 12.4 million tonnes. The diverse brinjal varieties are loaded with multi-vitamin complexes such as vitamins (A, B, and C), and minerals like calcium, iron, and phosphorus, which are highly beneficial for human health. However, the overall impact of climatic conditions on crop production and resistance is expected to be unfavourable under abiotic and biotic stress. Focusing on the crop wild relatives (CWR), which are hostile species with inherent tolerance towards various climatic conditions or stresses such as drought, salinity, heavy metals, high temperature and disease, we have attempted to explore the potential of brinjal wild relatives to biotic and abiotic stresses. In this work, we focused on using short gene sequences (400–800 bp) from the nucleus (*ITS2*) and chloroplast–plastid (*Kim matK*) at the DNA barcode region to distinguish between 13 wild brinjal relatives based genomic characteristics, followed by predictions of their secondary structures at *ITS* region. We have also characterized the early responsive consequence of wild brinjal to *Ralstonia solanacearum,* causing bacterial wilt in relation to antioxidant activity, reactive oxygen species and enzymatic assays. A detailed study on morpho-physio-biochemical traits was investigated to isolate drought and salinity-tolerant lines in wild brinjal under induced stress conditions. Our study will aid in genetic discrimination, biodiversity conservation, and the safe use of wild eggplants to improve crops for harsh environments.

Keywords: Wild Brinjal, DNA barcoding, *Ralstonia solanacearum*, Drought, Salinity

EFFECT OF ORGANIC COMPOST ON THE ANTIOXIDANT PROPERTIES OF CHICKPEA PLANT (*Cicer arietinum*)

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In the nineteenth and early twentieth centuries, plants were a central focus of investigation in the early studies of life processes. In addition to enriching our intellectual life, this research contributes to our understanding of other biological processes. Plant systems can also provide insight into agricultural, health, and environmental problems and how to solve these issues. This study aimed to compare the antioxidant activity of Chickpea plants (Cicer arietinum) with organic compost added to normal soil. A complete block randomised design was used three times in the experiment. A 16-week experiment revealed that organic compost improved antioxidant activities in Chickpea leaves and seeds compared with normal soil. As a result of using organic compost, nitrate levels were also reduced. A concentration of 90 kg N/ha was also observed to have the highest DPPH and ABTS activity levels. The results indicated that using green vegetable compost can improve the antioxidant activity of the plant.

Keywords: *Vigna radiata*, Compost Effects, Antioxidant Activity, Vegetable Compost

EFFECT OF PHENOTYPIC TRAITS ON ITS BIOACTIVE CONSTITUENT YIELDS TO IDENTIFY ELITE GENOTYPES OF BLACK TURMERIC

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Black Turmeric (*Curcuma caesia* Roxb.), valued for its pharmaceutical and industrial promise, is underutilized in cultivation despite its variability in traits and secondary metabolites. To bridge this gap, the present investigation dealt with a correlation analysis between phenotypic parameters and bioactive constituent yields to identify elite genotypes. The Koraput genotype displayed tall plant height (138cm), long rhizome length (10.2cm), abundant leaf biomass (450g), and high anthocyanin content (7.14%). Deoghati and Maliguda genotypes had remarkable leaf surface areas (748 cm^2 and 747 cm^2, respectively). Additionally, Deoghati and JK Pur genotypes exhibited high rhizome oil yield (2.55%) and oleoresin content (14.2%), respectively. GC-MS analysis revealed eucalyptol as the predominant component of leaf essential oil, with the Puri genotype exhibiting the highest concentration (31.6%), while camphor was identified as the major constituent of rhizome essential oil, predominantly found in the Cuttack genotype (38.9%). Correlation analysis indicated the influence of physical parameters on yield attributes, with variations observed in phytoconstituent yields among genotypes. Despite similar oil compositions, compound percentages varied across genotypes. The study identifies elite genotypes from different geographical regions, such as North Eastern Ghat (JK Pur), Eastern Ghat highland (Koraput and Deoghati), and South Eastern Ghat (Maliguda), for optimal growth and yields. Additionally, genotypes from East and South Eastern Coastal Plain (Cuttack, Puri) are recommended for their potential in Eucalyptol and Camphor production. By identifying suitable agroclimatic zones for cultivation, this research aims to promote the sustainable utilization and conservation of Black Turmeric, thereby enhancing its medicinal properties and economic value.

Keywords: Black Turmeric, Agroclimatic zones, Physical parameters, Bioactive constituents, Elite genotypes, Coefficient correlation.

PHYTOTOXICITY AND STABILITY EVALUATION OF COMPOST PRODUCED FROM CHICKEN MANURE AND JATROPHA SEED CAKE

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The application of toxic and unstable material in soil can be detrimental to plants and can lead to land, water and air quality problems. Stability and maturity evaluation is important to assess the safety of a compost. This study evaluates the phytotoxicity and stability of compost produced from co-composting of chicken manure and jatropha seed cake. 11 kg of feedstock materials (66.2 % of JSC and 33.8 % of CM) was thoroughly mixed and composted in a bioreactor of with operating volume and height-to-diameter ratio 15, 000 cm^3 and 2 respectively for 30 days. The Germination Index was evaluated on maize seeds grown in compost and control extracts for 72 hrs. Carbon was analysed using standard method while Nitrogen was obtained using Khadjel method. Germination index surpassed 80 % in 30 days of composting and. Stability and maturity indices values (C/N ratio = 6.69, TNO_3^+ - N = 68 ppm) indicated a good level of maturity and stability of the produce compost. It can therefore be concluded that the produced compost is safe for land application.

Keywords: Phytotoxicity, Stability, Compost, Chicken Manure, Jatropha seed cake

GINGER GERMPLASM COLLECTION, CHARACTERIZATION, EVALUATION, AND CONSERVATION IN EASTERN GHAT HIGH LAND ZONE OF ODISHA

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Field experiments were carried out during the Kharif seasons of 2020-21, 2021-22 and 2022-23 in the Eastern Ghat High Land zone at the research farm of High-Altitude Research Station (Odisha University of Agriculture and Technology), Pottangi, Koraput, Odisha to evaluate the performance of earlier collected 198 ginger germplasm from across the country in Augmented Block Design. It was revealed from the pooled data analysis that, out of 198 ginger germplasms studied, 42 accessions gave more than 10 Kg/3m^2 fresh rhizome yield, the range of plot yield being 2.2 Kg(PGS-34) to 19.0 Kg/3 m^2 (PGS-36) with the mean yield of 5.2Kg /3 m^2 in tested germplasms. The highest fresh rhizome yield was recorded by PGS-36 (19.0Kg/3 m^2) followed by S-692 (16.5 Kg/3 m^2), Tura local (14.8 Kg/3 m^2) , Tura Local-1(14.3 Kg/3 m^2) , S-642-1(12.5 Kg/3 m^2), GCP-31(12.0 Kg/3 m^2), PGCAL-1(11.5 Kg/3 m^2) etc. The clump weight of germplasms varies from 110g (S-554) to 450g (PGS-36) with a mean value of 204.6g. China (88.5cm) was the tallest among all. KG-132(13.0) had the highest number of tillers per clump. V_1K_1-1 (15.2cm) had the longest fully opened last leaf. GCP-5(2.5cm) had the wider leaves.

Keywords: Germplasm, Ginger, Eastern Ghat Highland Zone, Pottangi

Theme-II Biodiversity and Conservation

AVIFAUNAL DIVERSITY IN AND AROUND THE BANDIPUR NATIONAL PARK, KARNATAKA: A COMPARATIVE STUDY

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Bandipur National Park, a part of the Nilgiri Biosphere Reserve is located in the Indian state of Karnataka. It is located where the Deccan Plateau meets the Western Ghats, a global 'biodiversity hotspot'. It harbours a variety of biomes including dry deciduous forests, moist deciduous forests and shrublands making it the heaven for a diverse range of organisms especially avifauna. But anthropogenic intervention has led to the habitat degradation and loss of biodiversity. Objective of the current study was to record and compare avian densities and their community structures at the forest edges and the areas with human settlement and tourist activities around the national park. A total of 64 bird species belonging to 18 families were recorded from the area. Avian diversity and density was found to be more in the forest edges with representing 15 families when compared the areas with human settlements representing only 8 families. Study areas with open canopy with much vegetation intergradations sheltered avian community of high diversity. Community structure analysis with diversity indices also supported the current findings. More intensive study is required to find out the impact of anthropogenic activities on the avian diversity, distribution and abundance in this biodiversity hotspot.

Keywords: Avifauna, Hotspot, Bandipur National Park, Western Ghats, Diversity Indices

CHANGE IN MACROFAUNAL DIVERSITY AND COMPOSITION IN DIFFERENT LAND USE PRACTICES IN THE SEMI ARID REGION OF EASTERN INDIA

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The loss and fragmentation of natural habitats posed a major threat to ecosystems and biodiversity globally. It assumes that land-use impacts propagate through cascading bottom-up mechanisms. Soil macrofauna is an important group of below-ground ecosystems that perform many critical ecosystem services and soil nutrition processes. Considering the relationships between soil macrofauna abundance, soil management, and environmental disturbance, soil macrofauna

can be a useful as tool for monitoring soil sustainability and environmental health. This present research was carried out to evaluate the impact of edaphic and climatic conditions on soil macrofaunal diversity and composition in different land use practices in the semi-arid region of Eastern India. Seasonal studies were conducted in the year 2022–2023. Soil macrofauna were collected using a pitfall trap, line transects, and hand-shorting sampling approach and the TSBF protocol was used for soil sampling and analysis. The ANOVA shows that there is a significant difference in macrofaunal abundance at different land use sites ($F(2, 63) = 43$, $2\ p < 0.01$). According to the PCA analysis, ecological indicators such as termites and earthworm ants exhibit strong correlations with soil organic carbon (%), available phosphorus (Kg/ha), and bulk density, which explain with PC1 and PC2 shown 41.6% and 15.1% variance of total variance, respectively. The nMDS analysis shows that soil community assemblage changes with season and land use management.

Keywords: Soil Macrofauna, Ecosystem, Eastern India, Land Use

VERTEBRATE DIVERSITY OF CHANDAKA FOREST OF ODISHA, INDIA

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Vertebrates are the dominant group of animals on the earth, given their abundance, large body sizes and presence at the top of both aquatic and terrestrial grazing food-chain. Chandaka forest of Khurda District, is centrally located in the state of Odisha being the part of Eastern Cost of Indian Peninsula. It is rich in natural resources and has varied and wide spread forests harbouring dry deciduous, moist deciduous as well as mangroves with several unique, endemic rare and endangered flora and fauna. In the present study, field visits were carried out during 2012 documented the most common wild animals including 17 species of fishes, 13 species of Amphibians, 23 species of reptiles, 26 species of birds and 35 species of mammals. Endangered and vulnerable species of Pisces, Amphibians, Reptilians and Mammals have been marked. Deforestation, shifting cultivation, forest fires, grazing, tribal hunting, wildlife trading, biotic interference, natural calamities, hemp plant cultivation by tribals, stone collection firewood business, and shifting cultivation most often cause environmental crisis upholding the signs of stress in Chandaka Forest. Chandaka forest act as a critical repository of Eastern Ghat tropical forest of India. The current rate of deterioration demands conservation of the rich biodiversity of Chandaka Forest and its sustainable development is the need of the hour.

Keywords: Endangered, Ethnic Tribes, Waterfalls, Human Dimensions, Bow And Arrow, Human-Animal Conflict

BIODIVERSITY OF LOACHES FROM WATERBODIES OF KORAPUT, SOUTHERN ODISHA, INDIA

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The present study was carried out from September 2017 to August 2021 to find out biodiversity of loaches in three seasons (Pre-monsoon, Monsoon, and Post Monsoon) from different water bodies of Koraput district, southern Odisha. A total of five species of loaches under two families and four genera were recorded from five different water bodies; four hill streams (Deomali-S_1, Dudhari-S_2, Rani Duduma-S_3 and Gupteswar-S_4) and a river stretch (Ghatguda-S_5). Loaches of the family Cobitidae have ornamental values whereas others are of no interest to fisheries. The present study added two species *Indoreonectes evezardi* and *Paracanthocobitis mackenziei* from the family Nemacheilidae to the existing list of ichthyofauna from the district. All the species showed preference to riffles and pools as primary habitat with diverse substrate composition of Sand, mud, gravels, pebbles, cobbles, boulders and bedrocks. Restricted distribution of the above two loaches in the hill streams (S_1 and S_2) and the river stretch (S_5) respectively indicated their preference to particular habitat types. In this study, the one-way ANOVA showed no significant difference in species abundance in three seasons while diversity, richness and evenness indices showed significant difference in three seasons.

Keywords: Loach, Biodiversity, Koraput, Southern Odisha

IMPACT OF UNSUSTAINABLE AGRO PRACTICES IN BLACKBUCK HABITATS OF GANJAM: AN OVERVIEW

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A recent report by WWF indicates a 69% average decline in wildlife populations globally since 1970, thereby posing unprecedented challenge in management of habitats inhabited by wildlife. Habitat destruction, overexploitation, deforestation, land use changes, agricultural expansion cum intensification and unsustainable agro-practices are the leading causes of biodiversity decline (including many free ranging species) in South-east Asia and particularly in India. The known predominant habitats of blackbuck (*Antilope cervicapra)* in Ganjam district in Odisha has been under such anthropogenic pressures. The unsustainable farming practices (agricultural expansion and intensification) are potential enough to exert stress (physical and chemical) on blackbucks and their habitats in Ganjam, Odisha.

Reportedly, the use of chemical pesticides has increased by 23% in 2022-23 in Odisha, as per the Govt. of India records. Most of the blackbuck inhabited areas in Ganjam is predominantly farming landscape and are under crops, legumes, oil seeds, economical crops (e.g. sugarcane, Cotton), vegetables. Based on the available literatures, the food preference of Blackbucks is *Oryza sativa* (Crops), *Phaseolus radiatus* (Pulses), *Arachis hypogea* (Oil seeds) *and Lycopersicon esculentum* (Vegetables). Approximately (56.66%) of Blackbuck population prefer farming landscape as their habitat. To accomplish the UN SDG2 (zero hunger) it is essential to boost agricultural production through modern agricultural practices. Consequently, the utilization of pesticides became an unavoidable necessity and the trophic levels (soil and vegetation) establish the exposure pathway of the pesticides to blackbuck. The preliminary visit to the area confirms the application of different groups of synthetic pesticides (e.g. organochlorines, organophosphates) in the farmlands, especially in the cash crop farm. Thus, a review of the available records was made to provide better insights on the unsustainable agro-practices in the area, and their potential impact on blackbuck population and their habitats.

Keywords: Biodiversity, Blackbuck Habitats, Organochlorine Pesticides, Unsustainable Agro-Practices

ETHNOMEDICINAL PLANTS USED TO CURE THE GYNAECOLOGICAL DISORDERS BY THE LOCAL PEOPLE OF BARGARH DISTRICT, ODISHA, INDIA

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The present study deals with survey and documentation of ethnomedicinal plants used to treat different gynaecological disorders in different villages of Bargarh district, Odisha, India. Bargarh has the location of 21.33°N and 83.62°E having 171 meter (561 feet) of elevation. The study site is mainly inhabited by tribal people. The field survey was conducted during the period of 2022-2023. The gynaecological disorders which were taken into consideration for research includes menstrual disorders, gonorrhoea, lactation problem, delivery problem and abortion .The data was collected from traditional healers, medicinal plant part venders and local people of Bargarh district by face to face interviews and questionnaire distribution methods. The plant specimens collected were identified in the laboratory of botany department, Anchal College Padampur by the help of Flora of Odisha (Saxena and Brahmam) and other available literatures. Voucher specimens are prepared and stored. A total number of 35 plant species under 35 genera of 22 families have been collected. The various plant parts are used in the preparation of traditional medicine includes seeds, roots, barks, rhizomes, fruits and whole plants. Plants have the habits of tree, shrub, herb and climber. The different modes of uses involves decoction, paste, powder and juice. Herbal drugs are prepared mixing various additives like milk, sugar candy, molasses, curd etc. and also prepared without adding any additives. Most of the herbal medicines are taken orally. These plant resources are now in threat due to different natural and anthropogenic activities. Hence their conservation is very urgent.

Keywords: Ethnomedicinal Plants, Gynaecological Disorders, Tribal, Anthropogenic Threats to Flora

PRESENT STATUS OF SEAGRASS OF CHILIKA LAGOON, EAST COAST OF INDIA

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In the era of the Anthropocene when seagrass meadows experienced a global declining trend, at the same time in Chilka seagrass experiences spreading on significant manner that measures 33% of the total seagrass area of India. Six species seen in Chilika lagoon namely *Halophila ovalis*, *Halophila beccari*, *Halophila ovata*, *Halodule pinifolia*, *Holodule uninervis*. *Ruppia maritima*. Out of 1000 square kilometres of Chilika premises, around 172 square kilometres are under the sea grass coverage representing 17.2 % of the total lagoonal area. Locations where seagrass grown predominantly viz. Outer channel, the entire southern sector, Nalban Bird Is., Margarmukh, Barunakuda area. Sharp spatio-temporal variation has been marked among the various species. Seagrass also supports varied floral and faunal communities, conspicuous representatives belongs to the benthic invertebrates, fishes and shell fishes, birds and mammals (sea cow *Dugong dugong*). However, our survey (year 2020 to 2022) on Chilka lagoon deciphers plastic pollutions at some localities exhibits gradual augmentation. Instances are marked with the physical disturbances related to boat and fishing operations. A couple of occasion also manifested where polyethene was entangled with seagrass twigs. The cumulative impact of such instance would be drastic and likely to impact in a deprived manner for a prolonged period upon the existing lagoonal biodiversity. Since, sea grass meadows possess eminence ecological functions and ecosystem services thus considered as the suitable indicator of the ecosystem health status. Therefore, appropriate management steps should be taken on a priority basis towards conservation of sea grass meadows in Chilka lagoon.

Keywords: Chilka Lagoon, Sea Grass, Presents Status, Biodiversity And Conservation

VARIATION IN ZOOPLANKTON DIVERSITY WITH RESPECT TO WATER QUALITY

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Zooplanktons are the free-floating organisms which are highly sensitive to environmental variation hence, changes in species diversity or community composition can indicate environmental health. Zooplanktons are also beneficial to economically important fish cultures. They are the primary means of energy transfer between phytoplankton and fish. The present study was undertaken to investigate the zooplankton diversity and water quality in different water bodies (five) in the adjoining area of Bhubaneswar and Cuttack. The physicochemical parameters such as water temperature, pH, salinity, electrical conductivity (EC), total dissolved solid (TDS), and dissolved oxygen (DO) were also measured. Total 41 zooplankton species were identified. The distribution of the species was 15, 14 and 12 for Rotifer, Cladocera and Copepod, respectively. Population-wise, the Rotifer, Copepod, and Cladocera species were dominant. Overall population density of zooplankton was found maximum in pond D with pH value of 7 and DO value 12 mg/l. The data from the present study revealed that pH value has a negative correlations whereas salinity, EC and TDS have shown positive correlations with different groups of zooplanktons observed in the present study. It is known that ponds are ideal for natural pisciculture operations. If suitable water quality control measures were taken, zooplankton could be used constantly for aquaculture as its productivity was high.

Keywords: Zooplankton, Water Pollution, Bio-Indicators, Aquaculture

GREEN SYNTHESIS, CHARACTERIZATION, AND MICROBIAL GROWTH ACTIVITY OF SELENIUM NANOPARTICLES FROM *Azadirachta indica*

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The green synthesis to produce nanoparticles has gained more attention than the physical and chemical methods since this method is clean, non-toxic and environmental friendly. Plants contain a variety of metabolites that are rich in pharmacological components and serve as a bio-reducing medium during SeNP synthesis. Plant-derived nanoparticles use target-oriented medication delivery to effectively combat bacterial strains that have been shown to exhibit multiple drug resistance while also avoiding any harmful side effects. The results of UV-VIS Spectroscopy, FESEM and FTIR analysis revealed that SeNPs were synthesized at

260nm, had spherical shape NPs and phytochemicals such as phenols, flavonoids and amino acids are present in neem extract. These SeNPs showed inhibition of the bacterial growth in the nutrient broth.

Keywords: Green Synthesis, Nanoparticles, Drug Resistance, UV-VIS Spectroscopy, FESEM, FTIR Analysis

EVALUATION OF THE CURRENT STATUS OF FISHES & FISHERIES RESOURCE MANAGEMENT BY USING THE GIS TOOLS LIKE FISH-FINDER AND DATA-LOGGER INCHILIKA LAGOON, ORISSA, INDIA

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This Study evaluate the current status of the fisheries by using GIS tools like fish-finder and data-logger of the commercially important species in theLagooni.e.*Dayscieaenaalbida*,*Eleutheronematetradactylus*,*Etroplussuratensis*, *Lates calcarifer*, and *Mugil cephalus* in the Chilika Lagoon. In total, 4645 of *D. albida*, 3356 of *E. tetradactylus*, 4192 of *E. suratensis*, 1232 individual of *L. calcarifer*, and 3100 of *M. cephalus* were measured with their total length or fork length during the study period. The growth features of these fish species, different cohorts were identified through multiple length frequency analysis on the total (fork) length of these species and their growth curves were estimated. The estimated growth parameters of von Bertalanffy, Linf (cm), K, and t0, was 73cm, 0.15, and -0.36 for *D. albida*; 78.1cm, 0.15, and -0.47 for *E. tetradactylus*; 33.7cm, 0.20, and 0.01 for *E. suratensis*; 118.5cm, 0.15, -0.39 for *L. calcarifer*; 60.6cm, 0.28, and -0.74 for *M. cephalus*. The length at 50% maturity (L_{50}) i.e. the estimated L_{50}s of *D. albida*, *E. tetradactylus*, *E. suratensis* and *Scylla serrata* were 308mmTL, 165mmTL, 315mmFL, and 92mmCW, respectively. The peak spawning seasons of *D. albida*, *E. tetradactylus*, *E. suratensis*, *L. calcarifer*, *M. cephalus*, and *T. Ilisha* were estimated during the months of March to June, November to June, January to December, April to July, September to December, and July to September, respectively. The spawning ground of *E. suratensis* was considered in central and southern parts of the Lagoon, and *T. ilisha*, northern part of the Lagoon. The spawning grounds of *D. albida*, *E. tetradactylus*, *L. calcarifer*, and *M. cephalus* were considered in the sea and in a part of the Lagoon. The information are very important to carry out the fishery resources management of these commercially important species in Chilka Lagoon.

Keywords: Chilka Lagoon, fisheries, GIS, Spawning Seasons

OPEN BILLED STORK INDICATOR OF MONSOON ARE IN RISK

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Open billed stork *Anastomus oscitans* (commonly known as *Gendalia* in Odia), is a species of storks which are largely found in wetlands in India, Sri Lanka and some parts of Southeast Asia. They are highly colonial, and prefer to stay within their native range throughout the year. In a study from January-2019 to January-2024, it was observed that during the breeding season in monsoon, typically from June to December, they migrate to specific locations of Dhanamandal, Jajpur, Odisha, India, returning to the same tree where they've built nests in previous years.

During mating season, Open-billed storks lay eggs in their nests, which may sometimes be shared by multiple storks. They exhibit cooperative behaviour, with one stork guarding the eggs while another searches for food. The eggs typically hatch in September, and after 4 to 5 weeks of parental care, the young storks begin to forage for themselves. They consume a diet consisting of snails, insects, worms, crabs, frogs, lizards, and other aquatic creatures found in paddy fields, wetlands, and canals near the Dhanamandal Railway Station.

In January, young chicks and adults' birds returns back to their feeding place. Openbills stork contribute to the ecosystem health through their dropping which turn as fertilizer for wetland plants that increases the plants growth, crab and other aquatic animals' population. They are considered a symbol of a healthy ecosystem in their locality. Our findings indicate that the use of insecticide in agriculture and loss of wetland due to urbanization are important for gradual decrease of birds year after year. The study recommends for organic farming in the study area to maintain a sound population of these storks.

Look closely at nature. Every species is a masterpiece, exquisitely adapted to the particular environment in which it has survived. Who are we to destroy or even diminish biodiversity?

E. O. Wilson

ASSESSMENT OF BIRD FAUNA, OCCURRENCE STATUS, DIVERSITY INDICES AT CENTRAL UNIVERSITY OF ODISHA, SUNEBEDA

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The bird survey was conducted at the Central University of Odisha, Sunabeda campus and in surrounding area of 5km during the late monsoon and winter seasons, spanning from September 2023 to February 2024. The study aimed to measure avian diversity during these specific periods and understand the occurrence status of bird fauna, diversity indices, and ecological threats to their conservation on campus grounds. Data collection utilized the point count method and trail method. The research findings during this late monsoon and winter survey period revealed significant avian diversity. Despite the seasonal shift, a considerable number of birds were observed, with diverse species represented. Passeriformes continued to exhibit notable diversity within the university campus during these seasons. The diversity indices during this late monsoon and winter survey period showed robust values, with a Shannon-Weiner Diversity Index (H´) of 2.21, Census Index (CI) of 20/Km^2, Simpson's Diversity Index (D) of 0.86, and a bird evenness of 0.55. Regarding the occurrence status of birds at the Central University of Odisha, Koraput during late monsoon and winter seasons, 11 species were classified as very abundant, eight (08) as abundant, 16 as very common, 19 as common, five (05) as uncommon, and three (03) as rare. The seasonal distribution of bird species indicated specific patterns during the late monsoon and winter seasons. The most dominant species observed on the university campus during this survey period included the Common myna (*Acridotheres tristis*), House crow (*Corvus splendens*), Red-vented Bulbul (*Pycnonotus cafer*), Indian Pied Starling (*Gracupica contra*), Cattle Egret (*Bubulcus ibis*), Spotted Dove (*Spilopelia chinensis*), Black Drongo (*Dicrurus macrocercus*), Paddyfield Pipit (*Anthus rufulus*), House sparrow (*Passer domesticus*), Little swift (*Apus affinis*), Rock pigeon (*Columba livia*). Major threats to the avian population observed on the university campus included lack of big trees and habitat loss due to construction work. Major shrubs are present and the shrubs and bushes supported bird's diversity is in abundance in the campus.

Keywords: Birds, Diversity, Avian Fauna, Seasonal diversity, CUO

HARNESSING CRISPR-Cas9 FOR RICE TILLERING ENHANCEMENT THROUGH AAP3 GENE EDITING

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Rice is a key staple food and a model crop plant in genetic research. Genetic resource manipulation has contributed significantly to meet rising food demand for the world's growing population. Tillering is one of the agronomical features that have an impact on rice yield. Tillering is the process by which rice plants produce numerous stems from the base of their main stem. More tillers imply more potential grain-bearing structures, can greatly boost overall production. Tillering is also a useful model for researching monocotyledonous branching. Although there are numerous genes that govern rice tillering, one of them is amino acid permease3 (AAP3). AAP transporters help to load amino acids into the nitrogen sink and supply, as well as allocate nutrients throughout plant development. Increased OsAAP3 expression in rice results in significantly higher Lys, Arg, His, Asp, Ala, Gln, Gly, Thr, and Tyr amino acid concentrations, as well as decreased bud outgrowth and rice tillering. However, inhibiting OsAAP3 expression results in a small reduction in amino acid concentrations, which promotes bud outgrowth, increases tillering and effective panicle numbers per plant, and improves grain production and nitrogen usage efficiency (NUE).Thus, knocking down the AAP3 gene using the CRISPR-cas9 genome editing technology will result in high tillering.CRISPR-Cas9 has provided unprecedented opportunities for precise genomic editing in rice. AAP3 gene editing using CRISPR-Cas9 may be able to open up new routes for increasing rice output and resistance. This might have significant implications for food security, agricultural sustainability, and the livelihoods of millions who rely on rice as a primary crop.

Keywords: CRISPR-Cas9, Rice, AAP3 Gene , Tillering

BIRD ASSEMBLAGES IN CHANGING LULC DYNAMICS OF KORAPUT DISTRICT

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With over 10,000 extant species, birds are the most diverse terrestrial vertebrate group and are renowned for their highly adaptable body design. Koraput district in Odisha holds significance as a part of the Eastern Ghats. Some divergent avian population has been reported from the forests of the region. Over the past 60 years, industry, mining, urbanization, rail transportation, and hydroelectric activities have altered the district's ecology. The present study on Koraput's bird assemblages from October 2014 to September 2019 in five different Land Use and Land Cover (LULC) categories and its modification shows forests had the most species of birds, followed by scrublands, whereas developed areas had the most number of birds. Human commensals like *Corvus splendens*, Columba *livia*, and *Acridotheres tristis* account for 10% of urban bird encounters. These findings imply bird species are homogenizing and fewer human-associated species are increasing, which is a cause of concern. Diversity and richness in forests indicate bird species variety as a factor of habitat heterogeneity. LULC data shows scrubland and forest areas have increased during the past two decades. Scrubland bird diversity grows with scrub area and is richer than agricultural, developed, and wetlands. The increase in scrub area with agricultural lands being abandoned may have led to increasing scrubland bird diversity making it an important bird habitat and also it is vulnerable to development as they lack dense vegetation. More intensive studies on dominant families of birds in the scrublands like Estrildidae can give better insights on the impact of changing LULC dynamics on bird species.

Keywords: Birds, Koraput, Eastern Ghats, LULC

GENETIC DIVERSITY OF INDIGENOUS RICE LANDRACES FROM KORAPUT FOR SUBMERGENCE TOLERANCE

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Flooding-induced submergence is a major stress constraint that limits rice (*Oryza sativa* L.) production in rainfed lowland areas. This is becoming a more serious issue concerning global climate change as the modern high-yielding rice varieties are susceptible to submergence The present study evaluated submergence responses in 88 lowland indigenous rice (*Oryza sativa* L.) landraces of Koraput, India, for two consecutive years with an aim for identification of new submergence-tolerant rice genotypes. Taken together, five rice landraces (*Samudrabali, Basnamundi, Gadaba, Surudaka* and *Dokarakuji*) showed the highest degree of tolerance to submergence compared to other genotypes. More significantly *Samudrabali, Basnamundi* and *Godoba* had more survival along with better elongation growth and biomass accumulation under submergence than flooding tolerant FR 13A check variety. These landraces may be beneficial for lowland rice growing areas that are affected by both moderate stagnant water and flash flood. The molecular genotyping study also revealed that these genotypes have submergence tolerance properties may be due to the presence of one or more different *Sub* 1 locus. The identified landraces might be useful for the breeding programme for the development of submergence-tolerant rice varieties as well as for the further improvement of yield stability in the rainfed lowland agro-ecosystem.

Keywords: Genetic Variability; Genotyping; Indigenous Rice; Submergence Tolerance; *Sub1*

ADDITIVE PARTITIONING OF BUTTERFLY DIVERSITY ACROSS SPATIAL SCALES IN THE TROPICAL DRY FORESTS OF THE EASTERN GHATS, INDIA: IMPLICATIONS FOR REGIONAL BIODIVERSITY CONSERVATION.

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The Eastern Ghats hill range in India, with its ancient origins and unique biodiversity, hosts numerous endemic and relic species crucial for conservation and ecological research. However, human activities such as industrialization, urbanization, agriculture expansion, deforestation, mining, infrastructure development, dam construction, and livestock grazing threaten its natural environment. With limited data on butterfly ecology in this region and the landscape changing rapidly, this study aims to assess how different spatial scales affect butterfly functional groups to develop conservation strategies and engage the community in habitat protection.

The study was conducted in a tropical dry forest of the northern highlands of the Eastern Ghats of India from November 2016 to October 2017, recording a total of 3343 individuals of 88 butterfly species, under 62 genera, 18 subfamilies, and six families, across three different forest types (open, riparian, dense). It investigated species diversity (γ) using an additive partitioning framework, distinguishing within-community diversity (α) and among-community diversity (β), assessed through species richness (S) and the Shannon–Wiener index (H′).Butterfly species richness remained unchanged ($p > 0.05$), yet diversity patterns varied significantly across transects ($p < 0.05$), indicating differences in common species populations. The analysis showed that β transect (S: 32.02%, H′: 10.65%) contributed more to gamma diversity than β elevation (S: 25.97%, H′: 9.65%), except for specialists (S: 41.93%, H′: 25.42%), which favoured landscape attributes over forest type. This highlights the significant influence of environmental factors on butterfly populations, with landscape attributes favouring specialist species. Elevational gradients play a crucial role in shaping habitat specialization, emphasizing the importance of spatial considerations in conservation planning.

Keywords: Additive Partition, Butterfly Assemblages, Landscape Factors, Eastern Ghats.

THE SIGNIFICANCE OF LICHEN DIVERSITY AND THEIR CONTRIBUTION TO ECOLOGICAL SUSTAINABILITY IN NTPC SIPAT, BILASPUR, CHHATTISGARH

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NTPC Sipat, located in Bilaspur district, Chhattisgarh, India, represents a significant industrial site amidst diverse ecosystems. This paper revels into the importance of lichen diversity within the NTPC Sipat and its role in promote ecological sustainability. Lichens, comprising fungi and algae or cyanobacteria in symbiotic relationships, serve as crucial indicators of environmental health, reflecting changes in air quality and pollution levels. The industrial activity at NTPC Sipat, understanding lichen diversity becomes imperative for monitoring environmental impacts and implementing mitigation measures. Additionally, lichens play fundamental roles in ecosystem functioning, contributing to nutrient cycling, soil stability, and microclimate regulation. Their presence within the industrial landscape enhances biodiversity and promotes ecological hardiness. Furthermore, lichens hold cultural and medicinal significance, emphasizing their value beyond ecological considerations. This paper evaluates the current status of lichen diversity in NTPC Sipat, identifies potential threats posed by industrial activities, and suggests strategies for their conservation and sustainable management. The ecological significance of lichens and integrating their conservation into industrial practices, NTPC Sipat can mitigate environmental impacts and uphold ecological sustainability in the region.

Keywords: Ecological Sustainability, Conservation, Sustainable Management, Monitoring, Lichen Diversity.

DIVERSITY OF WEEDS FOR HUMAN FOOD- A CONQUEST FOR CHEAPER MINERAL SOURCES

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A weed is an unwanted plant growing in a place where some other plants are also growing or no other plant has grown at all. The plants growing in a wrong place i.e. in agriculture fields are often referred to as weeds. They proliferated quickly and aggressively. In many parts of India, wild edible plants and weeds are frequently used in everyday meals. Wild weedy edible plants are essential for tribal cultures' survival as a source of food and as a source of money like lumber and other resources. With a goal of closing the knowledge gap in traditional wisdom regarding the usefulness of wild plants and unlocking the resources' hidden potential for appropriate use, assessment of nutrition and exploitation. The poor families used these weeds abundantly during the season and also they dried them for off season use. The nutritional studies show these weeds are rich in protein, Ca, P, Mg, Mn, Cu, and Zn content more than domesticated green vegetables. Thorough investigation indicated that these plant species are used to cure diseases like diarrhoea, dysentery, gonorrhoea, rheumatism, headache fever, ulcer, cough, jaundice, blood purification and boils, etc. The conclusion of the study is that edible weeds can be proved to be good sources of nutrients for human consumption. Further work is needed on the chemical composition of all weeds used as human diet.

Keywords: Weed, Plant, Assessment of Nutrition

STUDY OF SOME SPIDER SPECIES OF CHATRAPUR, GANJAM DISTRICT, ODISHA

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Spiders, the second largest order (Araneae) among arachnids, are air-breathing arthropods with eight limbs, chelicerae equipped with venomous fangs, and spinnerets producing silk. They are important predators in various terrestrial environments, including agricultural ecosystems, where they control insect pests. Their presence indicates ecosystem health and they serve as bioindicators of environmental changes. However, documentation on spider species in Ganjam district is lacking. The present field study was carried to record variety of spiders in Chhatarpur (latitude 19.354979° north, and the longitude is 84.986732° east) near Rusikulya river of Ganjam district, Odisha, India. The field survey was carried from January 2024 to February 2024. The spiders were photographed using a camera covering all significant area with natural vegetation along 5 km of river patch. Ideally, the sites along the river basin were studied during this period. Diversity of spider species were studied using Google lens and World Spider Catalog (2024) version 25. This survey showed the occurrence of 12 species (11 genera) belonging to seven families with Salticidae being the dominant family. Among all those species found *Platycryptus undatus* is critically endangered according to IUCN Red list. These spiders are maintaining ecological equilibrium by suppressing insect pest. However, the forest is under pressure from habitat loss and degradation due to deforestation which is the primary threats to spider diversity.

Keywords: Spiders, IUCN, Ecosystem, Diversity, Habitat, Feeding, Breeding

MICROBIAL DIVERSITIES ASSOCIATED WITH TREE BEAN (*Parkia roxburghii* G. Don) DECLINE UNDER CHANGING CLIMATIC CONDITIONS OF MANIPUR

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The northeastern hill region of India is a treasure trove for many indigenous fruits and vegetables. Tree bean (*Parkia roxburghii* G. Don), indigenous to the Indo-Myanmar region, is one of the most preferred delicacies among the tribal population. Tree bean decline threatens the production and productivity of edible pods under changing climatic conditions. The present study was carried out to identify the microbiome associated with acute *Parkia* decline (APD). We have systematically investigated the microbes associated with tree bean decline using 16S and 18SrRNA sequencing. We have isolated a cocktail of Gram-positive and Gram-negative bacteria (15, 22 and 4 bacterial strains from infected soil, stems and root samples) from the infected samples. About twelve fungal strains were isolated from infected root and stem samples when cultured on PDA plates. To identify these bacterial and fungal strains, the gDNA were isolated and amplified with respective 16S (*27F* and *1492R*) and 18S universal primers (*ITS1* and *ITS4*).PCR-purified products of the bacterial and fungal pathogens were sequenced for identification. A complex of pathogenic, non-pathogenic and opportunistic bacterial and fungal pathogens associated with tree bean decline was identified. We have performed pathogenicity tests to confirm the stringent role of this fungal complex in APD. This study will pave ways for sustainable management of the acute decline of tree bean.

Keywords: Fungal Complex, 18S rRNA, Climate Change, Decline, Tree Bean, Microbiome

ASSESMENT OF GROWTH TRENDS IN BARB SPECIES FROM LENTIC AND LOTIC WATER BODIES OF EASTERN GHATS, SOUTHERN ODISHA, INDIA

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Barbs, a group of small native fish species that live in all kinds of freshwater bodies and are favoured as a food source. For understanding growth in barbs, their length-weight relationship was studied in selected freshwater bodies in Koraput District of Odisha in Eastern Ghats. Barbs were sampled from both lentic (two ponds, Jagannath Sagar and Damyanti Sagar) and lotic (tributary of Kolab River at Ghatguda and Dudhari and hill streams of Deomali Hills) waterbodies. A total of 492 specimens of six species of barbs were collected i.e. *Puntius sophore (n=122), P. amphibius* (n=100)*, P. dorsalis* (n=54), *P. chola* (n=54), *Pethia ticto* (n=87) and *P. conchonius* (n=75).With the exception of *P. chola* and *P. conchonius*, the average total length and fresh weight of rest four species were found to be greater in lentic waterbodies. The growth performance was found to be high as the correlation coefficient 'r' between length and weight exhibited high value ($p<0.05$) for all the species in both the habitats except for *P. ticto* (r= 0.4) and *P. conchonius* (r=0.386) in lentic body. *P. chola, P. dorsalis, P. ticto, P. amphibius* showed positive allometric growth ($b>3$) in lentic bodies while negative allometric growth ($b<3$) for lotic bodies. *P. sophore* showed positive allometric growth for lotic bodies while *P. conchonius* showed negative allometric growth for both habitats. The computed weight ($W=aL^b$) for every species was found to be nearly identical with the observed weight, indicating good health of fishes, as indicated by the condition factor (Kn), which was found to be nearly Kn=1 for every species in both habitats.

Keywords: Length Weight Relationship, Lentic, Lotic, Allometric Growth.

DIVERSITY AND DISTRIBUTION OF SCRUBLAND BIRDS IN KORAPUT DISTRICT, EASTERN GHATS OF SOUTHERN ODISHA, INDIA

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Birds play a vital role in the global ecosystem as they contribute to food webs, act as pollinators, and serve as bio-indicators for assessing ecosystem health. However, they are currently facing threats due to dynamic climate change. The present study focuses on scrubland bird diversity in Koraput district, Odisha, which has the largest area of scrubland among all districts in the state. The study was conducted during November 2022 to February 2023. A total of 140 birds under 17 orders, 61 families and 110 genera were sampled, which included 116 (82.86%) species of resident and 24(17.14%) are migratory. Passeriformes is the dominant order with maximum number of species (S=81).

During the study one Vulnerable (VU) species, the Green Munia (*Amandava formosa*), two Near Threatened (NT) species Oriental Darter (*Anhinga melanogaster*) and Alexandrine Parakeet (*Psittacula eupatria*) were recorded. Rests of the 137 species are under Least Concern (LC) category. During the study most recorded species were Red vented bulbul (*Pycnonotus cafer*) (RA=12.3%), followed by Red whiskered bulbul (*Pycnonotus jocosus*) (RA= 11%) and Common myna (*Acridotheres tristis*) (RA=8.68%) respectively. While the above three species mostly preferred *Lantana camara*, *Butea superba*, *Madhuca longifolia, Royal poinciana and Ficus carica* plants for their feeding and nesting, whereas the vulnerable Green munia preferred *Ageratum conyzoides*, *Alternenthera sessilis, Aristida setacea, Botriochloa bladhii, Botriochloa pertusa,* and *Chrysopogon aciculatus.* Once ignored by the conservation community as wastelands, the finding of our study indicated that scrublands are quite rich in bird diversity and require management from the conservation point of view.

Keywords: Scrubland, Koraput, Eastern Ghats, Passeriformes

EARTHWORM DIVERSITY RELATIVE TO SOIL CHARACTERISTICS IN DIVERSE LAND USE SYSTEMS IN THE KORAPUT REGION OF THE EASTERN GHATS, INDIA

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The study in the Eastern Ghats Highlands of India aimed to evaluate the impact of soil properties and various land use systems on earthworm diversity. It surveyed six land use categories: moist deciduous forest, dry deciduous forest, fallow land, cropland, compost pit, and sewage soil. Sampling occurred in randomly selected 10×10 km^2 grids, covering 25% of the study area from April to December 2022. Of the 17 earthworm species identified, 14 were new records for the region, including two new species under the genus Megascolex (*M. jeyporeghaensis* and *M. quadripappilatus*). The Megascolecidae family exhibited the highest taxonomic diversity. The most abundant earthworm species were from the endogeic group, followed by anecic and epigeic species. Analysis using Hill numbers revealed that fallow land had the highest Shannon index (1D=9.89) and Simpson diversity (2D=9.14). Earthworm abundance varied significantly across different land use systems [$F_{(5,84)}=3.256$, $p<0.05$] and seasons [$F_{(2,87)}=46.463$, $p<0.01$]. Additionally, earthworms were positively correlated with soil moisture, organic carbon, available nitrogen, and clay content, while negatively correlated with sand content. The study highlighted cropland as having a high number of earthworm species, while fallow land exhibited greater diversity due to factors like increased moisture levels, moderate soil conditions, and proximity to undisturbed forests. The presence of native earthworm species underscores the importance of implementing well-planned land management strategies for conservation in the area.

Keywords: Koraput, Odisha, Oligochaeta, Species Abundance, Edaphic Factors, Hill Numbers

A STUDY ON BIODIVERSITY OF BARUNEI HILL WITH SPECIAL REFERENCE TO AVIFAUNA, KHORDHA, ODISHA

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Barunei hill of Khordha district is a popular tourist place, famous for temples and its breathtaking natural beauty. It is situated 25kms. away from the capital of Odisha, Bhubaneswar. It is about 7kms. long, 800m. wide and 304.8m. above the sea level. Swarna ganga is a perennial stream flowing down the Barunei hilltop. The water of this beautiful stream has many medicinal properties. One of the main attraction of this hill is its rich flora and fauna. The hill is covered with dense forest of Sal, teak, bamboo and mango trees which provide a natural habitat for a variety of animals and birds. About 5species of amphibia, 10species of reptiles, 6 species of mammals were identified during field survey. In the present study a survey was conducted in summer, winter and rainy season of the year 2023. For sampling Barunei was divided in three regions, foothill, water mass and hilltop. Around 60minutes spent in each sampling region in the morning and afternoon for several days and bird species were observed by binoculars. After long period of watching 20 species of birds were enlisted. It has been observed that most of the birds inhabiting this area are vulnerable to habitat degradation. Therefore community knowledge enhancement should be strengthened for a sustainable conservation of avifauna while maintaining their ecological interactions.

Keywords: Medicinal Water Properties, Flora and Fauna Diversity, Habitat Degradation Awareness, Ecological Interactions Preservation.

DIVERSITY, ECOLOGY, ETHNOBOTANY AND CONSERVATION OF FIGS (*Ficus* species) IN ODISHA, INDIA

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Commonly known as figs, the genus *Ficus* Tourn. ex Linn. (Moraceae) is comprised of about 880 species of trees, shrubs, climbers, creepers growing as epiphytes or semi-epiphytes, rheophytes or lithophytes and distributed in the tropical and subtropical parts of the world. In India, the genus is represented by 115 taxa, 91 species and 24 infra-specific categories; 10 species being endemic to the country. Species of *Ficus* are considered as an assemblage of keystone species in different ecosystems by providing shelter and food to frugivorous animals, birds and insects; fodder for wild and domesticated animals, and a wide range of ecosystem services in tropical forests. Most of the species are used in traditional medicine by tribal and rural people; some yield edible fruits and several of them have mythological significance and worshipped in rural India.

The taxonomic diversity, distribution, ecology, ethnobotanical uses and conservation aspects of 32 wild and cultivated species of *Ficus* collected from different parts of Odisha are presented in this paper. These figs exhibit great diversity in terms of their habit, habitat, root system, leaf morphology, inflorescence, pollination and seed dispersal mechanisms. While species like *F. benghalensis, F. religiosa* and *F. hispida* are common in all types of habitats, *F. exasperata*, *F. auriculata*, *F. semicordata*, *F. racemose* etc. are predominantly forest dwellers mostly confined to river and stream banks. Some of them like *F. benghalensis, F. religiosa, F. benjamina* and *F. tinctoria* ssp*. Gibbosa* grow as epiphytes, hemiepiphytes or lithophytes on other trees, dilapidated buildings and rock crevices. The fruits of *F. auriculata*, *F. benghalensis*, *F. hispida*, *F. racemosa* and *F. semocordata* are consumed by tribals as distress food during times of food shortage. Several species of the genus are of ethnomedicinal importance and many have cultural and religious significance. Among the figs of Odisha, *F. semicordata*, *F. mollis* and *F. arnottiana* have been identified as rare ones needing conservation interventions.

Keywords: Ficus Genus Diversity, Keystone Species, Epiphytic Growth, Ethnobotanical Significance, Endemic Species

GENETIC VARIATION IN *GIGANTEA* GENE OF NORTHEAST INDIAN BANANA LINKED WITH DIVERSITY IN MORPHOLOGY AND CHROMOSOME STRUCTURE

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Bananas and plantains (*Musa* spp.) with its rich cultivar diversity in India needs to be explored genetically for improvement. Twenty three banana varieties of Northeast India were assessed using morphological scoring and grouping based on Simmonds and Shepherd (1955), karyotype asymmetry based cytotaxonomy and *GIGANTEA* gene analysis. Morphological characterization of the *Musa* varieties revealed predominance of triploid (2n=3x=33) varieties with AAA, AAB and ABB genome composition. In diploid varieties (2n=2x=22), AB and BB genomic groups were found. Karyotypes with medium-sized chromosomes with median primary constriction were predominant with TF% and Total chromosome length ranging from 35.65% in var. Amritsagar to 44.63% in var. Ram Kola and 36.62 µm in var. Sita Kola to 81.88 µm in var. Jahaji Kol respectively. The pleiotropic gene *GIGANTEA* has roles in breaking seed dormancy, circadian cycle and disease resistance. The size of the PCR amplified sequences of *GIGANTEA* gene in the studied varieties varied from 288bp in var. Tulsi Manohar to 1017bp in var. Sita Kola. The phylogenetic analysis of quantitative morphological features and multiple sequence alignment of amplified *GIGANTEA* DNA sequences separated the diploid wild *M. laterita*, *M. acuminata* var. Ram Kola, and *M. acuminata* var. Sita Kola. These *Musa* varieties were considered to be advanced. It was reconfirmed by high asymmetry in karyotype of *M. acuminata* var. Ram Kola separating it from the rest of the species in karyotype asymmetry based phylogenetic analysis. Early flowering disease resistant plants can be obtained by the manipulation of *GIGANTEA* gene using gene editing approaches.

Keywords: *Musa* Diversity, Morphology, Karyotype Asymmetry, *GIGANTEA* gene, Phylogeny

CONSERVATION OF ETHNO-BOTANICALLY IMPORTANT PTERIDOPHYTES OF ODISHA

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Pteridophytes are one of the major plant groups after Angiosperms in India. It comprises about 13,038 species worldwide and 1267 species in India. These vascular cryptogams have several ecological, medicinal, and economic applications. Odisha's diversified topography, diverse vegetation, variable climatic conditions, and geographical position provide an amicable ambiance for the presence of approximately 170 species of pteridophytes. Compared to other vascular plants, pteridophytes remain underexplored in ethnobotanical aspects, despite being regarded as a valuable component of healthcare for centuries. In the current study, an attempt has been made to document medicinally important pteridophytes used by different local communities in Odisha. *Christella dentata*, *Cyclosorusparasiticus*, *Lygodiummicrophyllum*, *Parahemionitis cordata*, *Drynaria quercifolia*, *Diplazium esculentum, Selaginella bryopteris, Phlegmariurus squarrosus* and *Lycopodium clavatum* are recorded as the most important Pteridophytes of Odisha in terms of their ethnobotanical applications. The information collected in the current study could be used as a base for the discovery of active principles for phytochemical screening, pharmacological and clinical research. Habitat loss and fragmentation coupled with unsustainable harvesting of pteridophytes from the wild are posing serious threats to the fern and fern allies of Odisha. Efforts should be made to conserve these lesser-known plant genetic resources towards human welfare.

Keywords: Pteridophytes, ethnobotanical aspects, *Christella dentate, Cyclosorus parasiticus, Lygodium microphyllum, Parahemionitis cordata, Drynaria quercifolia, Diplazium esculentum, Selaginella bryopteris, Phlegmariuru ssquarrosus, Lycopodium clavatum*

ASSESSING THE INVOLVEMENT OF THE KOYA COMMUNITY IN PROTECTING BIODIVERSITY

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This paper delves into the vital role played by indigenous tribal communities in safeguarding biodiversity within and around their natural habitats since ancient times. These ethnic groups preserve various plant species that serve as essential sources of wild edible foods, encompassing roots, tubers, rhizomes, seeds, and fruits, as well as agriculture and horticultural crops. Additionally, they conserve indigenous crop varieties, which are subsequently integrated into agricultural improvement initiatives to enhance productivity and incorporate traits for increased resistance to pests and diseases. Many of the plants preserved by indigenous communities possess medicinal properties, serving as antidotes for snake bites and scorpion stings, aiding in the setting of bone fractures, wound healing, arthritis treatment, and addressing menstrual issues, among other uses. Tribal populations conserve plants through practices such as reclaiming abandoned sites from shifting agriculture and establishing sacred groves, thereby contributing to in-situ biodiversity conservation and ecological restoration efforts. Through the combination of both primary and secondary sources this paper explores the intricate relationship between the Koya community and their natural resources. Our analysis also reveals the significance of traditional customs, living spaces, and cultural practices of Koya community in safeguarding forest environments. Throughout history, tribal communities have developed their unique lifestyles that harmonize with nature, ensuring animal impact on the forests. They possess distinct methods of forest conservation driven by a genuine commitment to preserving these natural habitats showcasing a long-standing tradition of co-existence between humans and nature.

Keywords: Biodiversity, Indigenous Community, Medicinal Plants, Koya, Natural Habitat

FIRST INSIGHT INTO SEXUAL SHAPE VARIATION IN PARASITIC CYMOTHOID ISOPODS USING GEOMETRIC MORPHOMETRIC ANALYSIS

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The cymothoid isopods live in the buccal, branchial, and body surface regions of many commercially important fishes. Due to their different site of attachment behavior, the body shape varies. Adult males and females have different body shapes. Their shape variation analysis and interpretation will add to understating their ontogenic allometry and phenotypic plasticity, which are contributing to their survival strategies and reproductive success. This study was carried out to check at which part or point of their body the full-grown males and females differ with respect to shape through landmarks based on geometric morphometric analysis (GMA). The males and female individuals of the same species formed separate clusters in the Principal Component Analysis (PCA) in majority of the cases, and in a few instances, there were overlapping. In the Discriminant Function Analysis (DFA), there were distinctions in all the circumstances. However, the inter-sexual shape variation within the species was statistically insignificant ($p>0.05$). The inter-specific shape variation among male and female individuals was also carried out. The inter-specific males showed over-lapping clusters in both the PCA, and DFA, which was evident from the p-value ($p>0.05$). In inter-specific females formed separate clusters in the PCA with little overlapping, but clear distinction in DFA with statistically significant p value ($p<0.05$). The shape variation was noticed concerning the shape of the perionites from 3 to 7 and pleotelson between adult males and females of similar species and between the females of the different species. Therefore, species discrimination concerning the shape of the isopods based on females should be carried out, not males. This study is the first insight into the sexual shape variation in parasitic isopods of the family Cymothoidae based on GMA.

Keywords: Cymothoid Isopods, Ontogenic Allometry, Reproductive Success, PCA, DFA

PLANT SPECIES HAVING HIGH CONSERVATION PRIORITY IN ODISHA

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The unsustainable use of biological resources and its overexploitation coupled with habitat loss have caused a rapid decline in the population of plant species having socio-economic, ecological and biological significance. Biodiversity conservation and habitat management are identified as two most important approaches for protection and restoration of species and ecosystems in developing countries. IUCN Red List Categories and Criteria were developed for classifying species at high risk of global extinction, i.e. for assessment at the global level. At regional, national and local levels there are essentially two options: (1) to publish an unaltered subset of the global IUCN Red List encompassing those species that are globally threatened and occurs in the region and (2) to assess species that are threatened within the specific region or in regional level. After field studies, expert consultation and extensive literature review, 165 species of plants were identified as plants of conservation concern for Odisha. Present study deals with prioritization of habitats, and species for its conservation in different biodiversity rich sites of Odisha, India following herbarium records, population status and distribution, area of occurrence, Ethnobotanical applications, expert opinion and threat perception related to each species. Regular monitoring of prioritized habitats and along with management and restoration of prioritized plant taxa are suggested for protection of plants of conservation concern in Odisha.

Keywords: Unsustainable Use, Global Extinction, Biodiversity Conservation And Habitat Management, Ethnobotanical Applications

SPECIES DIVERSITY AND EX- SITU CONSERVATION OF ZINGIBERACEAE IN ODISHA

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Zingiberaceae is one of the largest families of monocotyledon. The species of Gingers are overvalued due to their nutritional, medicinal and economic potential. However, the diversity of gingers in different forest pockets of Odisha is still unexplored. Hence, the present study focused on the inventorisation, collection and conservation of the ginger germplasm resources of Odisha. During the survey, each plant with vernacular names, use categories, flowering & fruiting time were recorded. The study reported the diversity of 27 species of gingers under 8 genera, naturally distributed throughout Odisha. *Curcuma* being the largest genera of this family holds about 9 species on count followed by *Zingiber* (5 sp.), *Globba* (3 sp.), *Hedychium* (3 sp.), *Kaempferia* (2 sp.) *Alpinia* (2 sp.), *Amomum* (1 sp.), and *Boesenbergia* (1 sp.). Due to the suitable climate and varied edaphic factors of Odisha, about 5 gingers species were found cultivated and 22 species were well distributed in the wild. Based on the use values, about 96% of these species are used for medicinal purposes followed by ornamental (25%), Food (21%) and cultural significance (10%). The unsustainable utilization of wild gingers such as, *Curcuma montana* Roxb., *Zingiber capitatum* Roxb., *Zingiber montanum*(J. Koenig) Link ex A. Dietr., *Zingiber zerumbet* (L.) Roscoe ex Sm. may lead to local extinction. Hence, this study focused to collect fresh germplasm from wild, plant and conserve in the Botanical Garden, MSCB University, Baripada campus for further research and educational activities. The present taxonomic study on gingers will help researchers, scientists and biotechnologists in bioprospecting and adding value for sustainable production and utilization of gingers in Odisha.

Keywords: Taxonomy, Species diversity, Ex-situ Conservation, Zingiberaceae, Odisha

THE DIVERSITY OF LICHEN IN KORAPUT REGION ODISHA

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Koraput district is situated in southern part of the Odisha state which is known for its cultural heritage. Valuable tribe of the district is representing the unique tradition and vibrant cultures in the area. The Koraput district with having unique topographic features makes good diversity of flora and fauna including lichen. Lichen are symbiotic organism of algae and fungi living together for benefiting each other colonizing over all substratum. In this study a total of 23 species of lichen were identified in and around the Koraput area. Majority of genus like Pertusaria, Lecanora, Parmelia, Dirinaria and Graphis were observed frequently. Diversity of lichen was found rich all over the area in high hill range of Koraput area and low hill region of Jeypore area. In which Damanjodi, Sunabeda, Jeypore and upper Kolab dam were selected and surveyed for lichen diversity. Unique terricolouse fruticose lichen of single species Cladoniapraetermissa which comes under single genus found near central university area. More places like Subabeda, Koraput planation area lichen host and plant substratum were found under threat due to huge anthropological pressure and soil erosion in the area. Tree diversity like *Mangifera idica, Bombax ceiba, Madhuca Indica, Buchanania lanzan, Diospyros melanoxylon* , palm tree, *Acacia mengium, Zakaranda, Peltaphorgum, Syzygium cumini*, were observed as best host species of lichen. The lichen are known for the best indicator of environmental quality in any area and it reveals good environmental value in the region. The present study was aimed to observe diversity of lichen and its major threats including its bioprospecting use of lichen in medicine, food and dye. Koraput area is best home place of lichen diversity and this newly reported lichens in the area are need to be increase favourable substratum of forest diversity and valuable lichen species conservation .

Keywords: Lichen Diversity, Threats, Conservation And Bioprospecting Use

QUANTITATIVE DETERMINATION OF VOLATILE COMPOUNDS BY GC-MS AND USE OF CHEMOMETRIC APPROACH TO DIFFERENTIATE CHEMOTYPES OF *Magnolia champaca* FLOWER

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Magnolia champaca (L.) Baill. ExPierre (Magnoliaceae) is a perennial evergreen tree renowned for the multipurpose use of its fragrant flower in perfumery, fragrances, incense, aromatherapy, and pharmaceutical industries. In spite of having multipurpose use, very little work has been done for aroma profiling of the flower. Hence, in the present study, the variation in yield and chemical constituents of *M. champaca* flower essential oil (MCFEO) from different regions of Odisha is reported. The yield of hydro distilled EO was varied from 0.08±0.02% to 0.55±0.02% *(v/w)* on a fresh weight basis. GC-MS analysis identified 57 phytoconstituents accounting for 90.33±4.52% to 95.69±4.78% of the total oil. The EO was rich in sesquiterpene hydrocarbons (28.44±1.42% - 59.69±2.98%) followed by monoterpene hydrocarbons (2.81±0.14 % - 36.03±1.80 %). MCFEO is found to be rich in β-pinene (0.85±0.04% - 35.68±1.78%), β-elemene (5.71±0.29% - 29.08±1.45%) and 1,8-cineole (4.34±0.22% - 24.84±1.24%). Chemometrics analyses and cluster analyses, such as partitional clustering and hierarchical clustering, classified the MCFEO populations into three different chemotypes: chemotype I(β-Pinene rich), chemotype II (β-Elemene rich), and chemotype III (1,8-Cineole rich). The identification of chemical polymorphism within the studied populations offers valuable insights into the selection of specific chemotypes. The chemotypes identified among *M. champaca* populations have immense potential as valuable bio-resources for conservation purposes, as well as for utilization in the perfume and pharmaceutical industries, and for enhancing species improvement initiatives.

Keywords: *Magnolia champaca*, Essential Oil, Gas Chromatography-Mass Spectrometry, Chemometrics

ISOLATION OF FUNGAL PATHOGENS FROM RHIZOME ROT INFECTED *Curcuma* AND *Zingiber* SPECIES AND DETERMINATION OF ITS ANTIGENICITY

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Since time immemorial agriculture has played a pivotal role in the progression of civilisation. On contrary emergent of plant pathogen has significantly impacted the quality and quantity of agricultural commodities. Rhizome rot infection is one of such notorious disease that affects the cultivation of *Curcuma* and *Zingiber* species globally. There are speculations on association of various fungal pathogens causing the rhizome rot. Our current approach aimed to isolate, identify, and study the fungal pathogens that hampers production of these economically important species and to identify the antigenic sequences in order to develop early detection strategies. The symptomatic rhizomes of *Curcuma* and *Zingiber* samples were collected from various agroclimatic zones of Odisha and proceeded to identify and characterize three fungal isolates such as *Aspergillus tubingenesis, Athelia rolfsi* and *Fusarium verticillioides* basing on their morphology and further confirmed by 18srRNA analysis. After the nucleotide sequencing of the obtained fungal isolates, the antigenic study was carried out by sequence homology analysis with available antigenic nucleotide sequence of *Pythium aphanidermatum* and *Fusarium oxysporum*, thus confirming the sequence as antigenic. The confirmed antigenic nucleotide sequences were then used to determine complement amino acid sequences. Furthermore, this study emphasize d the diversity of rhizome rot associated fungi, their pathogenicity, which could be implemented to develop an effective rhizome rot management.

Keywords**:** Rhizome rot, fungal pathogens, antigenicity, *Curcuma* and *Zingiber* species

DECIPHERING THE MECHANISM OF ANTI-INFLAMMATORY EFFECTS OF CATMINT (*Anisomeles indica*) ESSENTIAL OIL THROUGH NETWORK PHARMACOLOGY AND *IN VITRO* BIOASSAYS

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Anisomeles indica(L.) Kuntze (Lamiaceae), commonly called catmint, is an essential oil-bearing herb used in traditional systems of medicine against rheumatism, convulsions, inflammatory skin disorders, and epilepsy. However, the efficacy and mechanism of action of its essential oil against inflammatory conditions remain elusive. The current study aims at the chemical characterization of the essential oil of *A. indica* leaves(AILEO) and understanding the mechanism of its anti-inflammatory activity. GC-MS analysis of AILEO revealed the presence of 30 constituents, of which diterpene hydrocarbons such as abietatriene (58.13%) and abietadiene (7.18%) were the predominant compounds. Of these, 20 compounds passed the ADME screening and were considered as active constituents. Ulti-level network analysis revealed that the pharmacological mechanisms of alleviation of inflammation by AILEO are due to its interaction with five core inflammatory targets such as PI3K, AKT1, MEK1, ERK1, and RXRA involved in the PI3K-AKT signalling pathway. AILEO did not exhibit any cytotoxic effect on RAW 264.7 cells, but it significantly inhibited the production of various proinflammatory mediators including nitric oxide (NO) andpro-inflammatory cytokines (TNF-α, IL-6, and IL-1β) in *in vitro* assays. Further, AILEO enhanced the expression levels of endogenous antioxidant enzymes (CAT, SOD, GPx, and GSH) in comparison to the LPS-induced group. RT-qPCR analysis revealed that AILEO modulated the level of mRNA expression of all five core targets associated with the PI3K-AKT signalling pathway, which further supported the findings of network pharmacology. This study provides valuable insights into the intricate mechanisms by which AILEO exerts anti-inflammatory effects.

Keywords: Anti-inflammatory; Catmint; Essential oil; Network pharmacology; PI3K-AKT pathway.

GREEN SYNTHESIS AND CHARACTERIZATION OF GOLD NANOPARTICLES USING AQUEOUS LEAVES EXTRACT OF WEDELIA TRILOBATA AND AN INVESTIGATION OF ANTIBACTERIAL PROPERTIES

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The green synthesis of gold nanoparticles (GNPs) using the aqueous leaves extract of *Wedelia trilobata* is presented in this study. *Wedelia trilobata*, a medicinal plant, was selected due to its rich phyto-chemical composition, which can potentially act as a reducing and stabilizing agent for the synthesis of GNPs. The synthesis was carried out by mixing the leaves extract with gold chloride ($HAuCl_4$) solution, followed by reduction using appropriate conditions. The formation of GNPs was confirmed by observing a change in color from pale yellow to deep red, indicative of the surface plasmon resonance phenomenon. The synthesized GNPs were characterized using various techniques. UV-Vis spectroscopy revealed a characteristic peak at around 520-550 nm, confirming the presence of GNPs. Fourier-transform infrared spectroscopy (FTIR) analysis provided evidence of the involvement of various functional groups present in the leaves extract, which contributed to the reduction and stabilization of GNPs. Transmission electron microscopy (TEM) showed that the synthesized nanoparticles were predominantly spherical in shape, with an average size ranging from 10 to 50 nm. The antibacterial properties of the synthesized GNPs were investigated against a panel of bacterial strains, including both Gram-positive and Gram-negative bacteria. The agar well diffusion method was employed to evaluate the antibacterial activity. The results demonstrated that the GNPs exhibited significant antibacterial activity, inhibiting the growth of various bacterial strains. The observed antibacterial effect can be attributed to the interaction of GNPs with the bacterial cell membrane, leading to structural damage and disruption of cellular functions.

The green synthesis of GNPs using the aqueous leaf extract of *Wedelia trilobata* provides a sustainable and eco-friendly approach to the production of nanoparticles. The characterized GNPs showed excellent antibacterial properties, suggesting their potential application as an alternative antibacterial agent. Further studies are warranted to elucidate the underlying mechanisms of the antibacterial activity and explore the potential applications of these GNPs in the field of nano-medicine and antimicrobial research.

Keywords: *Wedelia trilobata*, GNPs, Reduction, Phytochemicals, UV, FTIR, SEM, XRD, Anti-Microbial Property

CROP RAID: A NATURE OF CONFLICT WITH ELEPHANT IN SARANDA FOREST DIVISION, WEST SINGHBHUM, JHARKHAND

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Crop damage is considered the major cause of conflict with wildlife, ranging in size from elephants to rodents that not only affects the livelihoods of farmers living close to forest areas but also jeopardizes the objective of wildlife conservation. Our study examines crop raiding patterns in 20 severely impacted villages within Saranda Forest Division, Jharkhand, focusing on elephant raids using twenty years of secondary data from 2001-2020. We identified three types of raids: on standing crops, harvested crops, and plantations (specifically, banana plantations). Elephant conflicts primarily occur on the outskirts of the reserve forest. Villages most affected, like Samta and Koina Range, lie along elephant migratory routes and near perennial water sources like the Koina River, intensifying conflicts during summer. Rain-fed agriculture limited crop diversity, with paddy being the predominant crop cultivated from July to November and also the most targeted by raids. The highest crop loss of 39.49 acres occurred in 2014, with the average raided area peaking during the ripening stage (56.59%) followed by the reproductive stage (24.05%). In Saranda, house damage correlated with grain damage, with 74.32% occurring when harvested paddy was stored indoors. The use of vocal sound by the people (shouting in a loud voice either singly or in the group, clapping in the group) (97.29%) was the common method used in cultivated areas to drive away elephants. Mining activities are practiced more in forest ranges like Gua, Koina, and Sasangda compared to the Samta Range. However, maximum depredation and crop damage occurred in the Samta Range, which may be because elephants in Samta are close to human habitation, and attracted towards crops raised leading to HEC.

Keywords: Crop Damage, HEC, Elephant, Wildlife.

CHEMICAL COMPOSITION, ANTIOXIDANT, ANTIMICROBIAL AND ANTIPROLIFERATIVE ACTIVITIES OF THE LEAF ESSENTIAL OIL OF *MELALEUCA POLANDII* GROWN IN THE COASTAL PLAINS OF EASTERN INDIA

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The genus *Melaleuca* (Myrtaceae) is comprised of approximately 382 species, with the greater species diversity in Australia but a few also occur in South-East Asia. The essential oils isolated from several *Melaleuca* species are reported to possess a broad range of biological activities and are widely used by pharmaceutical, aroma and food industries. Of these, *Melaleuca polandii*, commonly known as "Gold- tipped Bottlebrush" is an important medicinal plant traditionally used to treat various disorders. It is widely grown in Indian gardens and parks as a beautiful flowering ornamental plant. GC-MS analysis of its leaf essential oil isolated from plants grown in coasts of Eastern India revealed the presence of 50 constituents with α-pinene (46.17%), 3Z-hexenyl acetate (10.10 %), α-terpineol (5.43%), limonene (3.63%) and ρ-cymene (2.44 %) as the major constituents. The EO of *M. polandii* exhibited moderate antioxidant capacity in DPPH, ABTS and FRAP assays with IC_{50} values of 7.94 ± 0.34µg/ml, 5.71 ± 0.21µg/ml and EC_{50} 7.09 ± 0.35 µg/mL, respectively. Of the 5 bacterial strains tested, the EO exhibited highest sensitivity against *Bacillus subtilis* with the ZOI of 12.66 ± 0.57mm and very strong antimicrobial activity against *Staphylococcus saprophyticus* with MIC value of 6.25 µg/ml. *M. polandii* EO showed significant antiproliferative effects in MTT assay against Human alveolar lung adenocarcinoma (A549), Human hepatocellular carcinoma (HepG2), Human cervix adenocarcinoma (HeLa) and normal Human Embryonic Kidney cell (HEK-293) with IC_{50} values of 9.5 ± 0.38µg/ml, 22.73 ± 0.95 µg/ml, 20.41 ± 0.82 µg/ml and 237.68 ± 9.26 µg/ml, respectively. This is the first report of the yield and composition of essential oil of *M. polandii* grown in the coastal plains of India. The antioxidant and antiproliferative activity of *Melaleuca polandii* leaf essential oil has been reported for the first time and its antimicrobial effects have been evaluated against some bacterial strains not studied earlier. The findings of the present study demonstrated that the EO of *M. polandii* could be an important bioresource having applications in pharmaceutical industries as an antibacterial and antiproliferative agent.

Keywords: *Melaleuca polandii*; Essential oil; GC/MS; Antioxidant; Antimicrobial; Antiproliferative.

GENETIC VARIATION IN *GIGANTEA* GENE OF NORTHEAST INDIAN BANANA LINKED WITH DIVERSITY IN MORPHOLOGY AND CHROMOSOME STRUCTURE

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Bananas and plantains (*Musa* spp.) with its rich cultivar diversity in India needs to be explored genetically for improvement. Twenty three banana varieties of Northeast India were assessed using morphological scoring and grouping based on Simmonds and Shepherd (1955), karyotype asymmetry based cytotaxonomy and *GIGANTEA* gene analysis. Morphological characterization of the *Musa* varieties revealed predominance of triploid (2n=3x=33) varieties with AAA, AAB and ABB genome composition. In diploid varieties (2n=2x=22), AB and BB genomic groups were found. Karyotypes with medium-sized chromosomes with median primary constriction were predominant with TF% and Total chromosome length ranging from 35.65% in var. Amritsagar to 44.63% in var. Ram Kola and 36.62 µm in var. Sita Kola to 81.88 µm in var. Jahaji Kol respectively. The pleiotropic gene *GIGANTEA* has roles in breaking seed dormancy, circadian cycle and disease resistance. The size of the PCR amplified sequences of *GIGANTEA* gene in the studied varieties varied from 288bp in var. Tulsi Manohar to 1017bp in var. Sita Kola. The phylogenetic analysis of quantitative morphological features and multiple sequence alignment of amplified *GIGANTEA* DNA sequences separated the diploid wild *M. laterita*, *M. acuminata* var. Ram Kola, and *M. acuminata* var. Sita Kola. These *Musa* varieties were considered to be advanced. It was reconfirmed by high asymmetry in karyotype of *M. acuminata* var. Ram Kola separating it from the rest of the species in karyotype asymmetry based phylogenetic analysis. Early flowering disease resistant plants can be obtained by the manipulation of *GIGANTEA* gene using gene editing approaches.

Keywords: *Musa* diversity, Morphology, Karyotype asymmetry, *GIGANTEA* gene, Phylogeny

BIOLOGICAL DECOLOURIZATION OF METHYLENE BLUE USING COCULTURE OF *Chlorella vulgaris* AND *Chlamydomonas reinhardtii*

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Azo dyes are synthetic dyes characterized by the presence of -N=N- in an aromatic system. These are the largest group of synthetic dyes and the most commonly used synthetic dyes in textile, paper, food, pharmaceutical, and chemical industries for dyeing and printing. However, 10-15 % of dyes used in industries remain unbound and are discharged into the environment causing water pollution. Methylene blue is such an azo dye which is highly consumed in fabrics and paper industries. Phycoremediation is an advanced technology that uses algae for the remediation process. Microalgae are small green cell factories which have the potential to remove or degrade synthetic dyes. Here, we evaluated the decolourization potential of the coculture of *Chlorella vulgaris* and *Chlamydomonas reinhardtii* against the toxic dye Methylene blue and compared it with that of individual algae treated with dye. The data implies that both the algae individually or as coculture can remove the dye completely treated at lower concentrations. Whereas, at 2%, 5% and 10% the dye is not completely removed. The highest colour removal is achieved by the coculture by 66.3%,45%, and 24% when treated with 2%,5% and 10% dye solution respectively. Moreover, The dye removal efficiency increases with an increase in algae biomass. The effect of MB dye on metabolic profiling of the studied algal species is under study.

Keywords: Azo Dyes, Remediation Process, Phycoremediation, Decolourization Potential

CHEMICAL PROFILING AND ANTI-INFLAMMATORY ACTIVITY OF *Cyperus rotundus* ESSENTIAL OIL

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Cyperus rotundus, a perennial creeper of family Cyperaceae is valued for its medicinal properties. The rhizome and leaves are used by the tribal people to cure anti-inflammatory responses like allergies, and urinary tract infections. However, there is no scientific suggestion to support the molecular mechanism through which this plant exerts its anti-inflammatory effect. The present research was to characterize the rhizome essential oil of *C. rotundus* and to explicate its anti-inflammatory action in lipopolysaccharide (LPS)-treated RAW264.7 cells. The rhizome oil of *C. rotundus* was extracted by hydrodistillation and the oil yield was estimated to be 0.27% (v/w). The GC-MS analysis showed a total of 46 constituents, accounted for 96.62% of total rhizome oil. The major compounds were cyperene (13.26 %), isolongifolen-5-one (10.24%), spathulenol (6.99 %), aristolone (6.98 %), longiverbenone (4.95 %), α-copaene (4.84 %), and cyperotundone (2.70 %). The cell viability was tested using MTT (3-(4, 5-dimethyl thiazol-2yl)-2, 5-diphenyl tetrazolium bromide) assay on LPS (Lipopolysaccharide) induced RAW 264.7 cell lines. The oil demonstrated cytotoxicicity with an IC_{50} of 229 µg/mL. The treatment of RAW 264.7 cells with *C. rotundus* rhizome oil and LPS, led to a remarkable concentration-dependent inhibition of prostaglandin E2 (PGE_2), nitric oxide (NO), and cytokines (tumor necrosis factor (TNF-α), IL-1β, IL-6) levels. Based on the findings it was concluded that *C. rotundus* rhizome oil exhibited remarkable anti-oxidant and anti-inflammatory activities and could be used as a potential therapeutic agent for the treatment of inflammatory diseases.

Keywords: *Cyperus rotundus*, Rhizome Essential Oil, Anti-Inflammatory Activity, RAW264.7 cells

PREY AND PREDATORS OF CRAB-EATING FROG IN MANGROVES OF BHITARKANIKA, ODISHA

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Bhitarkanika National Park is an important patch of mangrove along the east coast of India, a micro-environmental region of Rajnagar Block in Kendrapada district of Odisha. In Bhitarkanika National Park total of 14 species of amphibians belonging to five families including the Crab-eating Frog (*Frejervarya* cf. *cancrivor*a) is the only living modern amphibian species that can tolerate salinities up to 11 ppt. Distributed throughout Bhitarkanika even very close to sea, this species was found to be an opportunistic predator and it feeds on variety of prey items including marine crabs mainly of brachyuran crabs of *Episesarma species* (locally called Gunthia crabs). Adults were found to feed mainly on *Episesarma species*. Major food of cancrivora is crab, grasshopper, crickets, beetles, prawn, snails, ants, larval form of insects, round worms and other insects. The diet also includes spiders, snails, shed skins and of debris of insects, and plant matters were found in the gut content.

The main predators of Crab-eating Frog during the study are some species of birds and snakes seen in mangroves. The predator birds are Striated Heron (*Butroides striata*). Cattle Egret (*Bubulcus ibis*) and Common Crow (*Corvus splendens*). The predator snakes of these frogs in Bhitarkanika mangrove are Dog-faced water snake (*Cerberus rynchops*) and Chequered Keelback (*Fowlea piscator*) who mostly feed on adult frogs. Crab eating Frogs are components of transitional ecosystems in the estuaries and are important link in the mangrove food chain vulnerable to the effect of human actions both in the sea and. Findings indicate that there is a necessity of awareness and protection of mangroves along with its rich faunal diversity including the Crab-eating Frog.

Keywords: Mangrove, Crab-eating Frog, Food chain, Prey, Predator

PHENOLOGY OF DOMINANT GRASS SPECIES IN SUB-TROPICAL CLIMATE IN RELATION TO VARIOUS LAND COVERS IN ODISHA, EASTERN INDIA

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The plant-environment relation is well understood by phenological data. The change in biodiversity in different land cover was well understood by phenological data. The present investigation was carried out in four grassland communities containing three different landcover i.e. wetland, shrub land and grassland located in the Mayurbhanj district, Odisha, Eastern India from April to November 2022. Twenty dominant grass species were chosen for this experiment, and throughout one vegetative season, changes in each species' percentage cover, pheno-phase abundance, and species composition were examined. To ascertain the impact of species composition on seasonal variations and the proportion of seasonal shifting concerning time on specific species, multivariate statistical techniques i.e. RDA and CCA, were applied. Additionally, a Two-way ANOVA analysis was done to know the phenological index concerning time in various terrains. The results of the two-way ANOVA analysis indicate that compared to grassland and shrubland, moist land has a more diversified species distribution and a higher rate of pheno-phase shifting. Shrubland seems to have an early flowering time compared to grassland and moist land. The current data show that seasonal fluctuations and the amount of water available are the primary causes of pheno-phase shifting and that the positions of phenological maxima vary substantially among the three types of terrain. This work will help to understand the dynamics of vegetation in grassland ecosystems and also act as an indicator of climate change which is beneficial for future conservation strategy for the area.

Keywords: Phenology, Redundancy Analysis, Canonical Correspondence Analysis, Species Abundance, Land Covers, Eastern India

WAY FORWARD KORAPUT COFFEE SUPPLY CHAIN – FOR A SUSTAINABLE FUTURE

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Emerging India is faced with the challenge of sustaining its rapid economic growth while dealing with the global threat of climate change. Coffee is a sensational and emotional pleasure and a good cup of joe is enjoyed every day by billions of people around the world. Coffee is the second largest traded commodity in the world, next only to petroleum. In India, coffee is mainly cultivated in the hilly tracts of Karnataka, Kerala and Tamil Nadu and Southern states forming the traditional areas and to a small extent in non-traditional areas such as Andhra Pradesh, Odisha West Bengal, Maharashtra and North-Eastern states.

South-western part of Odisha covered by Eastern Ghats has evidence of coffee production since 1930's initiated by late Maharaja Bikram Dev Barma of Jeypore. Though coffee production and supply chain started a long year ago but it had a number of constrains and challenges. Lack of education and awareness among tribal plays an important factor for lesser amount of cultivation. Unavailability of land, labourers, uncertainty in seasonal rainfall ceases production. Inappropriate market structure, large marketing channels and selling price is not satisfactory to attract new growers. Biological challenges like insect pest infestation, newly emerging diseases are harmful for quality coffee beans.

Soil Conservation Department of Odisha State in 1958 started coffee plantation in in Machkund basin of Koraput and encouraged by the results, the department went for subsequent expansion in other areas suitable for coffee till 1989-90. Later, coffee plantation was introduced as a programme under Additional Central Assistance (Revised Long Term Action Plan - RLTAP) for undivided Koraput district to help the small marginal tribal farmers and landless people of BPL categories to become coffee growers. The success of coffee production and its emerging Koraput Coffee Supply Chain Practice is a success story for sustainable growth in India's economy.

Keywords: Coffee, Sustainable, Challenge, Economy, Supply Chain, Processes

AWARENESS OF BIODIVERSITY CONSERVATION THROUGH VISUAL ART

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Biodiversity and Conservation through Visual Art: Through artistic expressions such as drawing, paintings, sculpture, models, and visual aesthetics, art serves as a powerful tool to convey messages about environmental sustainability and the importance of preserving local cultural heritage. The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable, focuses on the protection and care of cultural property and cultural heritage. Conservation of biodiversity activities includes preventive conservation, examination, documentation, research, treatment, and education. Cultural property, also known as cultural heritage, comprises the physical items that are part of the cultural heritage of a group, society, or nation. They include such items as cultural landscapes, animals, birds, insects, aquatic life, and different types of crops and trees.

Conservation and preservation of biodiversity is very important to save the history, heritage, culture, etc. of a nation, convey its message to future generations, and help develop the country. This paper will discuss in detail how visual art can play an important role in biodiversity and its conservation work. Visual art is creative art whose products are to be appreciated by sight. The visual arts are art forms that create works that are primarily visual in nature, such as charts, models, posters, drawings, paintings, sculpture, collage work, clay modelling, woodwork, masks, terracotta, ceramics and pottery, designs, crafts works, and so on.

Keywords: Biodiversity, Conservation, Preservation, Cultural property, Heritage, Visual Art.

We share this planet with many species. It is our responsibility to protect them, both for their sakes and our own.

Pamela A. Matson

NAVIGATING PATHWAYS FOR A SUSTAINABLE FUTURE AND CONSERVING THE BIOLOGICAL RESOURCES OF INDIA THROUGH THE IMPLEMENTATION OF ACCESS AND BENEFIT SHARING PROVISIONS

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Biodiversity is considered as a safety net for the global communities as it provides various goods and services fundamental to the fulfilment of human needs. Conservation of biodiversity and sustainable use of biological resources is essential for maintaining the ecological functions and providing livelihoods for millions of people in this earth. However, biodiversity is being declined at a rapid rate globally on account of various manmade and natural factors. The emergence of Access and Benefit-Sharing (ABS) mechanisms under Biological Diversity Act, 2002 has given a new dimension to conservation efforts by integrating principles of equitable benefit-sharing between the conserver and users against commercial exploitation of biological resources. The bioresources have been collected by various traders, manufacturers, companies etc., for commercial purposes. As per the Section 2 to 7, 18, 19, to 24, of Biological Diversity Act, 2002 and Guidelines on access to biological resources and associated knowledge and benefits sharing regulations, 2014, the companies/traders/manufacturers are supposed to give ABS fees to the Biodiversity Management Committees (BMCs) and Individuals possessing traditional knowledge following Nagoya Protocols 2010. We examine the intricate relationship between biodiversity conservation and sustainable livelihood in context of functioning of ABS provisions in Odisha, India. We recommend that successful implementation of ABS provisions regulate access to biological resources while ensuring fair and equitable benefit-sharing among various stakeholders ultimately leading to sustainable management of biodiversity and securing livelihoods of resource dependent communities. As biodiversity conservation faces escalating challenges, ongoing evaluation and refinement of ABS mechanisms can address livelihood issues and optimize conservation outcomes, both in Odisha and globally.

Keywords: Access and Benefit-Sharing, BMCs, Biological resource, Sustainable Management

COMPARATIVE ASSESSMENT OF IRON OXIDE AND ZINC OXIDE NANOPARTICLES TOXICITY ON EARTHWORMS, *Eudrilus eugeniae*: AN ECOTOXICOLOGICAL TEST

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In the contemporary era, the widespread prevalence of nanoparticles, originating as byproducts from industrial procedures and consumer goods, raises notable apprehension due to their capacity to pollute soil ecosystems. Nanoparticles have been proven to disturb soil well-being and, consequently, endanger terrestrial creatures, especially soil-dwelling invertebrates like earthworms. Earthworms, typified by *Eudrilus eugeniae*, serve as vital gauges of soil condition and are essential for the preservation of soil fertility and health. The choice to include them in toxicological investigations is based on their fundamental function in soil environments. This study sought to compare and evaluate the detrimental impacts of iron oxide nanoparticles (IONPs) and zinc oxide nanoparticles (ZnONPs) on Eudrilus eugeniae. A range of thorough assessments was carried out to analyse the repercussions of these nanoparticles on the physical, behavioural, and anatomical attributes of earthworms. Two distinct methodologies were employed to scrutinise the effects of nanoparticles: direct exposure to nanoparticle solutions and interaction with soil tainted by nanoparticles. Both types of nanoparticles underwent these dual assessments. The findings provided profound insights into the toxicity of nanoparticles on earthworms. It was observed that IONPs triggered more pronounced adverse consequences in contrast to ZnONPs. The LC50 values were 871.63 ng and 1243.79 ng for direct contact test with IONP and ZnONP respectively, while 503.70 ug and 523.07 ug respective for soil exposure test in IONP and ZnONP exposure respectively. Particularly, IONPs led to modifications in the structure, conduct, and physiology of the earthworms in both experimental settings, underscoring their potential threat to soil environments. The subacute toxicity tests included analysis of morphological changes, behavioural changes (feeding, burrowing, locomotion, avoidance) and physiological changes (regeneration, reproduction, coelomocyte population).The heightened toxicity of IONPs could be linked to their composition, dimensions, or surface properties, necessitating further exploration.

Keywords : Nanoparticles, Nanotoxicity, Earthworms, *Eudrilus eugeniae*, IONP, ZnONP

POPULATION STRUCTURE, DISTRIBUTION MAPPING, GENETIC DIVERSITY, BIOPROSPECTING AND PROPAGATION OF *CYCAS SPHAERICA* ROXB. – AN ENDEMIC GYMNOSPERM OF INDIA

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Cycas sphaerica Roxb. (Cycadaceae), an endemic and threatened gymnosperm of India, is restricted to the Eastern Ghats region. In view of its rapidly declining wild populations and narrow range of distribution, the species has been listed as an 'Endangered' taxon by IUCN. The species has experienced serious human-induced interferences during the last 2-3 decades largely due to habitat destruction, over-exploitation coupled with biological bottlenecks such as slow growth rate, poor seed germination, inadequate seedling establishment and over-harvesting of mature seeds for use as food items. In view of its rarity and being an important ethno-medicinal plant, there is an urgent need for formulation of appropriate conservation strategies. The present study aimed to conduct a quantitative survey of wild populations of *C. sphaerica*, evaluate its genetic diversity, explore its practical uses, and develop effective propagation methods for mass production of planting stocks. Additionally, ecological niche modelling was utilized to map the species' distribution in the wild, identify sister populations, and locate suitable habitats for reintroduction. Population size and structure, including seedlings, saplings, immature, and mature individuals in various forest locations of the Eastern Ghats, were documented. The populations exhibiting maximum genetic diversity, determined using Inter simple sequence repeats (ISSR) molecular marker, were identified as priority sites for in situ conservation. Analysis of endosperm proximate composition and nutritional values indicated that the flour is rich in carbohydrates, proteins, fats, ash, as well as essential and non-essential amino acids. Furthermore, seed and vegetative propagation methods were standardized, and a large number of plants were reintroduced to potential wild habitats to reinforce existing populations, ensuring the long-term survival of this endangered species.

Keywords: Gymnosperm, Eastern Ghats, Molecular Marker, Proximate Composition

ANNOTATED CHECKLIST OF BIRDS OF SHRIRAMCHANDRAPUR, GANJAM DISTRICT, ODISHA

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Birds play a crucial role in maintaining healthy ecosystems. They can act as pollinators, seed dispersers, and pest control agents. Understanding their populations and behaviours can offer insights into the health of the local environment. With the pressures of habitat loss and climate change due to human activities, it's crucial to monitor bird populations to inform conservation strategies. Studies can help identify critical habitats and the impact of human activities on bird communities. The present field study was carried to record variety and abundance of birds in Shriramchandrapur (19.31° North latitude and 84.94° East longitude) of Ganjam district, Odisha which is a central place between Tampara lake and Indian Rare Earths Limited (IREL). The field survey was carried from January 2024 to February 2024. Pictures of birds were taken and sounds were recorded using camera and recorder app in mobile phone respectively and were identified using Google lens, BirdNet app and for the conformation purpose the Cornell lab of Ornithology and the book of Indian birds (Ali S, 1941) were used as references. This survey showed the occurrence of 15 species belonging to 13 families. All the birds identified are resident birds having a conservation status of least concerned by IUCN. However, bird study at Shriramchandrapur was done for the first time for estimating the variety of avifauna in the locality and this differs from bird species number of 46 in Tampara lake area as per a previous study report. Hence, there is a need for further study on human interference on avian population in this area.

Keywords: Birds; Checklist; Ganjam; Shriramchandrapur; IUCN; Occurrence; Diversity

Uniformity is not nature's way;
diversity is nature's way.

Vandana Shiva

PARASITIC PLANTS OF KORAPUT DISTRICT AND THEIR ETHNOMEDICINAL USES

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Most plants are photoautotrophic and produce organic materials from simple inorganic substances like carbon dioxide and water. But parasitic plants are exceptions for the fact that they derive readymade organic nutrients from the host plants. Parasitic plants create connection with the host vascular system through specialised structures known as haustoria. Unidirectional flow of nutrients to parasite put great constraint on the growth and reproduction of host plant. They cause damage to agriculture and forestry and reduce the growth and fitness of the host plants. Although most parasites are damaging to host plants, some parasites are keystone species in natural ecosystem. Parasitic plants attached to multiple host plants create a network for transferring systemic signals. They also have positive influence in community biodiversity and nutrient cycling. Parasitic plants have also been used as medicine by ethnic communities, including those in the Koraput region. Survey was conducted for a period of five years since 2018 in different parts of Koraput district to study the parasitic plants and their ethnobotanical uses. Total number of 12 species of plants were collected which belonged to 5 families. Family Orobanchaceae is represented by 5 species which is the highest among the families collected. Family Santalaceae is represented by 3 species, Loranthaceae by 2 species, families Convolvulaceae and Lauraceae by 1 species each. The parasitic plants used as medicine by the indigenous people of Koraput are *Centranthera tranquebarica* and *Alectra sessiliflora* for wound healing, *Striga angustifolia* for skin, *Parasopubia delphinifolia* and *Santalum album* for fever, *Dendrophthoe falcata* and *Viscum album* for boils, *Cuscuta reflexa* and *Cassytha filiformis* for sprain, *Scurrula parasitica* as aphrodisiac, *Viscum articulatum* for bleeding gum and toothache and *Aeginetia indica* as tonic.

Keywords: Parasitic, Haustoria, Ethnobotanical, Indigenous

AN ASSESSMENT OF ELEPHANT MOVEMENT PATTERNS AND HABITAT IMPROVEMENT STRATEGIES TO MITIGATE HUMAN-ELEPHANT CONFLICT IN DHENKANAL FOREST DIVISION, ODISHA, INDIA

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India harbours the largest population of Asian elephants (*Elephas maximus*), and 72% of the Elephant population in the eastern state region is occupied by Odisha state. Natural habitats or forest lands have been rapidly exploited due to increased anthropogenic activities. As a result, wild elephants frequently move towards agricultural fields to feed on cultivated crops, which later turns into a conflict between Humans and Elephants. The observation is based on the data of iWLMS, 2021 and habitat improvement work undertaken in Dhenkanal Forest Division (DFD) during the last 10 years. The study found that the Elephant movement along the boundary of existing forests in Dhenkanal creates situations that result in conflicts, especially in areas where the boundary is patchy and elongated. The agricultural land in the vicinity of existing forests has significant elephant movement. Change of existing agriculture practices from paddy to other alternative short-duration crops could be a key to mitigating conflicts. To mitigate these issues as well as the threat to Wild elephants, DFD has improved their habitat through fruit and fodder plantation, development of meadows, and construction of water holding structures (WHS) inside the Reserve Forests (RF) and Kapilash Wildlife Sanctuary (KWS). Also, various signages have been installed in the villages near the RF and KWS of DFD to inform the villagers about the protection of wild Elephants and protect them from attacks by wild Elephants.

Keywords: Human-Elephant conflict, Asian Elephant, Dhenkanal Forest Division

ASSOCIATION OF COVID-19 DISEASE WITH BLOOD GROUP AMONG THE TRIBAL POPULATION OF NABARANGPUR DISTRICT (ODISHA).

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The district of Nabarangpur is the part of Koraput-Balangir-Kalahandi (KBK) region located amidst the Gandhamardan hill where several tribal groups inhabit having their distinct cultural identity. A total number of 170 tribal populations were assimilated in the present study in which 55.73 percent male were found afflicted with Covid-19 while 44.27 percent were afflicted were female. ABO blood group system is found to be associated with disease development. It has been also found that the Antigens of the ABO blood group system is expressed on the membrane covering the RBC. Due to this, the RBC has been used as a major tool in the investigation of the causative agent for every pathogen whether they be viral, bacterial or parasitic. In the present study, COVID-19 was found a strong association with the blood groups. The blood group A+ (40.00%) has a strong association with Covid-19 followed by B+ (36.47%) and O+ (20.00%) while AB+ has a weak association with a percent of 3.53. Besides, COVID-19 has a strong affinity with B+ ($P<0.5=0.000535$) blood group among the Bhatra tribe. It has also been found that the encounter and spread of COVID-19 among the tribal population can be linked *vis a vis* with the genetic composition, immune profile, nutritional status, risk of infection as well as the tribal approach of tackling of Covid-19.

Keywords : COVID-19, ABO Blood Group, Tribal, Nabarangpur

DIVERSITY OF MEDICINAL PLANTS IN MODEL MEDICINAL GARDEN IN SOGAR VILLAGE OF DHENKANAL DISTRICT AND SUSTAINABLE EXPLOITATION ANALYSIS

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A model medicinal garden developed over 763 acres of land in the SOGAR village of Dhenkanal District of Odisha with more than 64000 plants of different varieties. The project includes the plantation of medicinal saplings, the construction of a research centre, a water harvesting structure, and many more mini-irrigation projects. A study has been undertaken to gather knowledge about ethnobotanical plant diversity, forest management tactics for sustainable development changing thinking of people on medicinal plants with awareness assessment of people on skilled and sustainable exploitation of medicinal plants by conducting several field trips, by interacting with forest officials, horticulturists, taxonomists and villages living around the model garden. During the awareness assessment for the sustainable exploitation of medicinal plants, I observed around 52% of the population of nearby villages depend on plants for health benefits but 83% of people were unaware of many medicinal plants in the model garden and in nearby forests, their uses, sustainable exploitation and ecological damage. Hence a targeted approach for the development and conservation of this kind of model medicinal garden in each district of Odisha for biodiversity conservation and sustainable exploitation is suggested. Key Words: SOGAR, ethno-medicinal diversity, sustainable exploitation, biodiversity conservation, awareness assessment.

Keywords: Sustainable Development, Ethnomedicine, Ecological Damage

A PHYSICO-CHEMICAL ANALYSIS OF DAYA RIVER, BHUBANESWAR

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Bhubaneswar City poses problems with liquid waste disposal and allows it to a natural drain (Gangua Drain) to the River Daya which is the hydrographic lifeline of the south Mahanadi Delta and a major freshwater source to the largest lagoon of Asia, the Chilika. The Daya River plays an important role in maintaining the urban and rural ecosystems. The river provides a habitat for various flora and fauna. With the increasing anthropogenic activities, the wealth of this river could

face threats and disturbed ecosystem soon. The present study was conducted to determine the water quality downstream in 2022. Weekly water samples were taken for the non–monsoon and monsoon to study the chemical toxicity and their impact on water quality parameters due to human activity. The water quality parameters determined are pH, DO, BOD, COD, TDS, Ca, P, K, Ni, and analysis of heavy metals. The result shows the water quality during the post-monsoonal period is deteriorating due to various anthropogenic impacts.

Keywords: Heavy Metals, Anthropogenic, Mahanadi, Daya, Chilka.

FLORISTIC COMPOSITION AND BIOLOGICAL SPECTRUM OF A PROTECTED GRASSLAND COMMUNITY OF EGRA IN EAST MEDINIPUR DISTRICT, WEST BENGAL

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The grassland floristic diversity of Egra (21.906193^{0}N, 87.538877^{0}E) in East Medinipur district of West Bengal was studied from July 2021 to July 2023. The grassland was protected for last one year before this investigation. The grassland community of Egra comprised of 94 species (28 Grasses and 66 Non-Grasses) belongs to 71 genera and 24 families. Among all, the family Poaceae occupies a great number of species i.e. 28 species (29.78%) followed by Cyperaceae 12 species (12.76%), Amaranthaceae seven (07) species (7.44%), Commelinaceae and Fabaceae 4 species each (4.25%). The species belonging to Asteraceae, and Malvaceae contribute 6 species each (6.38%), Convolvulaceae, Plantaginaceae, and Rubiaceae three (03) species each (3.19%), Lamiaceae, Linderniaceae, Bassicaceae and Euphorbiaceae two (02) species each (2.12%), while the remaining 10 families represent single species each (1.06%). The life-form classes when compared with Raunkiaer's (1934) normal spectrum showed a higher percentage of chamaephytes and therophytes. This variation in species composition and Biological Spectrum of this grassland community might be due to the geographical distribution and climatic condition of the locality.

Keywords: Floristic Composition, Biological Spectrum, Grassland, Egra, East Medinipur, West Bengal.

RECONNOITRING THE BINDING EFFICACY OF BIOLOGICAL COMPOUNDS TO CYANOBACTERIAL CARBONIC ANHYDRASE: *IN-SILICO*

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Cyanobacteria in water bodies cause harmful cyanobacterial blooms, releasing toxins that degrade water quality and cause health issues. Common Harmful Algal Bloom-related disorders (HABs) include neurotoxic shellfish poisoning, ciguatera poisoning, paralytic shellfish poisoning, diarrhetic shellfish poisoning, and amnesic shellfish poisoning. Cyanobacteria, adapting to high temperatures and humidity also colonize historical sites, causing staining and erosion, reducing their aesthetic value. This study aimed to identify the potent natural compounds from the COCONUT database that will diminish the growth of cyanobacteria. In this context, we have chosen carbonic anhydrase that plays an essential role in the interconversion of water and carbon dioxide to bicarbonates and makes it to available to RuBisCo. Based on the non-toxic nature and high docking score, the selected natural compounds were considered for further dynamics. They were compared with the reference ethoxzolamide. Further molecular dynamics study was conducted for a period of 100 ns to examine the stability of the natural compounds including the reference molecule to the binding site of CA. The free energy binding was calculated by the MMPBSA method. The molecules obtained could act as potent bio-algaecides. Further, experimental studies are necessary to validate the identified leads against a wide range of cyanobacterial species that are capable of secreting toxins in the environment.

Keywords: COCONUT Database, Cyanobacterial CAs, MD Simulation, MMPBSA

PLANT TISSUE CULTURE MEDIATED CONSERVATION: LAB TO LAND

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The rapid loss of biodiversity driven by factors such as habitat destruction, climate change, and anthropogenic activities has made traditional conservation methods inadequate for protecting plant species. Plant tissue culture has emerged as a beacon of hope in the face of biodiversity loss. It stands as a testament to the human determination to preserve and propagate plant species of medicinal as well as economic importance. However, the true success in the path of safeguarding the planet's unique flora would be the integration of laboratory-based tissue culture procedures into real-world conservation practices. Practices such as the successful reintroduction of the plants raised by tissue culture in their wild habitat are effective methods for germplasm conservation and ecosystem restoration. Furthermore, incorporation of plant tissue culture procedures, may it be the establishment of shoot, callus or cell suspension culture, in bioreactors provides a cost-effective and sustainable means for mass production of many valuable bioactive compounds. It enables the commercial utilisation of bioactive compounds without exploiting the wild population. In this review, we have attempted to compile the available literature on the practical implementation of plant tissue culture-mediated conservation from the laboratory to the real-world.

Keywords: Conservation, Climate Change, Tissue Culture, Germplasm

INDIGENOUS COMMUNICATION PATTERN IN ENVIRONMENT PROTECTION: A STUDY OF *PARAJA* TRIBE OF KORAPUT, ODISHA

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The world's indigenous and ethnic peoples have learned to exist in some of the most difficult environments in the cosmos. The most noteworthy aspect of indigenous and ethnic people is that they live in areas with a high biodiversity. It is believed that there are over 300 million indigenous people in the world, with roughly half of them living in Asia. These indigenous people play an important part in the conservation of the environment and the development process as they possess traditional knowledge that could be used for eco-restoration or environmental protection. It has been observed that these individuals understand how to live in peace with nature. Paraja is a well-known main Scheduled Tribe (ST) in Odisha. In comparison to other states, the tribe has the highest concentration in Odisha, which they regard as their homeland, with around three and a half lakh people, accounting for 3.89 percent of the total ST population and ranking as the state's tenth largest ST according to the 2001 census. In comparison to the 1991 census, their population has grown by 10.20% over the last decade. Culture plays a significant role in protecting the environment and critical ecosystems. The purpose of this study is to explore the relevance of indigenous beliefs, sacred sites, cultural practices, and communication patterns in promoting environmental conservation. The Paraja tribes practice their tribal religion, which combines worship of nature with God. The village's supreme deities, *Jakar*, the soil goddess, are worshiped as the deity of agriculture. They are installed under a tree shed on the outskirts. The village's deity, Nissani Munda, is worshipped by the traditional priest Jani in the centre of the street. During rites and festivals, she is worshipped as a protector of the village against disasters. They also worship nature's deities in hills, forests, streams, and rivers, such as dongar devta (hill God). The study will be based on the communication patterns followed by the Paraja Tribes in protecting environment, which can be replicated by the general society for preserving the eco system.

Keywords: Indigenous Culture, Environment Protection, Paraja Tribe, Nissani Munda

POTENTIAL OF MEDIA FOR BIODIVERSITY CONSERVATION

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Media platforms are important in shaping public perceptions, attitudes, and behaviors for biodiversity conservation. This paper examines the role of media in conservation efforts, exploring the various strategies, challenges, and opportunities inherent in the power of media for biodiversity conservation. Media is a catalyst for raising awareness, mobilizing support, and driving action on biodiversity conservation issues. Through storytelling, visual imagery, and interactive engagement, media channels can communicate the importance of biodiversity and the urgency of conservation action. Media provides a platform for showcasing successful conservation initiatives and inspiring individuals and communities to take meaningful steps toward protecting and preserving ecosystems and species. Discussion on the challenges of media engagement in biodiversity conservation also finds its place as media coverage often neglects marginalized voices and underrepresented conservation efforts, hindering efforts to promote inclusivity and equity in conservation discourse. The importance of strategic communication, media literacy, and collaboration among stakeholders is looked at. By adopting evidence-based messaging, fostering partnerships between scientists, communicators, and policymakers, and promoting media literacy among audiences, conservation practitioners can maximize the impact of media in advancing biodiversity conservation goals. By recognizing the potential of media as a force for positive change, stakeholders can work together to amplify conservation messages, foster public engagement, and promote collective action toward a more sustainable and biodiverse future.

Keywords: Media, Biodiversity Conservation, Communication, Challenges, Sustainability

Theme-III Biodiversity, Agriculture and Threats of Climate Change Conservation

SEED DORMANCY IN RICE: A POTENTIAL TRAITS FOR DEVELOPMENT OF CLIMATE RESILIENT RICE UNDER INCLEMENT WEATHER CONDITIONS

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Seed dormancy is a crucial trait that allows plants to survive unfavourable conditions, such as drought, extreme temperatures, and flooding. By understanding and manipulating the pathways involved in carbohydrate metabolism, researchers and farmers can enhance seed dormancy in rice, leading to more resilient crops that can better withstand the challenges of climate change. An experiment was conducted where germination%, time of germination, seedling vigor index, total soluble sugars, starch concentration and α-amylase activities were measured in contrasting seed genotypes. Dormant, semi-dormant and non-dormant seeds were used in the experiment and were classified based on the first screening on the basis of morpho-physiological characteristics at various sampling occasions. Dormant seeds had lower total soluble sugar concentration and α-amylase activity compared to semi-dormant seeds, while non-dormant seeds had the greatest concentration. In non-dormant seeds, 100% germination occurred whereas, in semi-dormant seeds, germination was declined dramatically and reached nearly zero for certain period of time. Dormant seeds reached their peak germination in mid-year and stopped during the harvest season. Even though the climatic is ideal for germination, seed germination does not occur in dormant seeds. The approach holds promise for improving agricultural sustainability and food security in the face of increasingly unpredictable weather patterns.

Keywords: Seed Dormancy, Climate Change, Rice Crop Sustainability, Environmental Stress Adaptation

ENHANCING ECOSYSTEM SERVICES FOR CLIMATE RESILIENCE: HARNESSING THE POTENTIAL OF BIOLOGICAL CONTROL IN AGROECOSYSTEMS

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As global agriculture faces unprecedented challenges from climate change, there is an urgent need to develop resilient and sustainable practices to ensure food security and environmental stability. This paper focuses on the critical role of biological control in enhancing ecosystem services and bolstering climate resilience within agroecosystems. Biological control, a sustainable pest management approach, utilizes natural enemies such as predators, parasitoids, and pathogens to regulate pest populations. Unlike chemical pesticides, biological control operates within the framework of natural processes, minimizing environmental risks while promoting biodiversity and ecological balance. In the context of climate change, biological control offers a flexible and adaptive strategy to mitigate the impacts of shifting environmental conditions on pest dynamics. By harnessing the potential of natural enemies, agricultural stakeholders can reduce reliance on chemical inputs, promote soil health, and enhance ecosystem resilience.

This abstract explores innovative strategies for harnessing biological control to enhance ecosystem services and climate resilience in agriculture. It discusses the importance of habitat diversification, conservation of natural enemies, and collaboration between farmers, researchers, and policymakers. In conclusion, the integration of biological control into agroecosystems is essential for enhancing ecosystem services, fostering climate resilience, and ensuring the long-term sustainability of global food production systems. Embracing biological control initiatives is paramount for building resilient agricultural systems capable of adapting to the challenges of a changing climate.

Keywords: Global Agriculture, Sustainable Practices, Habitat Diversification

BIOCHAR: A SUSTAINABLE TOOL FOR CLIMATE RESILIENT AGRICULTURE

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Climate change significantly impacts agriculture, with recent warming trends posing challenges for global food production. Agriculture itself is a major contributor to greenhouse gas emissions, notably carbon dioxide, methane, and nitrous oxide. The rice-wheat cropping system prevails, especially in Asia, where it accounts for approximately 90% of global rice production and consumption. To meet the demands of a growing population, rice production needs to increase by 60% by 2025. However, issues such as low nitrogen use efficiency, methane emissions, and inadequate crop residue management threaten the sustainability of rice-wheat systems, leading to environmental degradation and economic burdens. Biochar, a carbon-rich material, is gaining traction for its potential to enhance soil health and crop growth while mitigating climate change. Biochar-based fertilizers represent a novel resource conservation technology that is being explored worldwide to sustainably intensify agricultural production systems. By bolstering the soil's carbon pool as a soil amendment and improving nutrient use efficiency as a carrier, biochar holds promise for enhancing agricultural sustainability. The growing interest in biochar's applicability in agriculture and its broader impact on climate change, soil health, and plant growth has spurred research across agricultural, atmospheric, geological, and environmental sciences. Ongoing investigations into biochar-based slow or controlled-release fertilizers highlight a novel approach to optimizing plant growth efficiently.

Keywords: Climate Change, Residue Burning, Sustainability, Soil Health, Nutrient Use Efficiency

CLIMATE CHANGE - INDUCEDENHANCEMENT OF UV-B RADIATION IN THE ATMOSPHERE AND ITS DIFFERENTIAL IMPACT ON CONTRASTING RICE CULTIVARS

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Climate change and stratospheric ozone dynamics have influenced the amount of UV-B radiation reaching the earth's surface in recent years. This narrow but biologically active light spectrum (280-320nm) can affect plant growth and development. Increased UV-B radiation has a negative impact on crop development because it reduces leaf photosynthesis significantly. High-yielding rice genotypes are highly vulnerable to various stresses, particularly UV-B radiation. Traditional rice cultivars, on the other hand, are resistant to adversities of UV-B radiation. Traditional rice cultivars with high levels of anthocyanins and flavonoids in their leaf epidermal layers are particularly resistant to UV-B radiation. As a result, the current study attempted to understand the mechanisms underlying UV-B resistance in rice cultivars. To assess variety-specific differences in response to supplemental UV-B radiation, two contrasting cultivars, Lalkain and Swarnaprabha, were effectively screened. In response to supplementary UV-B radiation, the Lalkain cultivar produced more flavonoids and anthocyanin than Swarnaprabha. In contrast, the drop in chlorophyll and carotenoids and reduced chlorophyll fluorescence caused by UV-B treatment was significantly greater in the latter than in the former. Climate change induced enhancement of UV-B radiation in the biosphere and its impact on rice cultivars studied demonstrates potential for enhancing agricultural sustainability and food security amidst the escalating challenge of unpredictable UV-B radiation exposure.

Keywords: Climate Change, Leaf Photosynthesis, Traditional Rice Cultivars, Agricultural Sustainability, Food Security

EXPLORING THE IMPACT OF VARIED CLIMATIC CONDITIONS ON SORGHUM BICOLOR CULTIVATION

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In light of shifting climatic patterns, farmers will confront progressively intricate decisions regarding crop selection, cultivation locations, timing, and optimal management practices, underscoring the escalating challenges posed by climate change in agricultural contexts. Sorghum bicolour, commonly known as sorghum, is a vital cereal crop cultivated worldwide, particularly in regions susceptible to diverse climatic conditions. This paper investigates the profound influence of varying climatic factors on Sorghum bicolored cultivation. Through an extensive analysis of existing literature and empirical evidence, this study elucidates the intricate interplay between climatic variables and different aspects of sorghum growth and yield. It examines how factors such as temperature, precipitation patterns, humidity levels, and sunlight exposure affect the phenological stages, physiological processes, and overall productivity of Sorghum bicolor. Furthermore, the adaptive mechanisms employed by sorghum plants to cope with diverse climatic conditions are explored, highlighting the genetic diversity within Sorghum bicolor populations. Additionally, this paper discusses the implications of climate change on sorghum cultivation practices, emphasizing the urgent need for developing resilient sorghum cultivars and adaptive strategies to mitigate potential risks and ensure global food security. By deepening our understanding of the intricate relationship between diverse climatic conditions and Sorghum bicolor cultivation, this research provides valuable insights for policymakers, agronomists, and researchers working towards enhancing sorghum productivity and sustainability in the face of a changing climate. This study underscores the importance of prioritizing research and development efforts aimed at improving sorghum resilience and adaptation strategies to safeguard food production systems against the challenges posed by climate variability and change.

Keywords: Sorghum bicolor, Climatic Factors, Phenology, Physiology, Productivity, Genetic Diversity

EXPLORING WEATHER INFLUENCES ON SHOOT AND FRUIT BORER, EARIAS VITTELLA FAB. INFESTATION IN OKRA: A COMPREHENSIVE ANALYSIS

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A field study aimed to assess the seasonal occurrence and influence of weather conditions on the shoot and fruit borer (*Earias vittella*) infestation in okra (variety Arka Anamika) at the Central Research Station of Odisha University of Agriculture and Technology in Bhubaneswar, Odisha. The study period spanned the kharif seasons of 2019 and 2020, as well as the summer season of 2021. The initial infestation of E. vittella in the fruit was observed during the 37th SMW (second week of September) in 2019 and the 36th SMW (first week of September) in 2020. The highest infestation rates were recorded during the 39th SMW (fourth week of September) and the 40th SMW (first week of October) in 2019 and 2020, respectively, with rates reaching 18.81% and 17.06%. In the summer of 2021, the peak infestation, resulting in 13.95% damage, occurred during the 24th SMW (second week of June). In the kharif season of 2020, both maximum and minimum temperatures exhibited a significant negative correlation (r= -0.926 and r= -0.880, respectively) with the damage caused by the shoot and fruit borer. Bright sunshine hours also showed a significant negative correlation (r= -0.995), while morning relative humidity demonstrated a significant positive correlation (r= 0.939). During the summer of 2021, both minimum temperature (r= 0.974) and wind speed (r= 0.955) were significantly negatively correlated with fruit damage. When considering the combined impact of all three seasons, maximum and minimum temperatures (r=-0.699 and r=-0.588, respectively) and bright sunshine hours (r= 0.715) demonstrated a significant negative influence on pest population. Conversely, both morning and evening relative humidity (r= 0.649 and r= 0.681, respectively) and rainfall (r= 0.659) had a significant positive effect.

Keywords: Okra, Shoot and fruit borer, Seasonal incidence, Correlation

ESTUARINE FISHES AS INDICATOR OF HEAVY METAL POLLUTION: A CASE STUDY FROM BRAHMANI-BAITARANI ESTUARY, ODISHA, INDIA

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Aquatic pollution has become an unavoidable consequence of increasing industrialization and urbanization. Heavy metal pollution can arise from various sources, including direct atmospheric depositions, geological weathering as well as discharges from municipal, agricultural and industrial activities. When present in higher concentrations in water and sediment, heavy metal pollution poses a serious threat in terms of potential hazards associated with toxicity, as well as the accumulation and magnification of these metals within the food chain. Fish serve as crucial bio indicators for assessing metal pollution due to their natural characteristics and sensitivity to changes in the environment. In this context, the current study aims to evaluate the impact of heavy metal pollution on selected fish species from the Brahmani-Baitarani estuary, focusing on oxidative stress. Notably, significant alterations in water parameters such as temperature, pH and salinity were observed as part of this study. A higher concentration of Cu was detected in the water, with an increase noted from the monsoon period to the post-monsoon period. Metal accumulation followed the order: muscle > gills > liver for Cu, while for Cr, the order was liver > gills > muscle. Antioxidant enzyme activity was also observed as part of the study. There was a positive significant relationship (R^2>0.05) of GST in *Arius arius* with water temperature and salinity. But in case of *Liza parsia*, it was negatively significant. The calculated Daily Intake values were found to be lower than the standard reference dose, even though the amounts of Cu and Cr in the muscles exceeded the WHO permissible limits. This implies that the fish's muscle tissues are still safe for consumption by humans. Anthropogenic activities such as excessive fishing and industrial runoffs contribute to the escalation of pollution in estuarine waters, leading to physiological stress in aquatic animals. Regular monitoring is crucial in addressing this situation, offering a means to combat the rising water pollution and its associated effects.

Keywords: Bioaccumulation, Biological oxidative stress, BAF, EDI, Estuarine pollution, Heavy metals

SALTMARSH GRASS AS POTENTIAL BLUE CARBON SINK IN THE WESTERN BAY OF BENGAL

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Wetlands are dynamic in nature and Bhitarkanika mangrove ecosystem in Odisha is not an exception. This plays an immense role in global carbon cycle by storing organic carbon in biomass in sediments. In present study, investigation was carried out in pre-monsoon, monsoon and post-monsoon season during 2023 on biomass and carbon of two important coastal saltmarsh grasses of Poaceae family (namely *Porteresia coarctata* and *Myriostachya wightiana*). The study area was located at Gupti, Hawal, Dangamal and Kalibhanjadia. The result showed more biomass (7.5 tonnes/ha) and carbon (3.30 tonnes/ha) in *Myriostachya wightiana* at Dangmal than the biomass (3.21 tonnes/ha) and carbon (1.41 tonns/ha) of *Porteresia coarctata* at Gupti. Similarly the carbon dioxide equivalent was also high in case of *Myriostachya wightiana* (12.078 tonns/ha) at Dangmal than *Porteresia coarctata* (5.161 tonnes/ha) at Gupti. Soil parameters were also studied simultaneously which showed higher soil organic carbon at Dangmal (0.72%) and lowest at Hawal (0.21%). A significant positive relationship of biomass and carbon was established with soil organic carbon and pH whereas significantly negative relationship was observed in case of soil salinity. In case of water there was significantly negative correlation with water salinity and significantly positive correlation with water pH. The study infers *Myriostachya wightiana* species to be rich carbon sink than *Porteresia coarctata* in the selected study site. Hence looking at the crucial role of salt marsh grass as a carbon sink, it is necessary to conserve and restore the salt marsh grass to minimize carbon dioxide at a local level.

Keywords: Bhitarkanika Mangrove Ecosystem, Carbon Dioxide Equivalent, *Myriostachya wightiana*, *Porteresia coarctata,* Soil and Water Parameters

Bonda Tribe is Battling on Climate Change in Agriculture

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Bonda tribe is one of the first forest dweller tribe in India, which dates back at least 60000 years ago. The Bonda tribe nestled in remote forest hills of Malkangiri district, Odisha, which lies in the southern part of Odisha. It is between the junction of three states Odisha, Chhattisgarh and Andhra Pradesh. The Bonda peoples belong to the Austro-Asiatic group, they fall under 13 PVTGs recognized by government of India. Bonda tribe resides in the lap of nature amidst the rolling hills and forest land where they cultivate crops as per their needs and inhabiting the place away from others for generations. The tribe has sustained their living previously by cultivating traditional crops using traditional methods and following old ways like collecting minor forest produce, for any occasion or festival. They use the indigenous way to get liquor from trees or ferment the rice and other millets to produce the liquor. But in the few decades, due to government initiatives their way of cultivation has changed due to introduction of new forms of HYVs (High Yielding Variety seeds). In that area which helped them to fulfil their food needs. But new challenges also risen due to various factors in the name of climate change, which gave a shock pattern in that area. Due to climate change, it has a huge impact in their economy and crop cultivating pattern as for some few years due to heavy rain in that particular hill section leads to wash away the fertile top soil from the slop which destroy their crops and hence for the next crop to yield again. Bonda farmers are facing some financial crunch which reflects their dire situation over the period due to change in climate like rise in temperature, heavy rainfall, flash floods and land slides making their life hard and now for the sustenance they need to adopt or mitigates a different way to lead their life.

Keywords: HYVs, Climate change, Cultivation, Traditional method, Crop cultivation, Fertile soil, Rainfall, Flash flood, Landslide

The world will not be destroyed by those who do evil, but by those who watch them without doing anything."

Albert Einstein

MAPPING THE COMMONS: A GENDERED PERSPECTIVE ON CLIMATE CHANGE IN KORAPUT DISTRICT

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The intricate connection between gender, commons, and climate change in India is profound. Gender inequality and climate change have reciprocal impacts. In 10 villages of the Koraput district, indigenous women leaders conducted commons mapping, uncovering the depletion of shared natural resources and knowledge commons. This detrimentally affects the community's livelihood and quality of life, especially impacting women who possess vital knowledge and skills in utilizing and conserving these resources. Indigenous women in Koraput face the adverse consequences of degrading commons and climate change in multiple ways. Their sustainable practices in harvesting common resources are intertwined with the rituals and festivals observed by diverse ethnic groups in Koraput. Despite their innovative ideas to restore biodiversity and transform the commons into living commons, indigenous women play a passive role in the governance of these resources.

Keywords: Climate Change, Livelihood, Gender Inequality, Biodiversity, Koraput

CHARACTERIZATION OF SOIL AMENDED WITH ORGANIC MATTER IN ZARIA METROPOLIS

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The continuous application of inorganic fertilizers exclusive of organic matter addition has subverted soil health and resulted to environmental pollution. This problem can be alleviated by adding organic amendment to soil. The study characterized soil amended with selected organic matter in Zaria metropolis. The experimental field size of 200 m^2 (measuring 20 m by 10 m) was cleared and divided into six (6) strips labelled T1 to T6, with each strip measuring 40m^2. 50 kg each of Cow dung and poultry litter was applied into the furrow of strip T2 and strip T3, while T1 was the control strip with strip T4 through strip T6 had

proportionate mix ratios. Result showed Strip T2 (50kg cow dung (100%) had the highest average bulk density of 1.32 g·cm–3. Soil amended with 50kg poultry litter (T3) had the highest porosity value of 48.71%. T4 (37.5kg cow dung + 13.5kg poultry litter) had the highest degree of saturation of 5.12 % with 24.08% organic carbon, while T3 (50kg poultry litter (100%)) having the lowest 4.18%. T5 (25kg cow dung + 25kg poultry litter) strip recorded 2.20% the highest organic matter of 0.9%. There was a variation in hydraulic conductivity for all the treatment. It can be concluded that both amended had positive impact on soil properties.

Keywords: Organic Matter, Soil, Amendment

OPTIMIZATION OF ABIOTIC FACTORS INFLUENCING OIL YIELD AND PHYTOCHEMICAL COMPOSITION IN *Moringa oleifera* LAM. SEED OIL

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Moringa oleifera Lam. of family Moringaceae is highly valued worldwide for its medicinal and economic significance**.** The major barrier for production of *M. oleifera* oil in India is the lack of high oil-yielding genotypes and by simple chemotyping, genetically superior seeds with high yield is not possible as oil production is largely influenced by environmental factors. This study aims to report the optimization of drug yield in *M. oleifera* seed oil by development of RSM model. This is the first study of its kind to best of our knowledge. Oil was extracted from 10 different agroclimatic zones in Odisha. Phytochemical analysis was done by 2DGC-TOF-MS. Effect of environmental parameters on oil yield and phytochemical composition was determined by regression model and represented by two-dimensional contour plots and three-dimensional response surface curve using Minitab statistical software 17. There was a wide range of oil yield between all the regions, ranging from 6 to 33% on dry weight basis. Major phytoconstituents differed among agroclimatic regions. Regression analysis showed significant effect of temperature in production of more oil from *M. oleifera* seeds (minimum avg temperature p=0.04 and maximum. Avg temperature p=0.03), which was also observed in response surface plots. This study indicates that best oil yield was produced in the North West plateau, North Central Plateau, North Eastern Ghat and Western Central Table Land of Odisha. These results would also contribute to selection of elite genotypes or cultivars that are well suited to specific agro-climatic zones based on the production of secondary metabolites.

Keywords: *Moringa oleifera*, Response Surface Methodology, Environmental Factors, Oil Yield, Phytochemicals, Agroclimatic Regions**,** Odisha

IMPACT OF THE NEONICOTINOID INSECTICIDE ACETAMIPRID ON GROWTH AND PHOTO-FUNCTIONING OF *Synechocystis* sp. PCC 6803

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In the present era, modern agriculture heavily depends on the massive use of agrochemicals, such as pesticides and inorganic fertilizers, to meet the demand for food production. Neonicotinoids (NEOs) are being used as safe insecticides replacing the organophosphates and carbamates, which are found to have high mammalian toxicity. The NEOs are a fourth generation insecticide that targets the nicotinic acetylcholine receptor (nAChRs) of target pests such as aphids, whiteflies, plant hoppers, thrips and number of sucking and chewing pests. However, the adverse consequence of the reckless application of synthetic agrochemicals includes the eradication of beneficial non-target species and soil microbes, that aid in the cycling and retention of nutrients. Cyanobacteria can adapt and thrive in extreme environmental conditions and have the potentials to accumulate and degrade the pesticides. There are insufficient studies on the non-target toxicity of NEOs to soil cyanobacteria. In this study the effect of acetamiprid, a NEO, has been examined through the comparative analysis of growth and other physiological parameters such as pigment, chlorophyll fluorescence, PS II fluorescence, PBS fluorescence, PC fluorescence, PC/ PBS and PBS/ PS II ratio of *Synechocystis* sp. PCC 6803. Test organism was treated with 0-2 mM concentrations of acetamiprid and responses were recorded for 5 days at one day interval. The insecticide caused inhibition of growth and altered the biochemical composition of cells. There was increased fluorescence from photosystems and decreased photosystem functions.

Keywords: Modern Agriculture, Agrochemicals Use, Pesticides, Inorganic Fertilizers, Biochemical Composition Alteration, Environmental Impact of NEOs

DETERMINATION OF WATER QUALITY INDEX (WQI) OF JEERA RIVER, BARGARH, ODISHA

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Rivers are vital for a healthy society, but they are increasingly being contaminated for development of mankind and other purposes worldwide. In India, rivers in the past were pristine and unpolluted, but recent development has led to tainted freshwater resources. Negative anthropogenic acts deteriorate the ecosystem. Jeera River, a tributary of the river Mahanadi, in the western part of Odisha. It originates near the border of Bargarh and Chhattisgarh, and after traversing for about 80 km in this district in a south-easterly direction, it joins the right bank of river Mahanadi at Brahmani-Turum. The river now a days resembles a sewage channel. The river has recently gained public attention as a result of the National Green Tribunal's (NGT) directive to form a joint committee and submit a report on the quantity of waste produced in the Bargarh municipality as well as a water analysis of the Jeera River. Eighteen parameters were used in the study to determine the quality of the water: pH, temperature, turbidity, electrical conductivity, alkalinity, total dissolved solid (TDS), hardness, iron, chloride, fluoride, calcium, magnesium, nitrate, and phosphate for three seasons: pre-monsoon, monsoon, and post-monsoon. Analysis was conducted in accordance with American Public Health Association (APHA) standard procedure. Comparison of water quality in all the three seasons and evaluation of its CCMEWQI (Canadian Council of Ministers of the Environment Water Quality Index) and WAWQI (Weighed Arithmetic Water Quality Index) was done. According to WAWQI values it shows very poor to unsuitable water quality in almost all the sampling sites. The water quality found to be most deteriorated during monsoon season with an average WQI value of 516.430 as compared to pre-monsoon and post-monsoon with average WQI value of 154.558 and 276.014 respectively. CCMEWQI values indicates that the water quality ranges from marginal, poor to fair in all sampling sites. Iron concentration is high in almost all the sampling sites during the monsoon season. This study concludes that out of the eight sampling sites, station 5 is observed to be the most polluted sites. The water quality of river is site-specific and it depends on several parameters as there is significant difference in water quality of different sites.

Keywords: Jeera River, NGT, Physicochemical Parameters, Water Quality, CCMEWQI, WAWQI

RESPONSE OF A POTENTIAL DIAZOTROPH *Anabaena* sp. PCC 7119 TO ORGANOPHOSPHORUS INSECTICIDE MALATHION

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Majority of agricultural techniques now rely on chemical fertilizers and pesticides to boost crop yields. Pesticides of various chemical groups are being used to minimize on-field pests and diseases causing accumulation of residues. The residual toxicity of organophosphorus (OP) insecticides causes many environmental problems like decrease soil fertility, reduction of soil microflora and water pollution. Malathion is the wide spectrum organophosphorus insecticide, which has multiple applications in agricultural field to kill pests. Many bacterial, fungal and algal species have shown tolerance to malathion but the effect on cyanobacteria, *Anabaena* sp. PCC 7119 has been poorly evaluated. *Anabaena* sp. is a great nitrogen fixer in the paddy field and it can potentially perform photosynthetic activity to release O_2 and fix carbon. Estimating the toxic effect of malathion on cyanobacterial species can greatly influence the soil nitrogen and carbon concentration. In the present investigation the growth and photosynthetic efficiency of *Anabaena* sp. PCC 7119 was evaluated under malathion toxicity. The effect of insecticide was evaluated by taking various parameters such as growth, pigment content, enzymatic activity and specifically photosynthetic activity. The insecticide reduced the growth and pigment content at higher concentrations but there was a concentration dependent increase of fluorescence from phycobiliproteins and photosystems. Insecticide toxicity caused defective function of PS II and PS I with increase of non-photosynthetic quenching. The chlorpyrifos tolerant strain of *Anabaena* sp. PCC 7119 also showed tolerance to malathion with improved photosystem functions and stabilized pigment performance.

Keywords: *Anabaena* sp., Malathion, Pigment Content, Photosynthetic Activity, Pesticide

EFFECT OF COMPOSTING ON PHYSICOCHEMICAL PROPERTIES OF CHICKEN MANURE AND JATROPHA CAKE COMPOSITE

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The study evaluates the effect of composting on the physicochemical properties of Chicken Manure and Jatropha seed cake composite before and after composting. 11 kg of feedstock materials (66.2 % of Jatropha seed cake and 33.8 % of chicken manure) was thoroughly mixed to form a composite. Composting was done in a bioreactor for 30 days. pH and EC of the samples in a suspension of distilled water were measured using a pH and EC meter. Total organic carbon (TOC) was determined using standard method, while Total organic matter (TOM) was calculated by multiplying the value obtained for TOC by 1.72. Total nitrogen (TN) was done using Kjeldahl method. Phosphorous (P) and potassium (K) were read on a spectrophotometer at 470 nm, and on flame photometer after extraction. Ammonium (NH_4^+ - N) and nitrate (NO_3^- -N) were done using standard methods. Result revealed that TOC decreased from 27.65 % to 22.98 %, TOM decreased from 47.67 % to 39.62 %, TN increased from 2.42 % to 3.43 %, P2O5 increased from 4.68 % to 6.18 %, K2O increased from 1.30 % to 1.79 %, pH increased from 7.95 to 9.54, EC decreased from 0.70 ds/m to 0.3 ds/m, NH_4^+ - N increased from 0.0028 % to 0.0165 % and NO_3^- -N decreased from 0.0896 % to 0.0168 %. Results indicate that Composting also improves the nutritional quality of Jatropha seed cake and Chicken Manure composite and it can be used as organic fertilizer to supply plant nutrient.

Keywords: Composting, Physicochemical, Chicken Manure, Jatropha seed cake

UNVEILING THE RAMIFICATIONS OF FOREST FIRES: A PRELIMINARY STUDY OF SOIL CARBON STOCK DYNAMICS AND PRODUCTIVITY IN TROPICAL DRY DECIDUOUS FOREST (NAYAGARH), ODISHA

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Tropical dry deciduous forest is the epicentre of biodiversity and carbon storage which trap profuse quantities of carbon; however, rising forest fire is recurrent in forest of Odisha due to anthropogenic induced fire that not only affects the biodiversity but also leads to soil organic carbon loss and altered the soil quality which indicates the matter of concern. Post fire soil organic carbon dynamics is crucial to understand the carbon cycle. The objective of the study is to study the post fire soil carbon dynamics. The initial research endeavours to collect the samples in $1m^2$ sampling plots in various fire locations additionally from the control area from different soil strata and to analyse the soil carbon fractions as well as the soil physicochemical parameters in order to figure out the soil carbon dynamics fluctuation. Charred carbon which forms under the fire stress were quantified through organic carbon analysis by the Walkley-Black oxidation method. pH, E.C, W.H.C, texture, bulk density, moisture content was also determined. Study reveals that the percentage of organic matter varies from 1.6-6.3 %, OC-0.6 to 1.6 % and SOC varies from 0.8 to 3.8%. pH is slightly acidic to neutral, whereas E.C shows 1810 micro Simen/cm in fire affected soil. Investigation confirms the presence of some nutrient releasing agent which leads to enhancement of soil quality as well as soil carbon. Furthermore, studies will clarify the carbon dynamics status in other forest patches.

Keywords: Forest Fire, Soil Carbon Stock Dynamics, Tropical Dry Deciduous Forest, Soil Organic Carbon

PREPARATION OF METAL ANTIGENS (CR-EDTA-BSA) FOR THE DEVELOPMENT OF ANTIBODIES TO DETECT CHROMIUM IONS IN WATER SAMPLES OF SUKINDA

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Chromium augmentation in water systems results in bioaccumulation into living beings, increasing mortality in the vicinity of mines and industries. In Sukinda Valley, Odisha (World's 3rd most polluted place), overburdened mining activities poses significant environmental and health risk. The ionic resemblance of chromium with other essential nutrients of plants encourages the intake of chromium thus threatening the floral environment and shows its repercussion in animals and humans. These sequels of chromium have made its detection inescapable. To address the challenge, this study present a novel approach involving the preparation of metal antigen (Cr-EDTA-BSA) by binding the metal (chromium) with a carrier protein (BSA) using a chelating agent (EDTA). Initially BSA, EDTA and chromium chloride ($CrCl_3$) stocks were prepared. From the prepared stocks, BSA and EDTA were mixed (1:1 ratio) and kept in rotator for 24 hours (8.5 pH). This was followed by addition of $CrCl_3$ stock and spinning for 4 hrs. The conjugate was characterized using SDS-PAGE in which the differences in band migration of BSA and conjugates confirmed its successful preparation. The addition of chromium, EDTA and BSA of similar concentration (0.33 mg/ml) at 1:1:1 ratio was considered as optimum conjugation concentration for stable conjugate preparation which performed specificity for development of antibody. This can later be employed in preparing the immunochromatographic assay, thus facilitating early detection. This innovative approach not only provides a practical solution for rapid assessment of chromium ion levels in water sources of Sukinda but also contributes to broader efforts aimed at environmental contamination mitigation.

Keywords: Environment, Water, Contamination, Chromium, Detection

ANALYSIS OF HEAVY METALS IN CONTAMINATED MAHANADI AND ITS TRIBUTARY KATHAJODI RIVER WATER AT CUTTACK CITY AND ITS EFFECT ON FISH SPECIES BY MICRONUCLEUS ASSAY AND HAEMATOLOGICAL PARAMETERS STUDY

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Mahanadi and it's tributary Kathajodi river water is highly polluted. Alkalinity, hardness, pH of water has changed in the last few years due to domestic wastes, insecticides, herbicides, industrial wastes, livestock waste, chemical compounds, Swage water, etc. Heavy metals like Pb, Fe, Cu, Mn, K quantity increases which causes haematological and genetic damage to the aquatic ecosystem. Fish are the best biomarkers to find out the threats towards aquatic ecosystem as they show genetic damage and formation of micronucleus due to polluted habitat. Heavy metals analysis occurs by evaporation method. Fish species like *Labeo rohita, Catla catla, Cirrhinus mrigala, Cirrihinus reba* collected from the several stations of Cuttack 20.44°N 85.88°E to 20.46°N -85.89°E area and for Haematological study blood was collected by puncturing the caudal vein. Micronucleus assays done by Gemsa staining. And result shows high frequency micronucleus, DNA damage and changes in haematological condition which indicate high level of pollutants in water of River Mahanadi and Kathajodi Cuttack Odisha.

Keywords: Heavy Metals (Pb, Fe, Mn, Cu, K), Evaporation Method, Haematological Study, Micronucleus, DNA damage, Gemsa Stain

"Climate change is real. It is happening right now, it is the most urgent threat facing our entire species, and we need to work collectively together and stop procrastinating."

Leonardo Di Caprio, Actor & Environmentalist

EVALUATION OF PESTICIDE INDUCED GENOTOXIC AND HEMATOLOGICAL CHANGES IN FRESHWATER FISH *Clarias Batrachus* USING MICRONUCLEUS ASSAY

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Micronucleus test was proved to be successful for genotoxic study in mammals, aves and fishes. Micronuclei are the small chromatid bodies formed by the condensation of chromosomal fragments or whole chromosomes that are not included in the main nucleus following the anaphase. Micronuclei are the sign of the action of some aneugenes originating from chromosome which fails to attach to the mitotic spindle (Fenech and Morley, 1989) as a result of the damage of centromere, centriole or the protein components of mitotic spindle. In the present study genotoxic potential of herbicide, $CuSO_4.5\ H_2O$, was evaluated by employing micronucleus assay in *Clarias batrachus*. Three different doses 1.5, 3.0 and 4.5 mg/kg body weight were administered intraperitoneally (i.p) to *Clarias batrachus*. In another set of experiment, the fishes were exposed to 15, 25 and 35 ppm of copper sulphate in laboratory aquaria. Peripheral blood smears were stained in 15 to 20% Giemsa (pH=7.0). The result of the present study revealed that along with micronuclei, the chemical also induced nuclear and cytoplasmic anomalies. For haematological study fishes were exposed to the chemical for one week. It resulted in a decrease in haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and red blood cells (RBC) levels and increase in white blood cells level. The irrational use of pesticides containing $CuSO_4.5H_2O$ in agriculture cause harmful effects on *C. batrachus*, which is a most important species of fish for maintaining the aquatic diversity.

Keywords: *Clarias batrachus*, Copper Sulphate, Micronucleus Assay, Genotoxic Potential, Peripheral Blood, Smear

ISOLATION AND MOLECULAR CHARACTERIZATION OF *Rhizoctonia solani* AND *Aspergillus Species* CAUSING RHIZOME ROT DISEASES IN *CURCUMA* SPECIES

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India is a megadiverse country having a vast variety of flora and fauna. Among floras, the genus *Curcuma* of the family Zingiberaceae is widely cultivated for its rhizomes. It has been globally acclaimed for its great medicinal and aesthetic values. However, it has been observed that the rhizomes of this crop face a threat due to rhizome rot infections, resulting in a huge loss of plant productivity and quality. This rot infection is mostly caused by many soil-borne fungi that may vary from area to area imparting different impacts on these crops. The association of multiple fungal pathogens in a single rot infection turns out to be challenging for identification. Thus, identifying the exact rot-causing fungi is the needs of an hour. With this goal, the present study reports on the isolation and molecular characterization of the exact causative fungi linked with rot infections. The fungal pathogens from infected rhizomes were collected from the Eastern Ghats regions of Odisha, isolated and cultured, and then subjected to molecular characterization and phylogenetic analysis. The molecular identification by 18S rRNA ITS sequencing identified the isolated fungi as *Rhizoctonia solani*(CAR-02S), *Aspergillus niger* (CL-01S), and *Aspergillus carbonarius*(CAM-02S) with GenBank accession number PP447020, PP463721 and EU440774, respectively showing 98-99% of similarities. The obtained ITS nucleotide sequences were used to obtain complement amino acid sequences with their molecular weight. Further, the amino acid sequences were used to determine the antigenicity and epitopic regions using protein hydroplotter bioinformatic tools. The peptide sequence of the length 17-25 amino acids was found to be a strong epitopic sequence, less homologous, and strong antigens to be used in developing the antibody. Furthermore, the outcomes of the present study will be used to develop an enhanced diagnostic method for an effective, early, and easy disease management strategy.

Keywords: *Curcuma*, Rhizome rot, Internal Transcribed Spacer, Fungal pathogens, Antigenicity

CHARACTERIZATION OF MULTI-METAL-RESISTANT SERRATIA SP. GP01 FOR TREATMENT OF EFFLUENT FROM FERTILIZER INDUSTRIES

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The effluent generated from fertilizer plants in Paradeep (Odisha) is the major pollutant causing health hazard in the vicinity of the area with respect to plants, animals and microbes. Samples of effluent were found to contain heavy metals (mg L−1): Cr (100), Ni (36.975), Mn (68.673), Pb (20.133), Cu (74.44), Zn (176.716), Hg (5.358)and As (24.287) as analysed by XRF. Indigenous bacterial strains were screened for chromate and multi-metal resistance to remediate the toxic pollutants. The isolated strain G1 was identified as *Serratia* sp. through 16S-rDNA sequence homology. The potent strain *Serratia* sp. GP01 treated with 100 mg L−1 of $K_2Cr_2O_7$ has shown the efficiency of reducing 69.05 mg L−1 of Cr over 48 h of incubation. Further, presence of chromate reductase gene (*ChR*) in *Serratia* sp. confirmed the enzymatic reduction of Cr(VI). SEM–EDX and SEM mapping analysis revealed substantial biosorption of Cr and other heavy metals present in effluent by *Serratia* sp. GP01. Antioxidant enzymes such as catalase (72.15 U mL−1), SOD (57.14 U mL−1) and peroxidase (62.49 U mL−1) were found to be higher as compared to the control condition. FTIR study also revealed the role of N–H, O–H, C = C, C–H, C–O, C–N, and C = O functional groups of the cell surface of *Serratia* sp. treated with $K_2Cr_2O_7$ and effluent from the fertilizer industry. Isolated strain *Serratia* sp. could be used for the detoxification of Cr(VI) and other heavy metals in fertilizer plant effluent.

Keywords: Health Hazard, Heavy Metals, Chromate Reductase Gene, Biosorption

IRON DEFICIENCY RESPONSE PROTEIN 7 (IRP7) REGULATES ROOT SYSTEM ARCHITECTURE UNDER FE DEFICIENCY IN *Arabidopsis thaliana* REVEALED BY CRISPR/Cas9 MEDIATED GENE KNOCKOUT SYSTEM

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Iron (Fe) is an essential micronutrient that plays a critical role in plant growth and development, whereas it's deficiency severely affects plant growth and development. Iron deficiency anaemia is a major problem for human being around the globe. Identification, Characterization and genetic manipulation of iron-responsive genes to improve iron content in the plant is an important step to addressing Fe deficiency anaemia. The plant is the only direct source of Fe for the human diet, and the plant uptakes Fe from the soil by the root. The complex molecular mechanism of iron uptake, transport and how iron deficiency modulates root system architecture (RSA) in the plant is unexplored. Here it has been identified and characterized *IRP7* (Iron deficiency Response Protein 7) under Iron deficiency in *Arabidopsis thaliana*. Generation of the knockout mutant of *IRP7* by CRISPR/Cas9 revealed that it positively regulates RSA under Fe deficiency. Using Laser Confocal microscopy of the transcriptional reporter line (pIRP7:H2B:YFP) and quantitative real time PCR, we found *IRP7* upregulated under iron deficiency. We further identified IRP7 interacting partners PYE, bHLH100, bHLH38 and FIT using yeast two-hybrid assay. Knockout mutants *irp7* are sensitive to Fe deficiency, whereas over expression of *IRP7* (35S:IRP7:GFP) is tolerant to Fe deficiency and uptake more iron than the wild type. Overall, our study demonstrated the significant role of *IRP7* in maintaining iron homeostasis by modulating RSA and provided a potential target for improving iron content in the plant.

Keywords: RSA, IRP7, CRISPR/Cas9

BIOPRIMING OF RICE FOR INDUCTION OF DEFENSE AGAINST SHEATH BLIGHT

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Production of rice is significantly limited by an array of pathogens, leading to yield loss and deficit in current global supply. Sheath blight of rice is caused by a soil borne fungal pathogen (*Rhizoctonia solani*). Severe infection can cause significant reduction in yield and quality of rice grains. Several broad-spectrum fungicides have been used to control this disease; however, these methods are costly to implement practically, cause environmental issues and enhance the pathogen's resistance to the active ingredients. So, a sustainable approach such as biopriming of rice is an alternative and ecofriendly way to manage Sheath blight disease. In the present experiment, we have used a *Trichoderma* strain, and three *Bacillus* spp. separately, to study their role in induction of defence against *Rhizoctonia solani* in a susceptible variety of rice by studying various physiological, biochemical, pathological and yield parameters. *Trichoderma* strain followed by *Bacillus subtilis* treated plants showed enhanced growth promotion parameters, decreased disease progression, higher yield, chlorophyll content and ROS scavenging enzymes activity in comparison to diseased plants. Field trial has been carried out, with these two microbial isolates to study their effect on yield of diseased plants and it was found that biopriming of rice with *Trichoderma* strain induced defence against *Rhizoctonia solani* without having any adverse effect on the grain yield.

Keywords: Biopriming, Rice, Chlorophyll Content, Sustainable Approach

HARNESSING COTTON LEAFHOPPER RESISTANCE FROM WILD GENEPOOL

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Cotton holds significant importance in global agriculture and industry. As a mainstay of commercial farming, cotton plays a pivotal role in both local economies and international markets. However, the production of cotton, both in terms of quantity and quality, has faced significant challenges due to attacks from insect pests. In recent times, the cotton leafhopper has emerged as a prominent threat to cotton cultivation. To combat this issue and develop innovative genetic resources resilient to leafhopper attacks, an experiment was conducted on wide hybridization involving two widely used tetraploid *Gossypium hirsutum* varieties and two diploid wild species *viz. G. armourianum* and *G. anomalum* employing both direct and reciprocal crosses. Among the numerous crosses attempted, successful growth of F_1 plants from crosses such as CO17 x *G. armourianum*, CO17 x *G. anomalum*, and CO14 x *G. armourianum*, CO17 x *G. anomalum* was observed under both field and controlled conditions, alongside their respective parent plants. Through screening procedures conducted under insect stress conditions, CO17 x *G. anomalum* exhibited superior performance compared to other *hirsutum* parent varieties and F_1 hybrids. Highest incidence of leaf hopper was observed 45days after sowing to 75days after sowing. The hybrid materials generated can be further utilized in breeding programs to develop cotton lines resistant to leafhoppers or serve as a valuable germplasm line for future initiatives.

Keywords: Cotton, *G. armourianum*, Agriculture

ENHANCED DEGRADATION OF FOUR ORGANOPHOSPHORUS INSECTICIDES BY MALATHION TOLERANT *Aspergillus niger* MRU01.

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Insecticides see broad application across agriculture, horticulture, medicine, industry, and in households. The increased use of insecticides has been linked to enhanced agricultural productivity and reduced crop loss both during cultivation and after harvest throughout the 20th century. Malathion, an organophosphorus (OP) insecticide, is widely utilized on over 100 food crops in agriculture and for post-harvest storage. Various species of *Aspergillus* have demonstrated their effectiveness in breaking down OP chemicals. A strain of *Aspergillus niger* MRU01, enriched for tolerance to malathion, was assessed for its horizontal tolerance to three other frequently used OP insecticides: parathion, chlorpyrifos, and dimethoate. The tolerant strain exhibited enhanced growth efficiency and increased production of phosphatases and esterase enzymes compared to untreated and treated wild type *A. niger* (ATCC16404). Over a five-day period, the removal of malathion was 29% in the wild type strain, whereas in the tolerant strain, it reached 68%. Additionally, the tolerant strain demonstrated efficient removal rates of dimethoate (63%) and chlorpyrifos (54%), while exhibiting a lower removal rate for parathion (33%). Further assessment of the strain in controlled microcosm experiments is recommended, particularly for evaluating its potential in bioremediation of other OP insecticides before field application.

Keywords: Tolerant Stain, Agriculture, Insecticides, *Aspergillus niger.*

COMPREHENSIVE EFFECTS OF THIAMETHOXAM ON GROWTH AND PHYSIOLOGY OF *SYNECHOCYSTIS* SP. PCC 6803

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Pesticides play a pivotal role in the agricultural productivity of intensive farming systems. However, they have also steadily emerged as a significant cause of soil contamination and ecosystem degradation. The conventional pesticides belonging to the organophosphate, organochlorine, and carbamate groups are now being replaced by neonicotinoids (NEOs), the 4th generation of pesticides because of their low mammalian toxicity. Thiamethoxam (TMX), a 2nd generation NEO has widespread use with CAGR of 9.60% during 2020-2025. Its high hydrophilicity leads to rapid mobilisation within the crop posing a significant impact on food safety and the nutritional content of the plant. Also, the untargeted use has increased its detection rate in global soil and surface water (81.3 %), with the values ranging from 0.002 to 4315 ng/L. In the present study, effect of TMX (0-150 µM) for 1-5 days, on the cyanobacterium *Synechocystis* sp. PCC 6803 has been evaluated. Beyond 10 µM concentrations, the growth and pigment content were found negatively affected. Enhanced production of fluorescing chlorophyll metabolites and intense lipid peroxidation were observed at higher insecticide concentrations. further the chlorophyll fluorescence transients showed that the insecticide strongly enhanced the fluorescence at J inflection like a typical herbicide indicating the adverse impact of the insecticide on photosynthetic activity. The PS II, PBS and PC fluorescence decreased on net value basis but increased on pigment basis. The PC/PBS and PBS/PS II ratio showed an increasing trend which explains an impairment in the energy transfer processes.

Keywords: Pesticides, Agricultural Productivity, Intensive Farming Systems Ecosystem Degradation, *Synechocystis* sp. PCC 6803

CHLORANTRANILIPROLE INDUCED MULTIGENERATIONAL HORMESIS IN A KEY EGG PARASITOID *Trichogramma japonicum* (ASHMEAD)

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Hormesis for the intractable pests can be dreadful, but for natural enemies of pests, it is a puissant strategy in optimizing their mass rearing. It was studied multigenerational stimulatory effects of the widely used insecticide, Chlorantraniliprole, on the demographic traits of an important egg parasitoid *Trichogramma japonicum* (Ashmead) (Hymenoptera: Trichogrammatidae). The initial bioassay experiments revealed Chlorantraniliprole exhibiting the highest toxicity for the parasitoid with an LC_{50} of 0.972 μg·L^{-1}, whereas LC_5 and LC_{30} were 0.00001 μg·L^{-1} and 0.023 μg·L^{-1}, respectively, as well as a control, for five continuous generations (F_1 to F_5). Among biological traits, compared to the F_1 individuals, a substantial increase in the fecundity of *T. japonicum* was observed in the F_5 individuals by 51.50%,67.91%, and 2.03% when exposed to LC_5, LC_{30}, and LC_{50} respectively ($p < 0.00001$). Further, there was a significant enhancement in the adult longevity as well as oviposition days of the F_5 individuals at these concentrations. Considering the population traits, along with gross reproductive rate (GRR), net reproductive rate (R_0) was also enhanced by LC_5, $LC_{30,}$ and Lc_{50} in F_5 individuals than F_1; whereas the intrinsic rate of increase (r) and finite rate of increase (λ) was decreased in all the treatment comparing with control. The results were observed in Lc_{50} for the intrinsic rate of increase, finite rate of decrease, and the gross reproductive rate have significantly increased in f1 generation compared to control. Low and sublethal concentrations of Chlorantraniliprole did not have a major influence on demographic traits of *T. japonicum* at initial generations of exposure but can induce hormetic effects in the subsequent generations. Overall, chlorantraniliprole-induced hormesis stimulating the development of *T. japonicum* might be helpful under circumstances of mild exposure to Chlorantraniliprole in fields and could be leveraged for its mass rearing.

Keywords: Biological Control; chlorantraniliprole; Demographic Parameters; Hormesis; Sublethal Effects, *Trichogramma japonicum.*

COMBINED APPLICATION OF TETRACYCLINE AND STREPTOMYCIN ALTERS SOIL ENZYME ACTIVITIES AND MICROBIAL COMMUNITY STRUCTURE OF RICE FIELD SOIL

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A microcosm experiment was performed to quantify the residues of antibiotics [Tetracycline (TC), Streptomycin (STR) and Streptocycline (STC; a mixture of TC and STR)] in rice soil, and to assess their impact on microbial community structure using Illumina-MiSeq 16s rRNA/ ITS metagenomic analysis. Antibiotics were applied at half the recommended dose (0.5RD), recommended dose (RD), and double the recommended dose (2RD) as well as a control with no antibiotic application. TC was degraded in soil within 9 days of its application whereas, it took 21 days for STR and STC to degrade below limit of quantification (LOQ) level. Soil enzyme activities (dehydrogenase, β-glucosidase, fluorescein diacetate hydrolase, acid phosphatase, alkaline phosphatase, and urease) were negatively affected in the antibiotic treated soil. Margalef's species richness, Pielou's evenness, Menhinick's index and Shannon and Simpson diversity indices were affected by antibiotic treatments. Major bacterial phyla such as Chloroflexi, Actinobacteria, Planctomycetes, Crenarchaeota and Gemmatimonadetes were suppressed by antibiotic treatments as compared to control. Overall, the combination of antibiotics negatively affect the soil microbial community structure and function in comparison to their individual application. Despite the degradation of STR and TC happened within a reasonable time, these antibiotics may alter microbial activities and their diversity in rice field soil.

Keywords: Antibiotics, Streptocycline, Residue, Metagenomics, Microbial diversity, Soil enzymes

BIOCHEMICAL RESPONSES OF SESBANIA SP. TO NICKEL EXPOSURE

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Nickel is one of the micronutrients to plants, but there has been much more concern about the toxicity of Ni than about Ni deficiency. In general, the effects of long-term, low-level exposure to nickel are shown in growth inhibition with no other visible signs. However, many species of plants growing on soils contaminated with excess nickel show stunted and discoloured roots and tops, wilting, chlorosis, necrosis, twisted stalks, etc. In this study, the effect of nickel stress is shown by observing the alterations in pigment content and. The toxic effects of various doses of nickel such as 50, 100, 200 and 300 ppm along with a control (0 ppm) were studied. The growth was retarded at higher concentration of Nickel. The chlorophyll and carotenoid content gradually decreased with increase in concentration of nickel. Nickel in plants interferes with the pigment metabolism. The alterations in pigment content clearly showed its toxic effects. The protein content of nickel stressed plants were found to increase with increase in concentration but then starts to decline and becomes lower than that of control plants. The catalase and GPX activity also show a similar trend and suggest oxidative damage control to certain extent with the increase in concentration but declines with further increase in nickel toxicity.

Keywords: Nickel, Chlorophyll, Carotenoids, Oxidative Damage

INVASIVE ALIEN SPECIES ARE A MAJOR THREAT TO BIODIVERSITY OF FLORA IN SUNABEDA WILDLIFE SANCTUARY

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Invasive alien species are a major threat to biodiversity and ecosystems of Sunabeda Wildlife Sanctuary. It is located in the Nuapada district of Odisha, adjoining Chhattisgarh containing 600 km^2. Biological Invasions will inform scientists, policymakers, and the public on the seriousness of non-native species invasions that cause extinction as well as significant impact on the earth's ecosystems, has greatly increased in recent years due to expanding trade and

transport among different countries. Conservation for Biological Diversity (1992) visualize biological invasion of alien species as the second worst threat after habitat destruction. It may be considered as a form of biological pollution and significant components on human – caused global environmental change and one of the major causes of species extinction. A recent study has reported the occurrence of 256 alien species in Sunabeda. out of 1,599 alien plant species belonging to 841 genera in 161 families in India. More than one-third (35%) of the total alien flora of India has its origin in the South American continent. Most South American species come from Mexico and Brazil. More specifically, while analysing the native ranges of 225 invasive species, more than half (52%) are from South America. The contribution of other continents is as follows: Africa (16%), Asia (16%), Europe (9%), North America (4%), Australia (2%) and cryptogenic (1%). This availability of data on invasive alien plant species will contribute to the larger goal of setting robust Global Biodiversity Targets and Indicators, with far-reaching policy implications for the conservation and sustainable use of biodiversity in Sunabeda Wildlife Sanctuary.

Keywords: Biodiversity, Biological Invasions, Alien Flora, Global Biodiversity

EARLY POST-EMERGENCE HERBICIDAL EFFECTS ON SOIL MICROBIAL PROPERTIES OF SOYBEAN IN INCEPTISOL

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Soybean being a rainy season crop is heavily infested with many grasses and broad leaf weeds. Because of erratic rainfall, unusable soil on rainy seasons, and a shortage of labour in a timely manner, weed control in soybean has proven to be particularly difficult, especially during the *kharif* season. Under such conditions, using superior broad-spectrum herbicides is the only other viable way to suppress weeds. Though many earlier studies have reported that herbicides may have toxic effects on microorganisms, reducing their abundance, activity and consequently, the diversity of their communities an experiment was conducted to better understand the effectiveness of ready-mix herbicides fluazifop-p-butyl 11.1% + fomesafen 11.1% SL in controlling weeds and its effects on soil microbial properties of soybean and its residual effects on succeeding potato crop. The experiment was carried out at Kalyani C-Unit Farm, Kalyani, Nadia under Bidhan

Chandra Krishi Vishwavidyalaya (BCKV), Mohanpur, Nadia, West Bengal during the *kharif* season of 2020 and 2021 with Randomised Block Design, which was consisting of three replications and seven treatments, of which there were three levels of ready-mix fluazifop-p-butyl 11.1% + fomesafen 11.1% SL herbicide application @1000, 1250 and 2000ml/ha, quizalofop ethyl 5% EC @1000 ml/ha, imazethapyr 10% SL @1000 ml/ha, hand weeding at 20 & 40 DAS and weedy check control. After application of the post emergence herbicides at 2-4 leaf stage of weeds (20 days after crop sowing) the microbial population was drastically reduced as compared to the initial soil samples collected from the treated plots due to the toxic effects of herbicides. However, with the advancement of time on the later stages (45 and 60 DAA) of the crop herbicidal effect on the microbial population was minimized and there was no significant effect of herbicides on soil total microbial count *viz.,* bacteria, fungi and actinomycetes. Total bacterial, fungi and actinomycetes count were increased under the fluazifop-p-butyl 11.1% + fomesafen 11.1% SL@ 1250 ml/ha treatment compared to other herbicides treated plots which leads to better growth and yield parameters of soybean under this treatment. It may be because these bacteria engage in the process of herbicide breakdown, which releases carbon-rich substrates that boost the number of microorganisms in the soil. Similarly, there was no significant impact on dehydrogenase and urease activities of soil on later stages.

Keywords: Early Post-Emergence Herbicides, Fluazifop-p-butyl + fomesafen, Growth and Yield Parameters, Microbial Properties, Soybean.

ETHYLENE SENSITIVITY DOMINATES THE EXPRESSION OF PANICLE BRANCHING AND SPIKELET MERISTEM GENES TO THE DETRIMENT OF GRAIN FILLING IN CONTRASTING RIL RICE GENOTYPES

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During ontogeny numerous spikelets are formed within the rice panicle inside the flag leaf sheath enclosure. Although each spikelet of the panicle is competent to develop a good quality grain, spikelets located on the basal part of the panicle produces grains of poor quality unsuitable for human consumption. Panicle-wise grain-filling of individual spikelets is typically location-specific in rice; apical spikelets dominate over their basal counterparts. This pattern of grain filling often changes with panicle architecture among cultivars, but the underlying mechanisms are largely unknown. The cylinder-shaped panicles introduced more recently, though suited for high grain yield, exhibit several instances of poor grain

filling. In the present work, panicle branching and spikelet apical meristem gene expressions in the ontogeny stage and their influence on spikelet survival and grain filling at the post-anthesis stage were elucidated in two types of rice Recombinant Inbreed Lines (RIL) having similar spikelet density in their panicles, such as SR-157 (low-sterile) and SR-159 (high-sterile) and their parents NPT-V12 (low-sterile) and SPS-1-6-1 (high-sterile). Between cultivars, SR-157 versus SR-159, and spikelets located apically versus basally, grain filling was more vulnerable in the latter than the former owing to greater evolution of ethylene at anthesis. Present scenario of climate change causing abiotic stresses like temperature increase and incidence of higher solar radiation might have been exacerbated the problem of ethylene production in the rice panicle to the detriment of grain filling. Combined genome analyses revealed that branching genes like *DEP2, SPL-14, PTR,* and *FZP* over-expressed in rice cultivars with more secondary branching having high spikelet numbers in the high-sterile cultivar SR-159 compared to low-sterile cultivar SR-157 during the ontogeny stage of development. But this over-expression of panicle branching and spikelet meristem genes had no matching improvement in grain-setting in the post-anthesis period. Grain starch synthesis was higher, and expression of ethylene receptors and signal transducer genes was lower in the low- compared to high-sterile cultivars. Thus, the quantum of grain set in the post-anthesis stage determining actual panicle yield was not dependent on the expression of genetic factors in the pre-anthesis stage defining potential grain yield. It was concluded that the default expression of ethylene synthesis and transducer genes at anthesis cause spikelet degeneration and this ethylene sensitivity at anthesis dominates the expression of panicle branching and spikelet meristem genes during pre-anthesis stage resulting into poor grain yield due to failure of achieving the yield advantage of high spikelet number in the sterile genotype SR-159 compared to SR-157. Hence, the genomic studies involving ethylene production and action must be an inalienable part of any constructive contribution for manipulation of higher yield potential in rice.

Keywords: Ethylene Sensitivity, Panicle Branching, Spikelet Meristem, Higher Yield Potential

UNDERSTANDING THE NEXUS BETWEEN MINING ACTIVITIES AND CLIMATE CHANGE DYNAMICS

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Mining activities have emerged as significant contributors to environmental degradation and climate change, exerting profound impacts on ecosystems and human societies worldwide. There exists an intricate relationship between mining operations, environmental integrity, and climate stability. Mining activities entail a plethora of direct and indirect consequences that collectively shape environmental and climatic conditions. Direct impacts include deforestation, soil erosion, water contamination, and habitat destruction, stemming from the extraction and processing of mineral resources. These activities alter landscapes, disrupt natural habitats, and degrade soil and water quality, jeopardizing biodiversity and ecosystem functioning. Moreover, mining operations generate substantial greenhouse gas emissions, primarily through energy-intensive processes such as extraction, transportation, and refining which contribute to global warming and climate instability. Mining changes land use, worsening climate change by affecting carbon sinks and sources. It also presents socio-economic problems for local and indigenous communities. Tackling mining's impacts requires multiple strategies: enforcing strong environmental regulations, promoting sustainable mining, restoring lands with planting, and investing in clean energy. The environmental and climate effects of mining stress the need for holistic strategies that balance economic growth with environmental care and social equity. Recognizing these connections and taking action can lead to a sustainable and resilient future for ecosystems and communities.

Keywords: Climate Change, Habitat Destruction, Mitigation Strategies, Sustainable Mining Practices

Theme-IV Conservation and Sustainable Solutions

NAVIGATING PATHWAYS FOR A SUSTAINABLE FUTURE AND CONSERVING THE BIOLOGICAL RESOURCES OF INDIA THROUGH THE IMPLEMENTATION OF ACCESS AND BENEFIT SHARING PROVISIONS

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Biodiversity is considered as a safety net for the global communities as it provides various goods and services fundamental to the fulfilment of human needs. Conservation of biodiversity and sustainable use of biological resources is essential for maintaining the ecological functions and providing livelihoods for millions of people in this earth. However, biodiversity is being declined at a rapid rate globally on account of various manmade and natural factors. The emergence of Access and Benefit-Sharing (ABS) mechanisms under Biological Diversity Act, 2002 has given a new dimension to conservation efforts by integrating principles of equitable benefit-sharing between the conserver and users against commercial exploitation of biological resources. The bio resources have been collected by various traders, manufacturers, companies etc., for commercial purposes. As per the Section 2 to 7, 18, 19, to 24, of Biological Diversity Act, 2002 and Guidelines on access to biological resources and associated knowledge and benefits sharing regulations, 2014, the companies/traders/manufacturers are supposed to give ABS fees to the Biodiversity Management Committees (BMCs) and Individuals possessing traditional knowledge following Nagoya Protocols 2010. We examine the intricate relationship between biodiversity conservation and sustainable livelihood in context of functioning of ABS provisions in Odisha, India. We recommend that successful implementation of ABS provisions regulate access to biological resources while ensuring fair and equitable benefit-sharing among various stakeholders ultimately leading to sustainable management of biodiversity and securing livelihoods of resource dependent communities. As biodiversity conservation faces escalating challenges, ongoing evaluation and refinement of ABS mechanisms can address livelihood issues and optimize conservation outcomes, both in Odisha and globally.

Keywords: Access and Benefit-Sharing, Bio Resources, Traditional Knowledge, Biodiversity Management Committees (BMCs)

NTEGRATING TRADITIONAL ETHNOBOTANICAL KNOWLEDGE OF CURCUMA INTO CONTEMPORARY HEALTHCARE

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Among India's many biological practices and cultural traditions, the term "Ayurveda" (meaning herbal medicine) is just one example of how the country could contribute to this purpose. The broad pharmacological qualities of the genus *Curcuma*, part of the Zingiberaceae family, have made it a traditional cure for many ailments. Because of its medicinal qualities, it has been the subject of substantial research and application in developing new pharmaceuticals. There are many pharmacological actions attributed to the bioactive chemicals found in *Curcuma caesia*, making it a significant but unappreciated species of *Curcuma*. Several diseases have found relief through the medicinal use of its dried leaves and rhizomes. Because the plant's other parts may also contain helpful bioactive chemicals and medical properties, they can be investigated in future research. It is recommended that additional research be conducted to demonstrate its efficacy, including clinical, Phyto analytical, and toxicological evaluations on humans. The ethnobotanical discoveries were supplemented with images, video recordings of specimens and techniques, and thoroughly documented structured interviews. The methods, devices, and processes of using those plants are entirely conventional. Traditional healers worldwide use a broad range of therapeutic herbs in their practice, which helps promote the development of new drugs. Because of the importance of plant diversity as a resource for developing new therapeutic herbs, the formulations incorporate numerous species of plants. It is expected to become even more abundant and of higher quality due to the growing number of talented scientists and the broad range of biotechnology and food chemistry applications. Future research should focus on the potential of bioactive substances for use in liposomes, nanotechnology, etc.

Keywords: Bioactive Chemical, Plant Diversity, Ethnobotany

COMMUNITY-LED CONSERVATION STRATEGIES: THE CASE OF LODHA COMMUNITY IN MAYURBHANJ, ODISHA

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Conservation of biodiversity among indigenous communities is a crucial aspect of sustainable development, particularly in regions rich in natural resources like Odisha, India. This study focuses on the Lodha community, an indigenous tribe residing in the forests of Mayurbhanj district of Odisha, and their traditional practices for biodiversity conservation. Through a combination of ethnographic research, interviews, and participatory observations, this study aims to document the complex relationship between the Lodha community and their surrounding biodiversity. The study reveals that the Lodha community's conservation practices are deeply rooted in their cultural and spiritual beliefs, as well as their dependence on forest resources for livelihoods. Traditional knowledge passed down through generations guides their sustainable use of biodiversity, including medicinal plants, non-timber forest products, and wildlife. Furthermore, community-based institutions and customary laws play a significant role in regulating resource use and resolving conflicts, fostering a sense of collective responsibility towards conservation. Furthermore, it explores the socio-economic and cultural factors that underpin the Lodha community's commitment to biodiversity conservation. By highlighting the successes and challenges faced by the Lodha community, this study aims to provide insights into the role of indigenous Lodha peoples in safeguarding biodiversity and promoting sustainable development in ecologically susceptible areas.

Keywords: Biodiversity, Community-Led Conservation Strategies, Lodha Tribe of Odisha

CONSERVATION OF THREATENED PLANT SPECIES OF SIMILIPAL BIOSPHERE RESERVE: A PRELIMINARY STUDY

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The Similipal Biosphere Reserve, present in the Eastern Ghats of India, is renowned for its rich biodiversity, having different plant species, many of which are facing the threat of extinction due to anthropogenic activities as well as habitat degradation. Conservation of these species is a major concern in the worldwide context. Reinforcement of the declining populations of selected species through reintroduction into the natural habitat is essential to establish self-sustaining vegetation. To ensure the long-term survival of threatened plants both in situ and ex situ conservation strategies must be implemented. This preliminary study focuses on assessing the feasibility and efficacy of employing both macro and micropropagation techniques for conserving selected threatened plants which are native to Similipal. This study was initiated with comprehensive field surveys and literature reviews to identify some threatened plant species followed by the collection of plant material from wild populations and establishment of in vitro cultures in a controlled environment with conventional low-cost vegetative propagation techniques such as Seed germination, rooting, cuttings, budding, grafting and air-layering. Identification of factors responsible for higher seed germination and seedling establishment are some important aspects of the study that need to be addressed. Various parameters such as growth rate, multiplication potential, and genetic stability are going to be monitored throughout the culturing process. Furthermore, this study also optimized standard protocols for low-cost mass propagation techniques which is helped in the reintroduction of some threatened plant species within this protected area. Also, we are going to discuss the ecological importance of the identified selected species and their role in maintaining the balance of the ecosystem.

Keywords: Conservation; Plant Biodiversity; Seed Germination; Threatened Species; Vegetative Propagation

ALLOMETRIC MODELS AS TOOL FOR BIOMASS ESTIMATION OF TREES IN TROPICAL DECIDUOUS FORESTS OF NORTH CENTRAL PART OF EASTERN GHATS, INDIA

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The role of forest ecosystem in combating greenhouse emissions and maintaining atmospheric carbon dioxide (CO_2) levels is well understood since the last few decades. This requires accurate quantification of aboveground biomass (AGB) and aboveground carbon (AGC) at individual species level. The present research paper focuses on developing allometric equations for 30 tropical dry and moist deciduous tree species in north central part of the Eastern Ghats to encourage the future researchers to opt non-destructive way of AGB and AGC estimation using alone or in combination of diameter (D) and basal area (BA).The estimation of AGB has been done using non-destructive approach (volumetric equations) and carbon estimation was done based on literatures ranging between 47-50% of AGB. The AGB ranged from 0.2324 Mg ha^{-1} in *Buchanania lanzan* to 4.4976 Mg ha^{-1} in *Tamarindus indica*. The species specific component of AGB and AGC models were developed using tree diameter at breast height (DBH), basal area (BA) as independent variable. Among the 120 models developed, the best allometric model was represented by four species (*Schleichera oleosa*, *Samanea saman*, *Ficus glomerata* and *Tamarindus indica*) were R^2-value ranged between 0.91 to 0.99. The developed allometric models were validated by performing paired samples t-test where t-value (0.794) > p-value (0.448) which reject the null hypothesis and accept alternative hypothesis. The carbon stocks of forests determined in the present research project will also help in pin-pointing carbon allometry model focusing on the maximum absorption of atmospheric CO_2 in mitigating climate change issues, thus helping in species specific afforestation programmes.

Keywords: AGB, AGC, Allometric Model, Eastern Ghats, Climate Change, t-test

TISSUE TOLERANCE ALONG WITHION EXCLUSION IS THE KEY FOR PROVIDING SUSTAINABLE SALINITY TOLERANCE IN RICE AT REPRODUCTIVE STAGE

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Salt stress is a major production constraint for rice cultivation, particularly in the coastal agro-ecologies. Rice shows considerable variability for salt tolerance at seedling and reproductive stages. To date, salt-tolerant rice development programmes primarily focussed on imparting ion exclusion (IE) strategy (through introgression of *Saltol*/*SKC1* QTL) for salt tolerance which at the same time incur significant energy cost. Through a series of experiments using different salt-tolerant rice accessions, we observed that every good ion-excluder doesn't necessarily show satisfactory level of tolerance at the reproductive stage. Excellent ion excluders like FL478 minimize the overall loading of Na^+ into the xylem tissue and hamper the transportation of Na^+ to the greener metabolically active tissues but with a major caveat of energy expenditure. Moreover, these ion excluders need to synthesize higher amounts of organic osmolytes to maintain the tissue hydration process under increased Na^+load around the root zone. While genotypes like AC41585 and Rashpanjor were found to possess a higher leaf Na^+/K^+ ratio than FL478 under similar stress conditions. This encouraged us to understand the balancing strategy of salt stress, which helps to maintain growth and development in early seedling as well as reproductive stages. We found that ion excluders (FL478) and ion accumulator (Rashpanjor) generally follows two different mechanisms to achieve salt tolerance (ionic selectivity and tissue tolerance) and therefore, the overall Na^+/K^+ ratio varies in the mesophyll tissues. High tissue tolerance score (LC_{50} ≥ 400mmol g^{-1}) of ion accumulators not only helped them to retain the chlorophyll pigments of mesophyll tissue but also helped these genotypes to use inorganic Na^+ as cheap osmoticum against a high external pressure of salt stress, thereby minimizing the energy cost of salt tolerance. Based on our study, we conclude that traits like ion exclusion and tissue tolerance should be combined simultaneously to achieve sustainable salt tolerance in rice which can satisfactorily with salt stress at both seedling and reproductive stages.

Keywords*:* Salinity, Ion Exclusion, Tissue Tolerance, Osmolytes, Selective Ion Transport

AMBIENT AIR QUALITY STATUS NEAR JAGATPUR INDUSTRIAL ESTATE, CUTTACK, ODISHA: PREVENTIVE MEASURES FOR SUSTAINABLE LIVING

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Jagatpur Industrial Estate in Odisha hosts several small-scale air-polluting industries such as Cos Board, Mahanadi Coke Oven, and Rolling Industries. While industrialization fosters economic growth, it poses risks of environmental pollution. This study aims to investigate air quality across various monitoring sites in Jagatpur Industrial Estate, Cuttack, from November 2009 to October 2010. Seasonally, data on Suspended Particulate Matter (SPM), PM_{10}, $PM_{2.5}$, SO_2, and NO_X were collected from five sites near the industrial estate. The study found higher pollutant concentrations during winter compared to summer and rainy seasons. SPM, PM_{10}, and $PM_{2.5}$ levels at all sites exceeded prescribed limits set by the Central Pollution Control Board (CPCB), while SO_2 and NO_X levels remained below the prescribed limit. Exceedance factors, calculated using annual means and standard values of parameters, were used to assess air quality status. It was observed that SPM and $PM_{2.5}$ levels at J-02, J-03, and J-04 sites fell under the critical category, while J-01 and J-05 were in the moderate to high categories. PM_{10} levels at all sites were in the critical category, while SO_2 and NO_X levels remained in the low and moderate categories respectively across all locations. Some preventive measures like the plantation of ornamental plants and other plants such as bamboo, palm, lily etc. to curtail dust pollution are suggested. Hence proper pollution control measures may be taken by these industries for a sustainable lining as SD G17.

Keywords: SPM, $PM_{10,}$ $PM_{2.5,}$ Industries, pollution

SUSTAINING BIODIVERSITY THROUGH CULTURAL TRADITIONS: AN ANTHROPOLOGICAL STUDY AMONG THE *PARAJA* TRIBE IN KORAPUT DISTRICT OF ODISHA

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The *paraja* tribe indigenous to the Koraput District of Odisha, possesses a rich cultural heritage deeply intertwined with their natural environment. This research paper explores the symbiotic relationship between cultural traditions and biodiversity conservation among the *Paraja* tribe. Through an interdisciplinary approach combining ethnographic fieldwork, participant observation and semi structured interviews, this study explores the seven conservation aspects such as sacred grooves, Worship of nature deities, totemic origin, traditional food habits, usage of ethnomedicinal plants, folklore & folk dances and traditional farming practices, that elucidates the ways in which cultural traditions contribute to the sustainable management and preservation of biodiversity in the region. Despite facing challenges from external pressures such as modernization and climate change, the *Paraja* tribe demonstrates resilience in maintaining their cultural traditions and adapting them to contemporary conservation efforts. The study highlights the importance of integrating indigenous perspectives into biodiversity conservation policies and practices, recognizing the value of indigenous knowledge systems in promoting sustainability. The research findings reveal that cultural traditions serve as foundational pillars for the sustainable management of natural resources and the preservation of biodiversity among *Paraja* tribe. By highlighting the interconnectedness between cultural practices and ecological sustainability, this study offers insights into a holistic approach to biodiversity conservation that integrates cultural, ecological and spiritual dimensions.

Keywords: Cultural Traditions, Biodiversity Conservation, Sacred Grooves, Nature Worship, Totemic Origin

UNVEILING THE GENETIC ARSENAL: TOWARDS ENHANCED GALL MIDGE RESISTANCE IN RICE THROUGH MARKER-TRAIT ASSOCIATION ANALYSIS AND CANDIDATE GENE DISCOVERY

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Insect herbivores, such as the Asian rice gall midge, pose a significant threat to rice cultivation in India's eastern and north-eastern regions. Traditional pest control methods like pesticides have proven ineffective due to the midge's internal feeding habits. Developing resistant rice cultivars is essential to combat this menace. To achieve this, it's crucial to identify genomic regions responsible for resistance in the initial population. In our study, we phenotyped 202 rice genotypes and analysed them using genomic markers associated with gall midge resistance. Our findings suggest that gall midge resistance follows a quantitative inheritance pattern, with certain markers like GM3DEL3 showing substantial genetic variation. Through a marker-trait association analysis using a mixed linear model, we identified marker RM17480 on chromosome 4 as significantly associated with gall midge resistance. Allelic effects of this marker were correlated with phenotypic variation, indicating its importance. Genes near this marker are involved in stress response in rice plants. Notably, the 200 bp allele was linked to susceptibility, while the 250 bp allele conferred resistance. This association underscores the marker's potential for marker-assisted selection programs aimed at developing resistant rice varieties.

Keywords: Rice, Gall Midge, Phenotyping, Genotyping, Marker, Candidate Genes

SUSTAINABLE CIRCULAR ECONOMY APPROACH FOR MICROBIAL MEDIATED METAL RECOVERY FROM ELECTRONIC WASTE

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Electronic waste (e-waste) poses a pressing environmental challenge worldwide due to its complex composition, rapid proliferation, and hazardous components. As the consumption of electronic devices continues to escalate, there is a need for sustainable recycling practices. Sustainable recycling of e-waste has become imperative to mitigate environmental pollution, conserve resources, and promote circular economy principles. As depleting ores of metals is a problem, recycling e-waste is a way to replenish economically essential metals, e.g., some base and precious metals. Traditional methods like pyrometallurgy and hydrometallurgy often carry a high environmental burden due to their reliance on energy-intensive processes and harsh chemicals. In contrast, the paper focuses on biohydrometallurgy, a technique utilizing naturally occurring microorganisms, primarily iron-oxidizing bacteria, to dissolve and extract valuable metals from e-waste. Biohydrometallurgical processes operate at near-ambient temperatures, require minimal chemical input, and generate fewer toxic byproducts than conventional methods. In this process, microbial consortia, or specific microorganisms such as *Acidithiobacillus ferroxidans*, *Leptospirillum ferriphilum*, and *Acidithiobacillus thiooxidans,* use reduced sulphur and ferrous as energy sources and oxidize them into sulphate and ferric ion. This ferric iron oxidizes metal present in e-waste, releasing metals into the solution. This natural process offers advantages such as reduced energy consumption, minimal environmental impact, and selective metal recovery.

The review discusses upcoming research areas in eco-friendly e-waste recycling, emphasizing new technologies and research progress. It explores sustainable methods for extracting metals from e-waste, aiming to reduce environmental harm and increase resource reuse. This involves improvements in bioleaching techniques and creating closed-loop systems for metal recycling. Adopting these sustainable practices can turn e-waste management into a beneficial resource recovery process, lessening environmental impact and securing a stable metal supply for the future.

Keywords: Sustainable Solution, Circular Economy, Bioleaching, E-Waste Recycling, Metal Recovery

SUSTAINABLE WEED MANAGEMENT: THE IMPACT OF ALLELOPATHY

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A biological process known as "allelopathy" occurs when one organism creates biochemicals that affect another organism's development, survival, and procreation. Most people classify any plant that grows in an undesirable area as a weed. Weeds are organisms that cause problems for agricultural practices, have a detrimental effect on the structure and function of ecosystems, or are widely distributed. For several reasons, weeds must be eliminated from the environment. Due to their ability to impede or hinder crop growth and development, weeds constitute a significant risk to agricultural output and can result in substantial yield losses. Weeds cause considerable crop losses by interfering with crop growth and development. More yield loss occurs from weeds than from any other pest in agricultural production. As a result, synthetic herbicides are now frequently employed to control weeds. Nonetheless, public worry over herbicides' effects on the environment and human health has grown due to the growing usage of synthetic herbicides. Experts are looking into more ecologically friendly methods of managing weeds because synthetic pesticides pose numerous hazards to human health and the environment. Among these, using allelopathy in a comprehensive weed management plan could significantly reduce the number of pesticides applied. Even though allelopathic potential is known to exist in many essential crops, farmers are still hesitant to implement this knowledge. Therefore, it's critical to support consultants and farmers in determining whether allelopathy may be successfully incorporated into a sustainable weed control plan. Cover crops, crop rotation, and intercropping can be used to employ allelopathy to suppress weeds in field crops. Allelopathy may be used as a component of an integrated, ecological, and sustainable weed control approach. It is anticipated that more research will be done on allelopathy as a weed management method.

Keywords: Allelopathy, Bioherbicides, Crop Rotation, Environment, Weeds Management

STRIKING A BALANCE: THE QUEST FOR SUSTAINABLE MINING

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The mining sector is an important one that contributes significantly to the development of the global economy by creating jobs, boosting economic growth, and supplying vital raw materials for many other industries. Mining of mineral resources has a significant importance in various sectors like energy, construction, manufacturing, agriculture, and technology. This mining sector also poses challenges in the form of environmental degradation like pollution, deforestation, soil erosion, etc; adverse effects on society like displacement, health problems and many more. These challenges question the sustainability of the mining activity. Some various ways and practices can be adopted to make mining practices sustainable minimising the negative impacts of it. The mining industry is minimising its environmental imprint and maximising its contributions to positive social development through the use of more environmentally friendly mining techniques, more effective technology, and a sense of environmental stewardship. To achieve the goals of sustainable mining, which include striking a balance between the use of resources for economic development and concurrently protecting and conserving the environment, cooperation between the government and the mining industry is imperative.

Keywords: Environmental Degradation, Pollution, Mineral Resources

"Sustainability is about meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Gro Harlem Brundtland

MILLETS : ANCIENT GRAINS FOR SUSTAINABLE AGRICULTURE IN FUTURE

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The United Nations General Assembly has declared the year 2023 "International year of Millets" which renewed interest in millets around the globe. The IYM:2023 was an opportunity to raise awareness of, and direct policy attention to the nutritional and health benefits of millets and their suitability for cultivation under diverse and changing climatic conditions. It was an unique occasion to promote the sustainable production of millets while also highlighting potential to create sustainable market opportunities for producers and consumers IMY 2023 aims to contribute the UN 2030 Agenda for Sustainable Development, particularly SDG 2 (Zero Hunger), SDG 3 (Good Health & well-being) SDG 8 (Decent work and economic growth), SDG 12 (Responsible consumption and production), SDG 13 (Climate Action) & SDG 15 (Life on Land).

Millets are nutritionally superior as they contains dietary fibres, various useful minerals, antioxidants, proteins, vitamins, essential amino acids and are an attractive gluten-free substitute for cereals. Nutritional imbalances have a long-term adverse impact on health and may have leave people grappling with medical concerns. Malnourishment can manifest in the from of stunting in children, anaemia in adolescents, diabetes and obesity in adults, heart disorders risk in all ages people etc. and imposes serious challenges in leveraging the economic potential of a nation. A study indicated that taking millet- based food in diet during pe-natal and post-natal period play and important role in improving the nutritional status of pregnant and lactating mothers. Millets due to their low carbohydrate: fibre ratio high antioxidants and other effects are useful in life style diseases like Cardiac, diabetes mellitus, and some kinds of cancer.

Being C4 group cereals, millets covert more CO2 to O2 contributing in mitigating climate change. Millets are native grains which able to overcome issue water scarcity, desertification, global warming and managing carbon foot prints thereby ensuring environmental adaptability.

Keywords: Nutritional Benefits, Health Benefits, Sustainable Production, Superfood

HARNESSING VERMICOMPOST FOR SYNERGISTIC GROWTH IN AGRICULTURE AND ENVIRONMENTAL SUSTAINABILITYA CASE STUDY OF KORPUT DIST OF ODISHA

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In the pursuit of sustainable agriculture and eco-friendly options, vermicomposting stands out as a prime example of nature's efficiency. Vermicompost, often called "black gold," is created by earthworms breaking down organic waste into a nutrient-rich fertilizer. The heavy use of synthetic fertilizers in farming depletes soil fertility, removes beneficial microorganisms, weakens crop natural defences, increases susceptibility to pests, and harms human health and the environment. To address these challenges, we should prioritize green solutions like vermicompost, which can effectively reduce disease and pest outbreaks, enhance crop yields, and protect both the environment and human well-being. The nutrient-rich vermicompost, enriched with growth promoters like auxins, gibberellins, and cytokinins, along with beneficial microbes, not only enhances crop yield but also promotes nematode diversity and antagonistic microbe activity, suppressing soil-borne diseases. It has the potential to reduce soil degradation, sequester organic carbon, and maintain pH levels, moderating soil acidity and alkalinity. The organic matter in vermicompost improves soil structure by increasing aggregation, porosity, and water retention, facilitating root penetration, aeration, and drainage, thus creating an optimal environment for plant growth and microbial activity. Furthermore, its economic feasibility renders it appealing to farmers aiming to enhance productivity while cutting expenses and environmental footprint. A single vermicompost pit (measuring 12x4x2 feet) can yield approximately 400-450 kg of vermicompost every three months, totalling around 1600 kg per year. This quantity can effectively cover 1-1.5 acres of land for organic vegetable cultivation or 1.5 acres for cereal farming.

Keywords: Vermicompost, Soil, Organic Carbon

ROLE OF AGROECOLOGICAL PRACTICES IN PROMOTING BIODIVERSITY CONSERVATION, ENHANCING ECOSYSTEM SERVICES, AND SUPPORTING SUSTAINABLE FOOD SYSTEMS

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Agroecological practices have emerged as a promising approach to tackle the interconnected challenges of biodiversity conservation and sustainable food production. This study aims to explore the multifaceted role of agroecological practices in biodiversity conservation, improving ecosystem services, and fostering sustainable food systems. Through an extensive review of existing literature and case studies encompassing diverse agroecosystems and geographical contexts, the research delves into the ecological principles and management strategies that underlie agroecology. Key areas of focus include the incorporation of biodiversity-friendly farming techniques such as polyculture, crop diversification, agroforestry, and soil conservation methods, and their positive impacts on soil fertility, pest control, water management, and carbon sequestration. Additionally, the study assesses the socioeconomic dimensions of agroecological systems, exploring their potential to enhance livelihoods, food security, and build resilience to climate change and other environmental pressures. Moreover, the study evaluates the challenges and opportunities associated with upscaling agroecological practices, including the need for supportive policies, improved market access, enhanced farmer knowledge, and strengthened institutional capacities. By synthesizing insights from various disciplines, the study provides actionable recommendations for policymakers, practitioners, and stakeholders interested in promoting agroecology as a viable pathway towards biodiversity conservation, ecosystem rehabilitation, and sustainable food systems. Ultimately, this research aims to contribute to a deeper understanding of the transformative potential of agroecology in addressing urgent environmental and food security issues, while fostering social equity and resilience within agricultural systems.

Keywords: Agroecological Practices, Biodiversity Conservation, Sustainable Food Production, Ecosystem Services

A SUSTAINABLE TECHNIQUE IN DEVELOPING A TOLERANT *Anabaena* sp. PCC 7119 STRAIN TO TARGET TOXIC ORGANOPHOSPHORUS CHEMICALS IN AGROECOSYSTEM

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Agricultural sector is the backbone of Indian economy. The primary objective is to achieve a milestone in global food production without tampering the natural ecosystem and stability. The most efficient sustainable practice to provide food for the world's population is to maintain the health of the agroecosystem. There is a target to neutralize the toxic imprints of agrochemicals, specifically insecticides through microbes within their environment. Numerous microbial communities can be found in soil, but cyanobacteria populations play a major role in the soil carbon and nitrogen economy, increasing crop nutrient availability and facilitating improved agricultural nutrient management. Organophosphates (OPs) are a group of commonly produced man-made insecticides, used for on-field pest control as well as in domestic sectors. A heterocystous cyanobacterium *Anabaena* sp. 7119 was induced to develop tolerance to OP chemicals through prolonged exposure to incremental concentrations of chlorpyrifos (CP). The strain showed promising growth in CP containing medium (10 µM) without any growth and metabolic alteration. The CP tolerant strain of *Anabaena* showed improved growth and metabolic activities in the presence of growth inhibiting concentrations of the OP insecticide dimethoate as compared to a wild strain. The photosynthetic performance, key enzyme activities and the degradation potential of the tolerant strain was remarkably higher than of the wild type thus confirming the spectrum of horizontal tolerance. In terms of enduring dimethoate toxicity, the enriched strain displayed encouraging outcomes and also for the breakdown of OP.

Keywords: *Anabaena* sp., Tolerant Stain, Agrochemical, Chlorpyrifos

POSSIBLE PHYTOREMEDIATION FROM NICKEL CONTAMINATED AREA USING FABACEAE PLANTS

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Nickel is a potentially toxic heavy metal that occurs widely in the environment due to human activities. The release of nickel into the atmosphere during industrial processes has increased the concentration of this metal in the air, soil, and water. Although the bulk nickel emissions are from oil and coal combustion, municipal solid waste incineration, and sewage sludge incineration, other processes such as the production of nickel-cadmium batteries also result in the release of nickel into the environment. As a consequence, an ever-increasing land area is becoming contaminated with nickel. Although the toxic effect of nickel is demonstrated by its effect on the growth of plants, a little of the actual mechanism of toxicity is known. Nickel is indeed an essential nutrient for plant growth and plays a crucial role in enzyme activities and various physiological processes such as urease activity. However, with increasing urbanization and industrialization, the concentration of nickel in the environment is rising. In regions like Odisha, known for mining activities and holding a significant portion of India's nickel resources, heavy metals, including nickel, accumulate in the soil. While plants can tolerate certain levels of nickel, excessive concentrations can lead to toxicity. This work aims to provide insights into the effects of varying nickel concentrations on Fabaceae plants and explore phytoremediation strategies. It will shed light on the sources of nickel pollution, its impact on plant physiology, and metabolic activities in polluted soils.

Keywords: Nickel, Odisha, Pollution, Fabaceae, Phytoremidiation

"Sustainability is not just about conserving the earth's resources; it's about preserving the very essence of life on this planet."

David Suzuki

ASSESSMENT OF HEXAVALENT CHROMIUM TOXICITY ON *GOMPHRENA GLOBOSA* (L.)

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Chromium is one of the heavy metal which is released in the soil due to open cast mining and has a negative impact on a range of living things. Proven studies about the benefits of reclaiming the overburden sites create a great demand for use of such lands in agriculture. Phytoremediation is the use of plants and their associated microbes to clean the metal contaminated and the polluted ecosystem. The present study was under taken to determine the phytoremediation activity of *Gomphrena Globosa* (.L) in chromium contaminated soil. It is an extra dwarf and compact plant easy to grow, drought tolerant and also it has shown antimicrobial, antioxidant and cytotoxic activity. This plant is used as phytoremediation plants due to its ability to absorb, accumulate and detoxify heavy metals from the contaminated soil and its non-edible property. The plant was supplemented with various concentration of hexavalent chromium (10ppm, 30ppm, 60ppm, 90ppm & 120ppm). Morphological characters like root and shoot length, seedling length, dry and fresh weight, showed a decreasing trend in 90ppm in comparison to control but it the parameters did not vary much when compared to 60,90,120ppm. Biochemical parameter such as Protein, Carbohydrate, Reducing sugar showed a decreasing trend with increasing Cr (VI), non-enzymatic antioxidant proline and enzymatic antioxidant activities like Catalase, and Ascorbate peroxidase (APX) increased with increasing doses of Cr(VI).

Keywords: Hexavalent Chromium, Phytoremediation, Catalase, Reducing Sugar

"The world has enough for everyone's needs, but not everyone's greed,"

Mahatma Gandhi

VALUATION, ISOLATION AND IDENTIFICATION OF THE EFFECTIVE PLANT PRODUCTS FOR THE MANAGEMENT OF INSECTS INFESTING STORED GROUNDNUT

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The effectiveness of various botanicals was tested against the major pest, groundnut beetle *Caryedon serratus*, Oliver (Bruchidae: Coleoptera) under artificial infestation, in Laboratory conditions for one year. The various plants and their Powders @1%w/w, Ethanolic Soxhlet Crude Extracts, Isolated Chromatographic Fractions @1%v/w of (*Azadirachta indica, Pongamia pinnata, Vitex negundo, Mangifera indica , Carum copticum, Syzizium aromaticum, Datura stramonium, Lantana camara, Acorus calamus , Ocimum sanctum* and *Artocarpus heterophyllus* etc) and Essential Oils isolated by Clevengers Apparatus , @1%v/w of *Pongamia glabra* (Karanja Oil), *Azadirachta indica* (Neem Oil), *Brassica campestris* (Mustard Oil), *Cymbopogon nardus* (Citronella oil) *Mentha spicata* (Mint Oil) , *Dalbergia sisso* (Sisso Oil), *Cinnamomum camphora* (Camphor Oil) *Oryza sativa* (Rice bran oil), *Helianthus annus* (Sunflower Oil) , *Ricinus communis* (Castor Oil), *Aegle marmelos* (Bael Oil), *Sesamum indicum* (Til Oil), *Eucalyptus* sp (Nilgiri Oil), *Shorea robusta* (Crown oil) etc and @1%w/w of *Cinnamomum camphora* Pellets, *Mentha piperata* Pellets and Pellets of *Carum copticum* were tested for their bioefficacy. Out of all these plant products only the Powders and the isolated active components of *Carrum copticum*, *Syzizium aromaticum*, *Acorus calamus, Ocimum sanctum* and Nilgiri Oil (*Eucalyptus sp*), Citronella oil (*Cymbopogon nardus*), Camphor Oil (*Cinnamomum camphora*), Crownoil (resin of *Shorea robusta*) pellets of *Cinnamomum camphora* (Camphor), *Carrum copticum* and *Mentha spicata* (Peppermint), gave 100 % pod/Kernel protection for one year. The LD_{50} values were found to be - 0.5% v/w and- 0.5% w/w respectively also. The active components of *Carrum copticum*, *Acorus calamus, Ocimum sanctum* and *Syzizium aromaticum* were isolated by TLC and Column Chromatography and soxhlet apparatus and spectroscopic GC MS analysis of Nilgiri Oil (*Eucalyptus sp*), are identified as 1,8-Cineol and α-pinene. It may be due to the strong aromatic nature of these phytoproducts. Hence these phytoproducts may be used as fumigants or insect repellants against *Caryedon serratus* and can be included in the package of practices to save stored groundnut in storage.

Keywords: Ethanolic Soxhlet Crude Extracts, Isolated Chromatographic Fractions and Clevengers Apparatus and LD_{50}.

RECENT ADVANCEMENTS IN SUSTAINABLE BROWN PLANT HOPPER (*Nilaparvata lugens*) RESISTANCE IN RICE (*ORYZA SATIVA*) UTILIZING CRISPR-CAS9 TECHNOLOGY

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The brown plant hopper (*Nilaparvata lugens*) has become a major global threat to rice (*Oryza sativa*) production in recent years, resulting in significant financial losses. Rice plant hoppers are the most common and destructive rice pest causes hopper burn. Chemical pesticides and other conventional pest control techniques have shown to be ineffective and hazardous to the environment. As a result, there is increasing interest in creating sustainable strategies to strengthen rice's resistance to this destructive insect pest. CRISPR-Cas9 technology has transformed genome editing and opened up new possibilities for crop improvement. Even at the multiplex level, CRISPR-Cas9 technology is faster, cheaper, more precise, and highly efficient in editing genomes. Serotonin regulates feeding behaviour and digestion in insects. Phytoserotonin (5-hydroxytrptamine) is found in many tissues in plants and is involved in many aspects of plant growth and development, including maturation. Tryptamine 5-hydroxylase, which catalyses the conversion of tryptamine to serotonin, is encoded by the rice cytochrome P450 gene *CYP71A1*. Plant hopper feeding induces the biosynthesis of serotonin and salicylic acid in susceptible wild-type rice, whereas in mutants with an inactivated *CYP71A1* gene, no serotonin is produced, salicylic acid levels are higher, and plants are more insect resistant. These insights demonstrate that regulation of serotonin biosynthesis plays an important role in defence, and may prove valuable for breeding insect-resistant cultivars of rice and other cereal crops.

Keywords: CRISPR-CAS9, Brown Plant Hopper, Phytoserotonin, P450 gene

ENDOPHYTIC FUNGI: A NOVEL PURSUIT FOR SUSTAINABLE AGRICULTURE

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The widespread use of agricultural pesticides harms the environment, as well as human and animal health. The discovery of innovative solutions for the establishment of sustainable agriculture is crucial to avoid the excessive use of fertilizers and pesticides as a productivity booster. There is a global ever-growing demand for implanting ecologically compatible and eco-friendly practices in agriculture, capable of providing adequate solutions for improving agriculture productivity. For these reasons, the use of endophytic fungi offers a biological alternative for enhancing agricultural output sustainably. Endophytic fungi establish a beneficial symbiotic relationship with host plants and have been demonstrated to have a high impact on host plants. The fungal endophytes confer profound impacts on their host plants including plant growth promotion, production of secondary metabolites, and other bioactive compounds that are expressed as defensive weapons to protect the host plant against various abiotic and biotic stresses, improving agricultural productivity, providing disease resistance against dreadful phytopathogens, all of which promotes the crop production through sustainable approaches.

Keywords: Fungi, Pesticide, Sustainable Agriculture

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