An International Edition

ISBN: 978-81-970663-6-8

Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science

Editors

Prin. Dr. Vilas Patil

Dr. Asha Kadam

Dr. Sandeep Panari

Mr. Agastirishi Toradmal

Nature Light Publications

An International Edited Book *ISBN- 978-81-970663-6-8*

Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science

Editors

Prof. Dr. Vilas V. Patil
I/C Principal
Akhil Bhartiya Maratha Shikshan Parishad's
Shri Shahu Mandir Mahavidyalaya, Parvati, Pune-411007 (MH)

Dr. Sandeep S. Panari
I/C Principal
Anandi Shikshan Prasarak Mandal's
Padmashri Dr. G. G. Jadhav Mahavidyalaya,
Gaganbawada, Tal- Gaganbawada, Dist.- Kolhapur

Dr. Asha B. Kadam
Asst. Prof. Department of Botany
Dada Patil Mahavidyalaya, Karjat, Dist.- Ahmednagar (MH)

Mr. Agastirishi B. Toradmal
Department of Geography
Prof. Ramkrishna More Mahavidyalaya, Pradhikaran, Akurdi, Pune (MH)

Published By

Nature Light Publications, Pune

Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science

ISBN- 978-81-970663-6-8

An International Edited Book

Editors-

Prof. Dr. Vilas V. Patil
Dr. Sandeep S. Panari
Dr. Asha B. Kadam
Mr. Agastirishi B. Toradmal

Published in April 2024

Published by:

Nature Light Publications, Pune

Preface

We are happy to welcome the idea of publishing a book on relevant topic, "Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science". Further, it is good that the articles from various disciplines are included in the book. The scholars from Arts, Humanity, Commerce, Science and Social Science have attempted to identify the current trend and to provide ideas to doing the recent study.

The Spatial Dynamics, Phytoremediation tools, Medicinal Plants, Ecosystem services of birds, Biodiversity Conservation, Dairy development, Climate Change, Natural Disasters, Covid-19 and Its Impact, Effects of Meditation etc. This exhibits how variety of topics have been discussed in the book. The book provides open forum for the scholars and even graduate students to discuss further so that they can think about strategic planning to use emerging strategies in sciences.

Renowned researchers, scientists, educators, and business professionals have contributed pieces to the book. We would especially want to express our gratitude to the researchers and specialists whose contributions have made this book better.

Date: *30 April 2024*

Editors

Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science

Table of Content

Spatial Dynamics: Understanding Per Capita Land Distribution in Punjab and Haryana

Dr. Apperdeep Kaur
Department of Geography, Punjabi University, Patiala
Email: *apper.bajwa@gmail.com*

Article DOI Link: https://zenodo.org/records/11218549
DOI: 10.5281/zenodo.11218549

Abstract:

This study examines the spatial dynamics of per capita land distribution in Punjab and Haryana, offering a comprehensive decade-wise and district-wise analysis from 1961 to 2011. Utilizing census data and geographic information systems (GIS), the research maps out the evolving landscape of land availability over five decades, emphasizing the impact of demographic shifts and agricultural practices on land distribution. Key findings reveal a concerning trend of declining per capita land availability across both states, highlighting the mounting pressure on agricultural resources amidst population growth and urbanization. District-level analyses uncover spatial variations, with some regions experiencing more pronounced declines than others, underscoring the importance of localized interventions and land management strategies. The study's insights shed light on the intricate interplay between population dynamics, land use patterns, and socioeconomic factors, offering valuable implications for policy-makers, planners, and stakeholders. By understanding the spatial nuances of per capita land distribution, informed decisions can be made to mitigate land scarcity challenges and promote sustainable land utilization practices in Punjab and Haryana.

Keywords: Per capita availability of land, Punjab, Spatial Dynamics, District-wise analysis, Population growth, Urbanization, Land fragmentation, Sustainability.

Introduction:

Per Capita availability of land is a measure of the total land available per person in the country. The distribution of land per capita is a critical aspect of regional development and sustainability, particularly in agriculturally dominant regions like Punjab and Haryana. Over the past decades, these states have witnessed significant demographic changes and rapid urbanization, posing challenges to the equitable allocation of land resources. Understanding the spatial dynamics of per capita land distribution is essential for informed policymaking and effective land management strategies. With only 2.4% of the world's land area, India supports 18% of the global population. At 0.12 hectares per person, India's per capita availability of agricultural land is less than half the global average of 0.29 hectares. This severe imbalance between population and arable land has placed unprecedented strain on India's limited land resources, resulting in widespread degradation across the country (PIB, 2019).

Objectives:

The following objectives have been considered for the present study: -

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

i. To assess the district-wise variations in per capita land distribution over the study period.
ii. To identify the key factors influencing changes in per capita land availability, including population growth, urban expansion, and agricultural practices.
iii. To explore the implications of declining per capita land availability for agricultural productivity, food security, and rural livelihoods.
iv. To provide actionable insights for policymakers and stakeholders to address the challenges of land scarcity and promote sustainable land management practices in Punjab and Haryana.

Research Methodology:

The present study deals with districts as study units. The 2011 administrative map serves as the base to allow for comparability across the study period of 1961-2011. Secondary data sources have been used for this study, which ended at 2011 due to the unavailability of population statistics following that year's census because of COVID-19. The statistical data were computed, tabulated, analyzed, and mapped using ArcGIS 10.1 and appropriate cartographic techniques.

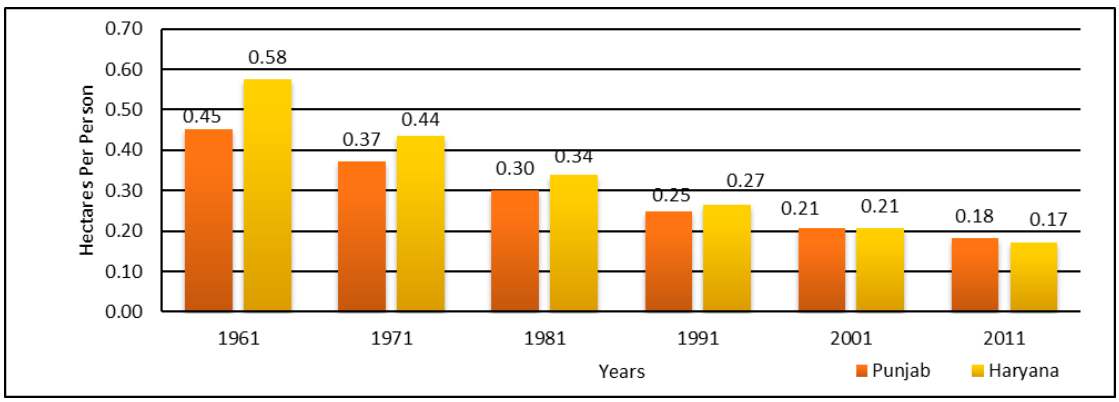
Study area:

The northwestern Indian states of Punjab and Haryana serve as the study area. Before 1966, these two states formed the single state of Punjab. The study area is bordered by Jammu & Kashmir to the northwest, Himachal Pradesh to the north and northeast, Uttar Pradesh and the Union Territory of Delhi to the east, Rajasthan to the west and southwest, and Pakistan to the west. Geographically, the study area lies between 27°37'N and 32°32'N latitude and 73°55'E to 77°46'E longitude.

Spatial Dynamics of Per Capita Land Availability:

The availability of land per person in Punjab and Haryana has plummeted since 1961, from 0.45 hectares and 0.58 hectares per person respectively to just 0.18 hectares and 0.17 hectares today (Fig 1).

Fig 1 Per Capita Availability of Land



Source: S.A.P. 1961, 1971, 1981, 1991, 2001, 2011; and S.A.H. 1966-67, 1971-72, 1981-82, 1991-92, 2001-02, 2011-12

District-wise analysis reveals that in 1961, Sirsa district had the highest per capita land availability at 1.15 hectares per person, followed by Fatehabad district at 1.00 hectares. Amritsar district had the lowest at 0.26 hectares. By 1971, Sirsa (0.80 hectares) and Fatehabad (0.66 hectares) still had the most, while Amritsar (0.22 hectares) and Faridabad (0.22 hectares) had the least. This downward trend in per capita land availability continued through the 1981 and 1991 censuses, driven by high population growth until 1991. The pattern persisted in 2001 and 2011 as well, across the region. Although shrinking, Sirsa maintained the highest availability while Faridabad saw a drastic decline in per capita availability of land.

Map 1 Change in Per Capita Availability of Land

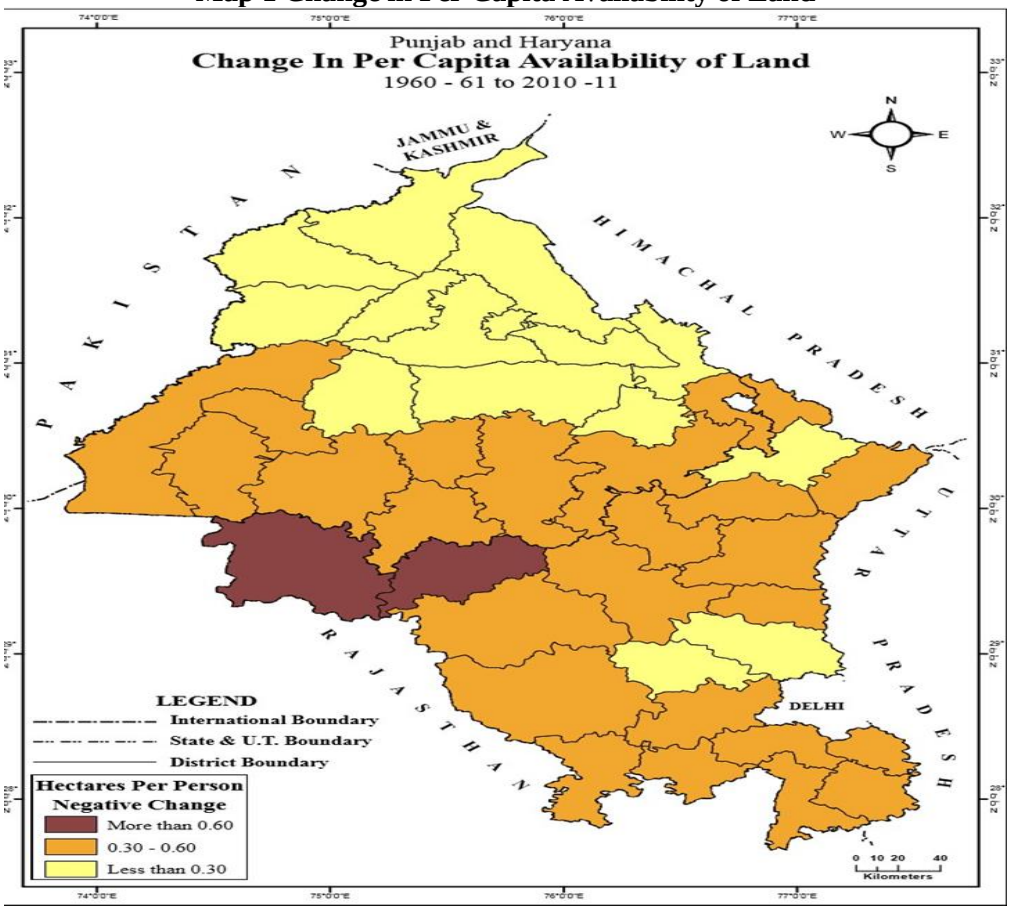


Table 1 Per Capita Availability of Land and change in it (Hectares Per Person)

DISTRICT	1961	2011	Change from 1961-2011
Punjab	**0.45**	**0.18**	**-0.27**
Gurdaspur	0.36	0.15	-0.21
Amritsar	0.26	0.11	-0.16
Tarn Taran	0.46	0.22	-0.24
Kapurthala	0.49	0.20	-0.28
Jalandhar	0.27	0.12	-0.15
S.B.S Nagar	0.38	0.21	-0.17

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Hoshiarpur	0.43	0.21	-0.22
Rupnagar	0.44	0.20	-0.23
S.A.S Nagar	0.51	0.12	-0.39
Ludhiana	0.34	0.11	-0.24
Firozpur	0.67	0.26	-0.41
Faridkot	0.60	0.24	-0.36
Muktsar	0.69	0.29	-0.40
Moga	0.50	0.22	-0.28
Bathinda	0.66	0.24	-0.42
Mansa	0.67	0.28	-0.39
Sangrur	0.52	0.22	-0.30
Barnala	0.58	0.24	-0.34
Patiala	0.48	0.17	-0.31
Fatehgarh Sahib	0.47	0.19	-0.28
Haryana	**0.58**	**0.17**	**-0.40**
Ambala	0.34	0.14	-0.20
Panchkula	0.54	0.10	-0.44
Yamunanagar	0.46	0.14	-0.32
Kurukshetra	0.48	0.17	-0.31
Kaithal	0.68	0.21	-0.47
Karnal	0.52	0.16	-0.35
Panipat	0.44	0.11	-0.33
Sonipat	0.39	0.15	-0.24
Rohtak	0.39	0.16	-0.23
Jhajjar	0.51	0.20	-0.31
Faridabad	0.40	0.04	-0.36
Palwal	0.47	0.13	-0.34
Gurugram	0.46	0.08	-0.38
Nuh	0.62	0.14	-0.48
Rewari	0.48	0.17	-0.31
Mahendragarh	0.57	0.21	-0.36
Bhiwani	0.84	0.28	-0.55
Jind	0.59	0.21	-0.38
Hisar	0.70	0.23	-0.47
Fatehabad	1.00	0.27	**-0.73**
Sirsa	1.15	0.33	-0.82

Source: S.A.P. 1961, 2011 and S.A.H. 1966-67, 2011-12

Change in Per Capita Land Availability:

When the per capita availability of land was compared between 1961 and 2011, the whole research region showed a negative trend in this regard. A negative change of 0.27 hectares per person has occurred in Punjab, and a negative change of 0.40 hectares per person has occurred in Haryana. The map 1 illustrates three categories of negative change in per capita land availability:

i) **Decline of Over 0.60 Hectares Per Person:**

This category includes only Sirsa and Fatehabad districts in Haryana, which had the highest per capita land availability in 1961 due to relatively sparse population. Over time, population growth occurred, leading to the maximum decline in per capita land availability.

ii) **Decline of 0.30-0.60 Hectares Per Person:**

This category predominates in southern Punjab and most of Haryana, covering 16 districts. In Punjab, the affected districts are Firozpur, Faridkot, Muktsar, Bathinda, Mansa, Barnala, Sangrur, Patiala and S.A.S Nagar. In Haryana, the districts are Panchkula, Yamunanagar, Kurukshetra, Kaithal, Karnal, Jind, Panipat, Hisar, Bhiwani, Mahendragarh, Jhajjar, Rewari, Gurugram, Faridabad, Palwal and Nuh. All these districts exhibited a moderate decline in per capita land availability.

iii) **Decline of Under 0.30 Hectares Per Person:**

This category prevails in northern Punjab and a few Haryana districts. The affected Punjab districts are Gurdaspur, Amritsar, Tarn Taran, Kapurthala, Jalandhar, Hoshiarpur, S.B.S Nagar, Rupnagar, Ludhiana, Moga and Fatehgarh Sahib. The Haryana districts are Ambala, Sonipat and Rohtak. These districts already had medium to low per capita land availability, hence the negative change is less compared to the above categories.

Causes of Declining Per Capita Land Availability: The following causes have been identified after evaluation of secondary data, reports and newspaper articles:

i. Population Growth: The steady increase in population over the decades has led to a higher demand for residential, industrial, and agricultural land, resulting in fragmentation and reduced per capita land availability.
ii. Urban Expansion: Rapid urbanization has encroached upon agricultural land, leading to its conversion for non-agricultural purposes such as housing, infrastructure, and commercial developments.
iii. Land Fragmentation: Inheritance practices and population growth have contributed to land fragmentation, with smaller land holdings per capita, reducing overall agricultural productivity.
iv. Industrialization: The establishment of industries and infrastructure projects has led to land conversion and reduced agricultural land availability, particularly in peri-urban areas of Haryana state.
v. Agricultural Practices: Intensive agricultural practices, including mechanization and irrigation, have led to changes in land use patterns, further reducing per capita land availability.

Implications of Declining Per Capita Land Availability:

i. Agricultural Productivity: Declining per capita land availability may lead to reduced agricultural productivity and output, impacting food security and rural livelihoods.
ii. Land Degradation: Pressure on limited land resources may intensify soil erosion, depletion of natural resources, and degradation of agricultural land, threatening long-term sustainability.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

iii. Rural-Urban Migration: Land scarcity in rural areas may drive migration to urban centers in search of livelihood opportunities, contributing to urbanization and associated challenges.

iv. Socioeconomic Disparities: Unequal distribution of land may worsen socioeconomic disparities, with marginalized communities facing greater challenges in accessing and utilizing land resources.

v. Environmental Impacts: Land conversion and intensive agricultural practices may have adverse environmental impacts, including loss of biodiversity, habitat destruction, and increased greenhouse gas emissions.

Conclusion and Recommendations:

The per capita availability of land has significantly decreased in both states. It is a multifaceted issue influenced by population growth, urbanization, land fragmentation, industrialization, and agricultural practices. As the human population grows exponentially, available land for living and farming shrinks. Consequently, there is a global emphasis on utilizing vertical rather than horizontal space for agriculture. Thus, the trend of declining per capita land availability poses significant challenges to agricultural productivity, food security, rural livelihoods, and environmental sustainability in the region. Policy interventions and sustainable land management strategies are essential to address the challenges posed by land scarcity and ensure equitable access to land resources. To address the issue of declining per capita land availability, the following strategies should be implemented:

- Sustainable land management practices that optimize land use through integrated planning are needed to mitigate the impacts of limited land resources.
- Policymakers must enact reforms that promote equitable land access via consolidation, and zoning laws.
- Diversifying rural livelihoods beyond agriculture through activities like agroforestry and horticulture can reduce dependence on cropland.
- Engaging communities in participatory land management and decision-making will ensure local needs are considered and sustainability improved.
- Research and innovation investments in agriculture, conservation, and planning will provide vital evidence to develop policies that tackle land scarcity effectively.

References:

1. PIB (2019). Union Minister for Rural Development Shri Narendra Singh Tomar releases ‘Wastelands Atlas’ – 2019. Press Information Bureau, Government of India, New Delhi. Retrieved from https://pib.gov.in/PressReleseDetailm.aspx?PRID=1590395#:~:text=India%20with%202.4%25%20of%20total,agriculture%20land%20is%200.29%20ha.
2. S.A.H. (1966-67). Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.
3. S.A.H. (1971-72). Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.

4. S.A.H. 1981-82. Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.
5. S.A.H. 1991-92. Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.
6. S.A.H. 2001-02. Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.
7. S.A.H. 2011-12. Statistical Abstract of Haryana. Haryana: Economic and Statistical Organization.
8. S.A.P. 1961. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.
9. S.A.P. 1971. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.
10. S.A.P. 1981. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.
11. S.A.P.1991. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.
12. S.A.P. 2001. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.
13. S.A.P. 2011. Statistical Abstract of Punjab. Punjab: Economic and Statistical Organization.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Review on Phytoremediation: A Potential tool

Khodade Hrishikesh
S. M Joshi College Hadapsar, Pune (MS)
Email: *rishikesh@live.in*

Article DOI Link: https://zenodo.org/records/11218612
DOI: 10.5281/zenodo.11218612

Abstract:

Phytoremediation, the utilization of plants for environmental cleanup, has emerged as a sustainable and cost-effective approach for remediating contaminated sites. This review paper provides a comprehensive analysis of the current trends and future prospects in the field of phytoremediation. The paper begins by presenting an overview of the various contaminants that can be targeted using phytoremediation techniques, including heavy metals, organic pollutants, and radioactive elements. It highlights the diverse mechanisms by which plants can remediate these contaminants, such as phytoextraction, rhizodegradation, Phytostabilization, and phytovolatilization.

Next, the review explores the factors influencing the effectiveness of phytoremediation, including plant species selection, genetic engineering, soil conditions, and interactions between plants and microorganisms. It discusses the importance of understanding the complex processes occurring within the plant-soil-microbe interface and the potential for enhancing phytoremediation efficiency through biotechnological advancements.

Furthermore, the paper evaluates the current state of phytoremediation research, encompassing case studies from contaminated sites around the world. It assesses the successes and limitations of various phytoremediation strategies, emphasizing the need for a holistic and site-specific approach to achieve optimal results.

The review also highlights the potential challenges associated with phytoremediation, such as long-term monitoring, regulatory frameworks, public acceptance, and scalability. It addresses the importance of addressing these challenges to promote wider adoption of phytoremediation as a sustainable remediation technique.

Lastly, the paper outlines future prospects in the field, including the integration of phytoremediation with other remediation technologies, the utilization of native and engineered plant species, and the exploration of emerging techniques such as phytosensing and Phyto management.

This review paper provides a comprehensive assessment of the current state of phytoremediation, highlighting its strengths, limitations, and future directions. It underscores the potential of phytoremediation as a sustainable solution for environmental cleanup and emphasizes the importance of interdisciplinary research and collaboration to advance this field further.

Keywords: Phytoremediation, phytosensing, Phyto management, Phyto stabilization, rhizodegradation

Introduction:

Phytoremediation is a natural, sustainable, and cost-effective approach to remediate contaminated soil, water, and air using plants. It harnesses the unique abilities of certain plant species to remove, degrade, or immobilize pollutants, thus restoring or improving the quality of the environment. (Flathman and Lanza 2010)

Phytoremediation is an environmentally friendly and cost-effective approach that uses plants to clean up and remove pollutants from soil, water, and air. The term "phytoremediation" combines "Phyto," meaning plant, and "remediation," referring to the process of addressing or solving an environmental problem (Padmavathiamma and Li 2007). Plants have a remarkable ability to absorb, metabolize, and sometimes even transform various contaminants, including heavy metals, organic compounds, and radioactive substances. Phytoremediation harnesses these natural abilities by strategically selecting and cultivating plants known as hyperaccumulators or metallophytes, which have a high tolerance for and accumulation capacity of pollutants (Flathman and Lanza 2010).

Phytoremediation is an innovative and environmentally friendly approach to remediate polluted soil, water, and air using plants. It harnesses the natural ability of plants to remove, degrade, or immobilize contaminants from the environment. The concept of phytoremediation has been around for centuries, but its modern development began in the 1980s and has since gained recognition and application worldwide (Dickmann 2006).

Sr	**Brief History of Phytoremediation**	
1	Early History of Phytoremediation:	The use of plants for environmental remediation can be traced back to ancient civilizations. For example, the ancient Greeks used aquatic plants to treat wastewater. Additionally, in China, traditional practices like the cultivation of water hyacinths in rice fields helped improve water quality and soil fertility (Gaballah, Saber, and Guo 2022).
2	Emergence of Modern Phytoremediation:	The modern concept of phytoremediation emerged in the 1980s as a response to increasing concerns about industrial pollution and its impact on the environment. Researchers and scientists began studying the potential of plants to clean up contaminated sites (Paz-Alberto and Sigua 2013).
3	Milestone Discoveries:	In the 1980s, researchers discovered that certain plants, known as hyperaccumulators, have the ability to take up and accumulate high concentrations of heavy metals in their tissues without being significantly affected. This

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

		discovery laid the foundation for the development of phytoremediation strategies focused on metal-contaminated sites (Burges et al. 2018).
4	Phytoremediation in 1990s:	Throughout the 1990s, research on phytoremediation expanded, and various plant species were identified for their potential in remediating specific contaminants. Scientists explored the use of plants in removing pollutants like organic compounds, pesticides, explosives, and even radioactive elements. The effectiveness of plants, such as poplar trees, in cleaning up contaminated groundwater was demonstrated in several field trials (Gobelius, Lewis, and Ahrens 2017).
5	Regulatory Recognition and Application:	By the late 1990s and early 2000s, phytoremediation gained recognition as a viable and sustainable remediation technique. Regulatory agencies, such as the United States Environmental Protection Agency (EPA), began to acknowledge phytoremediation as a potential solution for contaminated sites. This led to increased interest and investment in the field (Anon n.d.-a).

Selection of Plant:

Plant selection is a crucial aspect of phytoremediation projects, as the choice of plant species can greatly influence the success and effectiveness of the remediation process. Different plants have varying abilities to tolerate, accumulate, and degrade specific contaminants (Kidd et al. 2015).

Here are some key considerations for plant selection in phytoremediation:

- **Hyperaccumulators:** Hyperaccumulator plants are highly effective in extracting and accumulating high levels of contaminants from the soil. These plants have evolved mechanisms to tolerate and store large amounts of metals or other pollutants without being harmed (Burges et al. 2018).
- **Tolerance and Adaptability:** Plants selected for phytoremediation should exhibit tolerance to the target contaminants, as well as adaptability to the environmental conditions of the contaminated site (Kidd et al. 2015). They should be able to withstand high concentrations of pollutants in the soil or water, as well as adverse factors such as pH, salinity, temperature, and moisture levels. Native or locally adapted plant species often have better chances of survival and successful remediation (Prabakaran et al. 2019).
- **Biomass Production:** High biomass production is desirable in phytoremediation, as it allows for greater pollutant uptake and accumulation. Plants with fast growth rates and extensive root systems can efficiently extract contaminants from the soil or water

and provide a substantial biomass for subsequent harvesting and disposal (Yadav et al. 2010).

- **Root Characteristics:** The root system of selected plants plays a vital role in phytoremediation. Plants with deep and extensive root systems are capable of accessing pollutants in deeper soil layers and extracting them effectively (Cook and Hesterberg 2013). The root exudates released by plants can also influence soil microbial activity, enhancing degradation or immobilization of contaminants (Song et al. 2016).
- **Genetic Diversity:** Genetic diversity within the selected plant species can be advantageous for phytoremediation projects. Different genotypes may exhibit varying levels of tolerance, accumulation, or degradation capacities. Utilizing diverse genotypes can increase the chances of finding plants with the desired traits and enhance overall remediation effectiveness (Yadav et al. 2010).
- **Ecological Considerations:** Phytoremediation projects should consider the potential ecological impacts of the selected plant species. It is important to choose plants that do not pose invasiveness or disrupt the native ecosystem. Native plant species or non-invasive cultivars are generally preferred to maintain biodiversity and ecological balance (Prabakaran et al. 2019).
- **Maintenance and Harvesting**: Practical considerations such as ease of maintenance, harvestability, and the potential uses of harvested biomass should also be taken into account. If the harvested biomass can be utilized for energy production or other purposes, it can contribute to the economic viability of the phytoremediation project (Witters et al. 2012).

It is essential to conduct thorough research and screening to identify suitable plant species for specific contaminants and environmental conditions. Experimental trials and field testing can help evaluate the performance of selected plants in situ before large-scale implementation. Collaboration between botanists, ecologists, and environmental scientists is valuable for effective plant selection and successful phytoremediation outcomes.

Indian plants commonly used or studied for phytoremediation:

1. Pongamia (*Pongamia pinnata*): Pongamia is a native Indian tree known for its ability to tolerate drought and saline conditions. It has been studied for its effectiveness in phytoremediation of contaminated soils, especially those contaminated with heavy metals, organic pollutants, and hydrocarbons (Yu et al. 2021).
2. Neem (*Azadirachta indica*): Neem is a widely recognized Indian tree with diverse medicinal properties. It has been investigated for its phytoremediation potential, particularly for the removal of heavy metals from contaminated soils and water (Tiwari, Kumar, and Kumar 2017).
3. Vetiver Grass (*Chrysopogon zizanioides*): Vetiver grass, also known as khus or ramacham, is native to India and has been extensively used in phytoremediation projects worldwide. It is effective in stabilizing slopes, reducing soil erosion, and

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

improving water quality by absorbing and accumulating contaminants such as heavy metals and nutrients (Danh et al. 2009).

4. Indian Mustard (*Brassica juncea*): Indian mustard, known as sarson or rai, is a commonly cultivated crop in India. It is a hyperaccumulator plant that has been studied for its potential in removing heavy metals, particularly cadmium and lead, from contaminated soils (Lim, Salido, and Butcher 2004).
5. Water Hyacinth (*Eichhornia crassipes*): Water hyacinth is a floating aquatic plant that is widely distributed in Indian water bodies. It has been used in India for phytoremediation purposes, particularly for wastewater treatment and the removal of nutrients and organic pollutants from polluted water (Ting et al. 2018).
6. Indian Madder (*Rubia cordifolia*): Indian madder, also known as manjistha, is a medicinal plant native to India. It has been investigated for its potential in the phytoremediation of soils contaminated with heavy metals such as lead, copper, and zinc (Yusuf, Mohammad, and Shabbir 2017).
7. Duckweed (*Lemna spp*.): Duckweed is a small, floating aquatic plant found in ponds and wetlands across India. It has been studied for its ability to remove nutrients, heavy metals, and organic pollutants from water bodies, making it suitable for phytoremediation applications (Ekperusi, Sikoki, and Nwachukwu 2019).

The choice of plant species is crucial, as different plants have varying capacities to tolerate and remediate specific pollutants. Additionally, factors such as climate, soil type, and the extent of contamination play significant roles in determining the success of phytoremediation projects.

Plant's Mechanism in Phytoremediation:

Individual plants contribute to the cleanup process through various mechanisms. Here are some of the key mechanisms by which plants play a role in phytoremediation:

A. *Uptake*:

Plants have the ability to absorb contaminants from the soil or water through their roots. This uptake mechanism is crucial for removing pollutants from the environment. The contaminants can include heavy metals, organic compounds, pesticides, and even radioactive elements. Once inside the plant, the contaminants can be stored in different plant tissues or undergo transformation through chemical reactions (Gaballah et al. 2022).

B. *Translocation*:

After the uptake, plants can translocate the contaminants from the roots to other parts of the plant, such as the stems, leaves, or even flowers. This movement of contaminants within the plant allows for their accumulation and sequestration in specific plant tissues (Witters et al. 2012).

C. *Accumulation*:

Some plant species, known as hyperaccumulators, have a natural ability to accumulate high concentrations of specific contaminants in their above-ground biomass. These plants selectively uptake and store contaminants in their tissues

without being significantly affected by them. Hyperaccumulators are particularly useful for phytoextraction, where the plants are harvested and removed from the site, thereby removing the contaminants with them (Flathman and Lanza 2010).

D. *Transformation and Degradation*:

Plants can also facilitate the degradation or transformation of contaminants through enzymatic reactions that occur within their tissues. Certain plant species possess enzymes capable of breaking down or metabolizing organic pollutants, including petroleum hydrocarbons, pesticides, and other organic compounds. This process, known as phytodegradation, can result in the conversion of toxic contaminants into less harmful forms or mineralization into carbon dioxide and water (Yu et al. 2021).

E. *Rhizosphere Interactions*:

The rhizosphere, the region of soil surrounding the plant roots, plays a crucial role in phytoremediation. Plants release various compounds, such as organic acids, enzymes, and exudates, into the rhizosphere. These substances can enhance the availability and mobility of contaminants, making them more accessible for uptake by the roots. In addition, the rhizosphere supports the growth of beneficial microorganisms that can aid in the degradation or immobilization of contaminants (Song et al. 2016).

It is important to note that different plants and plant species exhibit varying degrees of effectiveness in these mechanisms. Selecting the appropriate plant species for a specific phytoremediation application is essential to maximize the cleanup efficiency of the process.

Different types of phytoremediation techniques:

Phytoremediation is a process that uses plants to clean up, degrade, or immobilize pollutants in soil, water, or air. There are several different types of phytoremediation techniques, each suited to different types of contaminants and environmental conditions. Here are some common types of phytoremediation:

1. Phytoextraction:

This method involves using plants to extract and accumulate pollutants, such as heavy metals, from the soil. The plants uptake the contaminants through their roots and store them in their shoots or leaves. Once harvested, the plant biomass can be properly disposed of, effectively removing the pollutants from the environment (McGrath and Zhao 2003).

2. Phyto stabilization:

In this approach, plants are used to stabilize and immobilize contaminants in the soil, preventing their spread or uptake by other organisms. The plants' root systems help bind the pollutants in place, reducing their mobility and bioavailability (Shackira and Puthur 2019).

Main mechanisms involved:

I. Root Uptake: The primary goal of Phyto stabilization is to establish a vegetative cover rather than extracting large amounts of contaminants.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

II. Root Exudates: Plants release root exudates, which are organic compounds secreted by their roots. These exudates can interact with contaminants and influence their chemical forms and mobility in the soil.
III. Erosion Control: The plant roots bind the soil particles, reducing soil erosion caused by wind or water.
IV. Stabilization of Soil Structure: Plant roots can enhance soil structure by promoting the formation of aggregates and improving soil porosity (Shackira and Puthur 2019).

3. **Rhizofiltration:** This technique employs plants with extensive root systems to remove contaminants from water or wastewater. As contaminated water passes through the plant roots, pollutants are either absorbed, adsorbed, or transformed by the plants. The cleaned water can then be released or recycled (Lee and Yang 2010).

I. *Filtration*: The root system acts as a physical filter, allowing water to pass through while trapping and retaining particulate matter and suspended pollutants.
II. *Absorption*: Plants selectively absorb dissolved contaminants from the water through their roots. This absorption process is facilitated by various mechanisms, including ion exchange, chelation, complexation, and adsorption.
III. *Accumulation*: Once absorbed by the roots, the contaminants are transported and accumulated in the plant's root tissues. The accumulated contaminants can be stored in the root cortex, vacuoles, or other cellular compartments.
IV. *Transpiration*: Transpiration is the process by which plants release water vapor through their leaves. As water is drawn up from the roots to the leaves, contaminants that have been absorbed by the roots are transported along with the water. Some contaminants may also be released through the leaves via transpiration.
V. *Harvesting and Disposal*: Once the plants have accumulated a significant amount of contaminants, they can be harvested, and the pollutants can be removed from the system.

4. **Phytodegradation:** Certain plants possess enzymes that can break down organic contaminants, such as petroleum hydrocarbons or pesticides, into less harmful substances. Phytodegradation relies on the plants' metabolic activities to transform and detoxify the pollutants (Muthusaravanan et al. 2018).
5. **Phytovolatilization:** Some plants have the ability to take up contaminants from the soil and release them into the atmosphere through their leaves in a gaseous form. This technique is particularly useful for volatile organic compounds (VOCs) and mercury. The contaminants are converted into a vapor or gas, facilitating their removal from the environment (Jeevanantham et al. 2019).
6. **Phytostimulation:** Phytostimulation involves the use of plants to enhance the activity of microorganisms in the rhizosphere (the soil zone influenced by plant roots) to degrade contaminants more effectively. Plants release certain compounds through their roots, which can stimulate microbial populations and their ability to break down pollutants (Purwanti et al. 2020).

7. **Phytocapping:** This method is used to isolate contaminated soils by placing a layer of vegetation on top. The vegetation helps reduce erosion, controls water infiltration, and minimizes the spread of contaminants. It also promotes the growth of beneficial microorganisms that can aid in the degradation or immobilization of pollutants (Lamb et al. 2014).
8. **Phytosensing:**

I. Phytosensing refers to the use of plants as living sensors to detect and monitor environmental conditions, including the presence of contaminants or changes in soil or air quality. By leveraging the natural physiological and biochemical responses of plants, phytosensing offers a non-intrusive and cost-effective approach for environmental monitoring (Volkov and Markin 2012).

II. Plants possess inherent abilities to respond to various stimuli, such as changes in nutrient availability, water stress, or exposure to pollutants. These responses can be harnessed to develop sensor systems that utilize plant-based indicators, such as changes in leaf color, fluorescence, or gene expression, to provide real-time information about environmental conditions (Kovalchuk and Kovalchuk 2008).

III. One common example of phytosensing is the use of plants to detect the presence of heavy metals or other pollutants in soil. Certain plant species have the capability to accumulate or exhibit visible symptoms in the presence of specific contaminants, serving as bioindicators of soil pollution. By monitoring the health and growth of these indicator plants, scientists can infer the level and extent of contamination in the surrounding environment (Kovalchuk and Kovalchuk 2008).

IV. Advancements in molecular biology and genetic engineering have also facilitated the development of genetically modified plants that can produce fluorescent proteins or other biomarkers in response to specific environmental cues. These engineered plants can act as biosensors, providing visual or chemical signals that indicate the presence or concentration of target substances (Kovalchuk and Kovalchuk 2008).

V. Phytosensing has the potential for diverse applications, including environmental monitoring in industrial sites, agricultural settings, and urban areas. It offers advantages such as low cost, non-invasiveness, and scalability. However, challenges exist in terms of sensor specificity, sensitivity, and the interpretation of plant responses in complex environments (Volkov and Markin 2012).

9. **Phytomanagement:**

I. Phytomanagement refers to the use of plants and vegetation to actively manage and mitigate environmental issues, particularly those related to soil and water quality. It involves the strategic selection and management of plant species to address various challenges, such as contaminated soil, wastewater treatment, erosion control, and ecological restoration (Zine et al. 2020).

II. In the context of contaminated soil or groundwater, phytomanagement techniques aim to mitigate the risks associated with pollutants through the use of specialized plants that can either remediate or contain the contaminants. The selection of

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

suitable plant species is crucial, as certain plants possess the ability to uptake, degrade, or immobilize contaminants through processes like phytoextraction, rhizofiltration, rhizodegradation, or phytostabilization (Zine et al. 2020).

III. Phytomanagement can be applied in different scenarios. For instance, in phytoremediation, specific plant species are used to remove or degrade contaminants from soil or water. This technique can be effective for heavy metals, organic pollutants, and certain nutrients. In phytostabilization, plants are utilized to immobilize contaminants, preventing their movement and reducing their bioavailability. This approach is often employed for contaminated sites where complete removal of pollutants is challenging (Robinson et al. 2009).

These various phytoremediation techniques can be applied individually or in combination, depending on the specific contaminants and environmental conditions.

Case Study International Level:

Case study at the international level involving phytoremediation is the restoration of the Ebro River in Spain using the common reed (*Phragmites australis*) and other wetland plants at 2008.

The Ebro River, one of the longest rivers in Spain, had been heavily impacted by industrial and agricultural activities, resulting in high levels of pollution from heavy metals, pesticides, and nutrients. The contamination posed a significant threat to aquatic ecosystems and the surrounding communities. To address the pollution issue, the Spanish government implemented a phytoremediation project using wetland plants, including the common reed. The common reed is a robust and adaptable plant that grows well in wetland environments and has the ability to absorb and accumulate various contaminants (Gacia et al. 2021).

The constructed wetlands with the common reed and other wetland plants proved highly effective in treating the polluted water of the Ebro River. Over time, the wetlands significantly reduced contaminant levels, improved water quality, and restored the ecological health of the river (Gacia et al. 2021).

This successful phytoremediation project in Spain served as a model for other countries facing similar water pollution issues. It demonstrated the potential of constructed wetlands and the common reed as a natural and sustainable approach to remediate contaminated water bodies and restore aquatic ecosystems (Grisey et al. 2012).

Case Study National Level:

One notable case study of phytoremediation in India is the remediation of heavy metal-contaminated soil in the abandoned Hindustan Copper Limited (HCL) copper mine site in Malanjkhand, Madhya Pradesh.

The HCL copper mine site had a history of mining activities, which resulted in severe soil contamination with heavy metals like copper, lead, zinc, and cadmium. The contamination posed a significant environmental risk to the surrounding ecosystem and

local communities (Anon n.d.-b).

To address the contamination and restore the site, a phytoremediation project was initiated in collaboration with the Indian Institute of Technology (IIT) Bombay and the Indian School of Mines (ISM), Dhanbad.

The phytoremediation project in Malanjkhand involved the following key steps and strategies:

- ✓ Plant Selection: Native plant species that were tolerant of heavy metal contamination and had the ability to accumulate and tolerate heavy metals were selected. Two plant species, namely Indian mustard (*Brassica juncea*) and sunflower (*Helianthus annuus*), were chosen for their known phytoremediation potential (Anon n.d.-b).
- ✓ Planting and Monitoring: The selected plant species were cultivated in the contaminated soil. The growth and performance of the plants were closely monitored over time, including measurements of biomass, heavy metal uptake, and plant health.
- ✓ Phytoextraction: Both Indian mustard and sunflower have the ability to accumulate heavy metals in their tissues. They take up metals from the soil through their roots and translocate them to their above-ground parts, mainly leaves and stems. The plants were allowed to grow for a specific period, and then harvested and removed from the site to effectively remove the heavy metals from the contaminated soil (McGrath and Zhao 2003).

The phytoremediation project in the Malanjkhand copper mine site demonstrated positive results in reducing heavy metal contamination. Indian mustard and sunflower effectively absorbed and accumulated heavy metals from the soil, thereby reducing their concentrations and mitigating the environmental risk (Anon n.d.-b).

The success of this case study highlighted the potential of phytoremediation as a sustainable and cost-effective approach for remediating heavy metal-contaminated sites in India. It showcased the importance of selecting appropriate plant species and monitoring their growth and metal uptake to ensure effective remediation. This case study provided valuable insights for future phytoremediation projects in similar contaminated sites across the country.

Engineered plant species for phytoremediation:

1. **Engineered *Arabidopsis thaliana*:** *Arabidopsis thaliana*, a small flowering plant commonly used as a model organism, has been genetically engineered for phytoremediation purposes. For instance, researchers have introduced genes encoding metal-binding peptides, such as metallothioneins, to enhance the plant's ability to accumulate heavy metals (Bizily et al. 1999).
2. **Engineered *Brassica juncea*:** *Brassica juncea*, commonly known as Indian mustard, has been genetically modified to enhance its tolerance and accumulation of heavy metals. Genetic engineering techniques have been used to introduce genes involved in metal uptake, transport, and sequestration, such as those encoding metal transporters and metal chelators like phytochelatins (Eapen and D'Souza 2005).
3. **Engineered *Populus spp.*:** Poplar trees (*Populus spp*.) have been genetically engineered for enhanced degradation of organic pollutants, such as trichloroethylene

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

(TCE), a common groundwater contaminant. Genes encoding enzymes involved in TCE metabolism, such as cytochrome P450, have been introduced into poplar trees to improve their ability to break down the pollutant (Doty 2008).

4. **Engineered *Nicotiana tabacum*:** Tobacco plants (*Nicotiana tabacum*) have been genetically modified for phytoremediation purposes. For example, researchers have engineered tobacco plants to express enzymes involved in the degradation of explosives, such as nitroreductases, to enhance their ability to detoxify and degrade these contaminants (Heaton et al. 2010).
5. **Engineered *Salix spp*.:** Willow trees (*Salix spp*.) have been genetically engineered for improved phytoremediation capabilities. Genes encoding enzymes involved in the degradation of organic pollutants, such as cytochrome P450 and laccases, have been introduced into willow trees to enhance their capacity to metabolize and break down contaminants like phenolic compounds (Pulford and Watson 2003).

Factors Influencing Phytoremediation:

1. Environmental Factors:

a) Soil Characteristics: Soil pH, texture, organic matter content, nutrient levels, and microbial activity influence the availability and mobility of contaminants and affect plant growth and root development (Robinson, Brooks, and Clothier 1999).

b) Water Availability: Sufficient water availability is essential for plant growth and the uptake of contaminants. Both waterlogging and drought conditions can negatively impact phytoremediation outcomes (Robinson et al. 2006).

c) Climate: Temperature, rainfall patterns, and seasonal variations affect plant growth, contaminant mobility, and microbial activity. Climate conditions need to be considered for selecting appropriate plant species and determining the timing of phytoremediation activities (Pant et al. 2004).

d) Sunlight: Adequate sunlight is necessary for plant photosynthesis and biomass production. Shading or insufficient light can hinder plant growth and phytoremediation effectiveness (Pant et al. 2004).

2. Plant-Related Factors:

a) Plant Species Selection: The choice of plant species depends on their tolerance to contaminants, accumulation capacity, biomass production, and adaptability to site-specific conditions. Selection of hyperaccumulator or tolerant plant species is crucial for effective phytoremediation (Padmavathiamma and Li 2007).

b) Plant Growth and Biomass: Fast growth rates, extensive root systems, and high biomass production enhance the contaminant uptake and removal capacity of plants. Plant species with these characteristics are desirable for efficient phytoremediation (Tiwari et al. 2017).

c) Root Exudates: Plants release root exudates that can influence soil microbial communities and enhance the degradation or immobilization of contaminants. The composition and quantity of root exudates can vary among plant species and affect phytoremediation outcomes (McGrath and Zhao 2003).

3. **Contaminant-Related Factors:** Contaminant Type and Concentration- Different plant species have varying abilities to tolerate, accumulate, and detoxify specific contaminants. The type and concentration of contaminants in the soil or water influence the selection of appropriate plants and the phytoremediation technique to be employed (Gerhardt et al. 2009).
4. **Interactions and Synergies:** Plant-Microbe Interactions- The interactions between plants and soil microorganisms can enhance phytoremediation outcomes. Certain bacteria and fungi can facilitate the degradation, immobilization, or transformation of contaminants, improving remediation efficiency (Karthikeyan and Kulakow 2003).

Future Prospects and Challenges for phytoremdiation:

1. **Advancements in Plant Genetic Engineering**: Genetic engineering techniques can be utilized to enhance the phytoremediation capabilities of plants. By manipulating plant genes, scientists can develop plants with improved tolerance, accumulation, and degradation capacities for specific contaminants. Future research in this area can lead to the development of tailor-made plant species optimized for phytoremediation (Bizily et al. 1999).
2. **Exploration of Plant-Microbe Interactions:** Plant-microbe interactions play a crucial role in phytoremediation. Further research is needed to better understand these interactions and identify beneficial microbial species that can enhance contaminant degradation, nutrient availability, and plant growth. Harnessing the potential of plant-microbe synergies can significantly improve phytoremediation efficiency (Karthikeyan and Kulakow 2003).
3. **Integration with Other Remediation Techniques:** Phytoremediation can be integrated with other remediation techniques to create hybrid or multi-stage approaches. Combining phytoremediation with physical, chemical, or biological methods can synergistically enhance contaminant removal and improve overall remediation outcomes. Developing integrated remediation strategies and optimizing their implementation is a promising future direction (Aksoy, Duman, and Sezen 2005).
4. **Application in Emerging Contaminant Remediation:** Phytoremediation has primarily focused on traditional contaminants such as heavy metals and organic pollutants. However, there is a growing need to explore its effectiveness in addressing emerging contaminants like pharmaceuticals, endocrine disruptors, and microplastics. Research and development efforts should be directed towards understanding the phytoremediation potential for emerging contaminants (Robinson et al. 2006).
5. **Field-Scale Application and Long-Term Monitoring:** Most phytoremediation studies have been conducted at the laboratory or small-scale field trials. The challenge lies in upscaling phytoremediation to larger contaminated sites and implementing it on a practical scale. Long-term monitoring is essential to assess the

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

effectiveness, stability, and potential risks associated with phytoremediation over extended periods (Tiwari et al. 2017).

6. **Regulatory and Policy Support:** Establishing regulatory frameworks and policies that encourage the use of phytoremediation is crucial. Clear guidelines, standards, and incentives can promote the adoption of phytoremediation as a viable remediation option. Collaboration between researchers, policymakers, and stakeholders is necessary to create an enabling environment for phytoremediation projects (Yusuf et al. 2017).
7. **Public Acceptance and Perception:** Building public awareness and acceptance of phytoremediation as a safe and effective technology is important. Public perception of phytoremediation projects, including concerns related to plant invasiveness, aesthetics, and long-term efficacy, needs to be addressed through education and communication efforts.

Conclusion:

In conclusion, phytoremediation emerges as a promising and sustainable technology for addressing environmental contamination. It utilizes the natural capabilities of plants to mitigate the effects of pollutants, offering numerous advantages such as cost-effectiveness, minimal site disruption, and the potential for long-term remediation. Through the selection of appropriate plant species, taking into account their tolerance, accumulation, and degradation capacities, phytoremediation can effectively target a wide range of contaminants, including heavy metals, organic pollutants, and nutrients. The ability of plants to uptake, sequester, and transform contaminants, either through phytoextraction, phytodegradation, phytostabilization, or rhizofiltration, provides a versatile approach for remediation. However, several factors must be carefully considered and optimized to achieve successful phytoremediation. Environmental factors such as soil characteristics, water availability, climate, and sunlight play a crucial role in determining the effectiveness of the remediation process. Furthermore, plant-related factors, including plant species selection, growth characteristics, and root exudates, influence the uptake and transformation of contaminants. Additionally, the type and concentration of contaminants, as well as their availability and mobility in the environment, pose significant challenges that need to be addressed. Future prospects for phytoremediation lie in advancements in plant genetic engineering, exploration of plant-microbe interactions, integration with other remediation techniques, and application in addressing emerging contaminants. However, to fully unlock the potential of phytoremediation, regulatory support, public acceptance, economic viability, and long-term monitoring are crucial elements that need to be addressed. In summary, phytoremediation represents a promising approach to address environmental contamination, offering a sustainable and environmentally friendly solution. With further research, technological advancements, and collaborative efforts among researchers, policymakers, and stakeholders, phytoremediation can contribute significantly to the restoration and preservation of our environment. By harnessing the

power of plants, we can pave the way towards a cleaner and healthier future.

Bibliography:

1. Aksoy, Ahmet, Fatih Duman, and Göksal Sezen. 2005. "Heavy Metal Accumulation and Distribution in Narrow-Leaved Cattail (Typha Angustifolia) and Common Reed (Phragmites Australis)." *Freshwater Ecology* 20(4):783–85. doi: 10.1080/02705060.2005.9664806.
2. Anon. n.d.-a. "Brownfields Technology Primer: Selecting and Using Phytoremediation for Site ... - Google Books."
3. Anon. n.d.-b. "THE ENERGY AND RESOURCES INSTITUTE Creating Innovative Solutions for a Sustainable Future Creating Innovative Solutions for a Sustainable Future THE ENERGY AND RESOURCES INSTITUTE Contamination of Heavy Metals in India Health Effects and Remediation Measures HEAVY METALS CONTAMINATION IN INDIA."
4. Bizily, Scott P., Clayton L. Rugh, Anne O. Summers, and Richard B. Meagher. 1999. "Phytoremediation of Methylmercury Pollution: MerB Expression in Arabidopsis Thaliana Confers Resistance to Organomercurials." *Proceedings of the National Academy of Sciences* 96(12):6808–13. doi: 10.1073/PNAS.96.12.6808.
5. Burges, Aritz, Itziar Alkorta, Lur Epelde, and Carlos Garbisu. 2018. "From Phytoremediation of Soil Contaminants to Phytomanagement of Ecosystem Services in Metal Contaminated Sites." *Https://Doi.Org/10.1080/15226514.2017.1365340* 20(4):384–97. doi: 10.1080/15226514.2017.1365340.
6. Cook, Rachel L., and Dean Hesterberg. 2013. "Comparison of Trees and Grasses for Rhizoremediation of Petroleum Hydrocarbons." *Https://Doi.Org/10.1080/15226514.2012.760518* 15(9):844–60. doi: 10.1080/15226514.2012.760518.
7. Danh, Luu Thai, Paul Truong, Raffaella Mammucari, Tam Tran, and Neil Foster. 2009. "VETIVER GRASS, VETIVERIA ZIZANIOIDES: A CHOICE PLANT FOR PHYTOREMEDIATION OF HEAVY METALS AND ORGANIC WASTES." *Http://Dx.Doi.Org/10.1080/15226510902787302* 11(8):664–91. doi: 10.1080/15226510902787302.
8. Dickmann, Donald I. 2006. "Silviculture and Biology of Short-Rotation Woody Crops in Temperate Regions: Then and Now." *Biomass and Bioenergy* 30(8–9):696–705. doi: 10.1016/J.BIOMBIOE.2005.02.008.
9. Doty, Sharon Lafferty. 2008. "Enhancing Phytoremediation through the Use of Transgenics and Endophytes." *New Phytologist* 179(2):318–33. doi: 10.1111/J.1469-8137.2008.02446.X.
10. Eapen, Susan, and S. F. D'Souza. 2005. "Prospects of Genetic Engineering of Plants for Phytoremediation of Toxic Metals." *Biotechnology Advances* 23(2):97–114. doi: 10.1016/J.BIOTECHADV.2004.10.001.
11. Ekperusi, Abraham O., Francis D. Sikoki, and Eunice O. Nwachukwu. 2019. "Application of Common Duckweed (Lemna Minor) in Phytoremediation of Chemicals in the Environment: State and Future Perspective." *Chemosphere* 223:285–309. doi: 10.1016/J.CHEMOSPHERE.2019.02.025.
12. Flathman, Paul E., and Guy R. Lanza. 2010. "Phytoremediation: Current Views on an Emerging Green Technology." *Http://Dx.Doi.Org/10.1080/10588339891334438* 7(4):415–32. doi: 10.1080/10588339891334438.
13. Gaballah, Mohamed S., Ayman N. Saber, and Jianbin Guo. 2022. "A Review of

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Constructed Wetlands Types and Plants Used for Wastewater Treatment in Egypt." 43–56. doi: 10.1007/978-3-031-03600-2_3.

14. Gacia, Esperança, David X. Soto, Romero Roig, and Jordi Catalan. 2021. "Phragmites Australis as a Dual Indicator (Air and Sediment) of Trace Metal Pollution in Wetlands – the Key Case of Flix Reservoir (Ebro River)." *Science of The Total Environment* 765:142789. doi: 10.1016/J.SCITOTENV.2020.142789.
15. Gerhardt, Karen E., Xiao Dong Huang, Bernard R. Glick, and Bruce M. Greenberg. 2009. "Phytoremediation and Rhizoremediation of Organic Soil Contaminants: Potential and Challenges."
16. *Plant Science* 176(1):20–30. doi: 10.1016/J.PLANTSCI.2008.09.014.
17. Gobelius, Laura, Jeffrey Lewis, and Lutz Ahrens. 2017. "Plant Uptake of Per- and Polyfluoroalkyl Substances at a Contaminated Fire Training Facility to Evaluate the Phytoremediation Potential of Various Plant Species." *Environmental Science and Technology* 51(21):12602–10. doi: 10.1021/ACS.EST.7B02926/SUPPL_FILE/ES7B02926_SI_001.PDF.
18. Grisey, Elise, Xavier Laffray, Océane Contoz, Eric Cavalli, Jacque Mudry, and Lotfi Aleya. 2012. "The Bioaccumulation Performance of Reeds and Cattails in a Constructed Treatment Wetland for Removal of Heavy Metals in Landfill Leachate Treatment (Etueffont, France)." *Water, Air, and Soil Pollution* 223(4):1723–41. doi: 10.1007/S11270-011-0978-3/METRICS.
19. Heaton, Andrew C. P., Clayton L. Rugh, Nian Jie Wang, and Richard B. Meagher. 2010. "Phytoremediation of Mercury- and Methylmercury-Polluted Soils Using Genetically Engineered Plants." *Http://Dx.Doi.Org/10.1080/10588339891334384* 7(4):497–509. doi: 10.1080/10588339891334384.
20. Jeevanantham, S., A. Saravanan, R. V. Hemavathy, P. Senthil Kumar, P. R. Yaashikaa, and D. Yuvaraj. 2019. "Removal of Toxic Pollutants from Water Environment by Phytoremediation: A Survey on Application and Future Prospects." *Environmental Technology & Innovation* 13:264–76. doi: 10.1016/J.ETI.2018.12.007.
21. Karthikeyan, R., and P. A. Kulakow. 2003. "Soil Plant Microbe Interactions in Phytoremediation." *Advances in Biochemical Engineering/Biotechnology* 78:51–74. doi: 10.1007/3-540-45991-X_2.
22. Kidd, Petra, Michel Mench, Vanessa Álvarez-López, Valérie Bert, Ioannis Dimitriou, Wolfgang Friesl-Hanl, Rolf Herzig, Jolien Olga Janssen, Aliaksandr Kolbas, Ingo Müller, Silke Neu, Giancarlo Renella, Ann Ruttens, Jaco Vangronsveld, and Markus Puschenreiter. 2015. "Agronomic Practices for Improving Gentle Remediation of Trace Element-Contaminated Soils." *Http://Dx.Doi.Org/10.1080/15226514.2014.1003788* 17(11):1005–37. doi: 10.1080/15226514.2014.1003788.
23. Kovalchuk, Igor, and Olga Kovalchuk. 2008. "Transgenic Plants as Sensors of Environmental Pollution Genotoxicity." *Sensors 2008, Vol. 8, Pages 1539-1558* 8(3):1539–58. doi: 10.3390/S8031539.
24. Lamb, Dane T., Kartik Venkatraman, Nanthi Bolan, Nanjappa Ashwath, Girish Choppala, and Ravi Naidu. 2014. "Phytocapping: An Alternative Technology for the Sustainable Management of Landfill Sites." *Http://Dx.Doi.Org/10.1080/10643389.2012.728823* 44(6):561–637. doi: 10.1080/10643389.2012.728823.
25. Lee, Minhee, and Minjune Yang. 2010. "Rhizofiltration Using Sunflower

(Helianthus Annuus L.) and Bean (Phaseolus Vulgaris L. Var. Vulgaris) to Remediate Uranium Contaminated Groundwater." *Journal of Hazardous Materials* 173(1–3):589–96. doi: 10.1016/J.JHAZMAT.2009.08.127.

26. Lim, Jae Min, Arthur L. Salido, and David J. Butcher. 2004. "Phytoremediation of Lead Using Indian Mustard (Brassica Juncea) with EDTA and Electrodics." *Microchemical Journal* 76(1–2):3–9. doi: 10.1016/J.MICROC.2003.10.002.
27. McGrath, Steve P., and Fang Jie Zhao. 2003. "Phytoextraction of Metals and Metalloids from Contaminated Soils." *Current Opinion in Biotechnology* 14(3):277–82. doi: 10.1016/S0958-1669(03)00060-0.
28. Muthusaravanan, S., N. Sivarajasekar, J. S. Vivek, T. Paramasivan, Mu Naushad, J. Prakashmaran, V. Gayathri, and Omar K. Al-Duaij. 2018. "Phytoremediation of Heavy Metals: Mechanisms, Methods and Enhancements." *Environmental Chemistry Letters 2018 16:4* 16(4):1339–59. doi: 10.1007/S10311-018-0762-3.
29. Padmavathiamma, Prabha K., and Loretta Y. Li. 2007. "Phytoremediation Technology: Hyper-Accumulation Metals in Plants." *Water, Air, and Soil Pollution 2007 184:1* 184(1):105–26. doi: 10.1007/S11270-007-9401-5.
30. Pant, H. K., M. B. Adjei, J. M. S. Scholberg, C. G. Chambliss, and J. E. Rechcigl. 2004. "Forage Production and Phosphorus Phytoremediation in Manure-Impacted Soils." *Agronomy Journal* 96(6):1780–86. doi: 10.2134/AGRONJ2004.1780.
31. Paz-Alberto, Annie Melinda, and Gilbert C. Sigua. 2013. "Phytoremediation: A Green Technology to Remove Environmental Pollutants." *American Journal of Climate Change* 2013(01):71–86. doi: 10.4236/AJCC.2013.21008.
32. Prabakaran, K., Jian Li, A. Anandkumar, Zhanrui Leng, Chris B. Zou, and Daolin Du. 2019. "Managing Environmental Contamination through Phytoremediation by Invasive Plants: A Review." *Ecological Engineering* 138:28–37. doi: 10.1016/J.ECOLENG.2019.07.002.
33. Pulford, Ian D., and C. Watson. 2003. "Phytoremediation of Heavy Metal-Contaminated Land by Trees—a Review." *Environment International* 29(4):529–40. doi: 10.1016/S0160-4120(02)00152-6.
34. Purwanti, Ipung Fitri, Adriana Obenu, Bieby Voijant Tangahu, Setyo Budi Kurniawan, Muhammad Fauzul Imron, and Siti Rozaimah Sheikh Abdullah. 2020. "Bioaugmentation of Vibrio Alginolyticus in Phytoremediation of Aluminium-Contaminated Soil Using Scirpus Grossus and Thypa Angustifolia." *Heliyon* 6(9):e05004. doi: 10.1016/J.HELIYON.2020.E05004.
35. Robinson, B. H., R. R. Brooks, and B. E. Clothier. 1999. "Soil Amendments Affecting Nickel and Cobalt Uptake by Berkheya Coddii: Potential Use for Phytomining and Phytoremediation." *Annals of Botany* 84(6):689–94. doi: 10.1006/ANBO.1999.0970.
36. Robinson, Brett H., Gary Bañuelos, Héctor M. Conesa, Michael W. H. Evangelou, and Rainer Schulin. 2009. "The Phytomanagement of Trace Elements in Soil." *Https://Doi.Org/10.1080/07352680903035424* 28(4):240–66. doi: 10.1080/07352680903035424.
37. Robinson, Brett, Rainer Schulin, Bernd Nowack, Stéphanie Roulier, Manoj Menon, Brent Clothier, Steve Green, and Tessa Mills. 2006. "Phytoremediation for the Management of Metal Flux in Contaminated Sites." *For. Snow Landsc. Res* 80:221–34.
38. Shackira, A. M., and Jos T. Puthur. 2019. "Phytostabilization of Heavy Metals: Understanding of Principles and Practices." *Plant-Metal Interactions* 263–82. doi:

10.1007/978-3-030-20732-8_13.

39. Song, Yang, Yang Li, Wei Zhang, Fang Wang, Yongrong Bian, Lisa A. Boughner, and Xin Jiang. 2016. "Novel Biochar-Plant Tandem Approach for Remediating Hexachlorobenzene Contaminated Soils: Proof-of-Concept and New Insight into the Rhizosphere." *Journal of Agricultural and Food Chemistry* 64(27):5464–71. doi: 10.1021/ACS.JAFC.6B01035/SUPPL_FILE/JF6B01035_SI_001.PDF.
40. Ting, W. H. T., I. A. W. Tan, S. F. Salleh, and N. A. Wahab. 2018. "Application of Water Hyacinth (Eichhornia Crassipes) for Phytoremediation of Ammoniacal Nitrogen: A Review." *Journal of Water Process Engineering* 22:239–49. doi: 10.1016/J.JWPE.2018.02.011.
41. Tiwari, Jaya, Atul Kumar, and Narendra Kumar. 2017. "Phytoremediation Potential of Industrially Important and Biofuel Plants: Azadirachta Indica and Acacia Nilotica." *Phytoremediation Potential of Bioenergy Plants* 211–54. doi: 10.1007/978-981-10-3084-0_8/COVER.
42. Volkov, Alexander G., and Vladislav S. Markin. 2012. "Phytosensors and Phytoactuators." *Plant Electrophysiology: Signaling and Responses* 173–206. doi: 10.1007/978-3-642-29110-4_7/COVER.
43. Witters, N., R. Mendelsohn, S. Van Passel, S. Van Slycken, N. Weyens, E. Schreurs, E. Meers, F. Tack, B. Vanheusden, and J. Vangronsveld. 2012. "Phytoremediation, a Sustainable Remediation Technology? II: Economic Assessment of CO2 Abatement through the Use of Phytoremediation Crops for Renewable Energy Production." *Biomass and Bioenergy* 39:470–77. doi: 10.1016/J.BIOMBIOE.2011.11.017.
44. Yadav, Rakesh, Pooja Arora, Sandeep Kumar, and Ashok Chaudhury. 2010. "Perspectives for Genetic Engineering of Poplars for Enhanced Phytoremediation Abilities." *Ecotoxicology* 19(8):1574–88. doi: 10.1007/S10646-010-0543-7/METRICS.
45. Yu, Xiumei, Tian Shen, Xia Kang, Yongliang Cui, Qiang Chen, Muhammad Shoaib, Han Liu, Fang Zhang, Sajad Hussain, Quanju Xiang, Ke Zhao, Yunfu Gu, Menggen Ma, Shuangcheng Li, Likou Zou, and Yueyang Liang. 2021. "Long-Term Phytoremediation Using the Symbiotic Pongamia Pinnata Reshaped Soil Micro-Ecological Environment." *Science of The Total Environment* 774:145112. doi: 10.1016/J.SCITOTENV.2021.145112.
46. Yusuf, Mohd, Faqeer Mohammad, and Mohd Shabbir. 2017. "Eco-Friendly and Effective Dyeing of Wool with Anthraquinone Colorants Extracted from Rubia Cordifolia Roots: Optimization, Colorimetric and Fastness Assay." *Journal of King Saud University - Science* 29(2):137–44. doi: 10.1016/J.JKSUS.2016.06.005.
47. Zine, Hamza, Laila Midhat, Rachid Hakkou, Mariam El Adnani, and Ahmed Ouhammou. 2020. "Guidelines for a Phytomanagement Plan by the Phytostabilization of Mining Wastes." *Scientific African* 10:e00654. doi: 10.1016/J.SCIAF.2020.E00654.

Study of Antibacterial Activity of Silver Nanoparticles Synthesis from Calotropis Gigantea flower Extract

Ashish Shivaji Sartape
Department of Chemistry,
Balwant College, Vita Dist. Sangli India- 415311
Email: *sartape_chem@yahoo.co.in; ashish.ana.chem@gmail.com*

Article DOI Link: https://zenodo.org/records/11218660
DOI: 10.5281/zenodo.11218660

Abstract:

The nanoparticles are fundamental blocks of nanotechnology which rapidly growing science. Synthesized silver nanoparticles have wide applications in biomedical, optical and electrical field etc. due to wide range of applications we have prepared silver nanoparticles with greener way. For this proposes we used green approach Calotropis Gigantea flower extract was used for silver nanoparticles synthesis. Single step synthesized particles were used for application of antibacterial activity. UV-visible spectrophotometer is used to confirm the synthesis. Finally, it may conclude that it is simple, rapid, non-toxic and green one step method.

Keywords: Calotropis Gigantea, flower, silver nanoparticles, antimicrobial activity, UV-visible study

Introduction:

Nanotechnology has gained momentum in the recent years since it has multiple applications starting from space, medical, industrial and allied fields to day-to-day life [1]. Nanotechnology has recently been given much attention as a result of the unique properties of the nanoparticles (1–100 nm). The parameters that give rise to these properties include size, morphology and shape hence a significant number of studies have been conducted to manipulate the shape and size of nanoparticles in during their preparation for different applications [2]. Nanoparticles show unique and significantly modified physical, chemical and biological properties, as compared to their macro scaled counterparts, which make them of particular interest. Day by day increasing incidence of microbial challenges, multiple drug resistance (MDR) micro-organisms, poor dietary intake and serious health hazardous drugs call on new site for researchers to work on prominent antimicrobial active metabolites with good antioxidant activity to boost metabolism of an individual and overcome the problem of clinically significant microorganisms including MDR microorganisms [3]. The most targeted use of Nano Particle (NPs) is their utilization in biomedical field for example, in drug loading, drug delivery, antioxidant, antidiabetic, antimicrobial etc. due to the above cited characteristics. One of the major problems associated with NPs is how to synthesize the desired nanomaterial for desired applications [4]. Silver NPs have been largely used in various electronic and sensing devices, coating materials, data packing, and molecular

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

switches. Apart from this, they have also been applied in the diagnosis and treatments of various diseases [5].

Plenty of physical, chemical methods, polar solvents, and reducing compounds have been employed for the synthesis of silver nanoparticles. In turn to develop biocompatible, nontoxic, ecofriendly silver nanoparticles, plant extracts have been extensively used [6]. Top-down and bottom-up approaches can be used for the synthesis of Ag NPs. The top-down approach involves breaking down a bulk material into nano-sizes using techniques such as laser ablation and puttering. In contrast, the bottom-up approach refers to building nanoparticles using smaller entities, such as chemical and biological methods [7]. Chemically prepared nanoparticles are not appropriate for medical usages due to hazardous chemicals binding on their surface. Furthermore, by-products produced in chemical routes are toxic for the environment. Physical routes for synthesis of NPs have some drawbacks, too. These methods require high energy and space, and are expensive [8]. This is when biological approaches employing less expensive sources are exploited as Ag NPs precursors. The green synthesis of nanoparticles has gained a lot of attraction since it uses non-toxic phytochemicals and avoids the dangerous ingredients that would otherwise be used in chemical synthesis. Green synthesis methods use extracts from diverse plant parts, microbial cells, and biopolymers, and are so classified as such. The nanoparticles created are biocompatible and have the correct level of efficacy for the purpose for which they were created. Metallic NPs can be synthesized biologically using various plants and their extracts which are easily available in huge quantities. The plants and their extracts are safe to handle, less toxic and eco-friendly [9].

Biogenic synthesis of AgNPs is an easy single-step protocol without generating harsh and toxic chemicals; hence, they are saved, economical and eco-friendly. In recent years, both plant and microbes are extensively investigated for the biosynthesis of AgNPs of varying size, shape, stability, and antimicrobial efficacy [10]. Eupatorium adenophorum Spreng. (E. adenophorum) [also known as Ageratina adenophora (Spreng.)] of Asteraceae family, have been used in traditional medicine for the treatment of wounds, diabetes, inflammation, fever, jaundice and dysentery has been used to synthesis of Ag NPs [11]. Along with this Capsicum (C. annuum, C. frutescens, C. baccatum and C. chinense) [12], Acalypha wilkesiana [13], Ageratum conyzoides Leaf Extract [14], Lallemantia royleana leaf Extract [15], Adhatoda vasica leaf extract [16], Cucumis prophetarum Aqueous Leaf Extract [17] were used to synthesis the silver nanoparticles. These developed nanoparticles were applied for various antimicrobial activities successfully.

In present work we have synthesized silver nanoparticles with Calotropis Gigantea flower extract. This is green synthesis with one of the medicinally used plant. Prepared material also applied for antibacterial application.

Materials and methods:

Chemicals and reagents:

All chemicals and reagents used in this research were >99 % purity.

Plant material:

Calotropis Gigantea plant is one of the medicinally important abundantly available plants in Maharashtra. Their flowers were collected from campus botanical garden of the Balwant College, Vita Dist. Sangli (M.S.).

Green synthesis of AgNPs:

Freshly collected flowers of Calotropis Gigantea plant was washed with distilled water number of times to remove dirt and other matters. Flower of Calotropis Gigantea were taken about 10g and then cut into small pieces. Small pieces of flower boiled for 30 minutes. Extract was cooled at room temperature and then filtrated by whatmann no. 1 filter paper. The process was followed as per Majid Sharifi-Rad et al. [15] reported. After completion of the heating brown colored silver nanoparticles were developed (Fig.1).

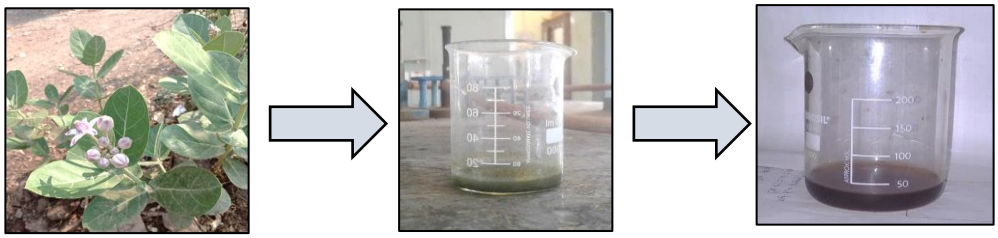


Fig.1 *Calotropis Gigantea flowers – flower extract- formation of silver nanoparticles*

Characterization of synthesized silver nanoparticles:

UV–visible spectroscopy:

Ecofriendly synthesized silver nanoparticles were characterized with UV-Visible spectrophotometer. Range for the spectrophotometer was 340 to 710nm. As per various previous reports it showed maximum absorption at 450nm. It is confirmation of the formation of Ag NPs as per previous many of the reports [1-8].

Antimicrobial Activity:

Antimicrobial property of silver owes to the fact that microbes cannot build up resistance against it as they are doing against conventional and narrow-target antibiotics, because the metal attacks a broad range of targets in the organisms, which means that they would have to develop a host of mutations simultaneously to protect themselves [3]. In present work prepared silver nanoparticles were used to determine the antimicrobial activities. We have determined antimicrobial activities against e-coli and bacillus and for these we found good result with Ag NPs.

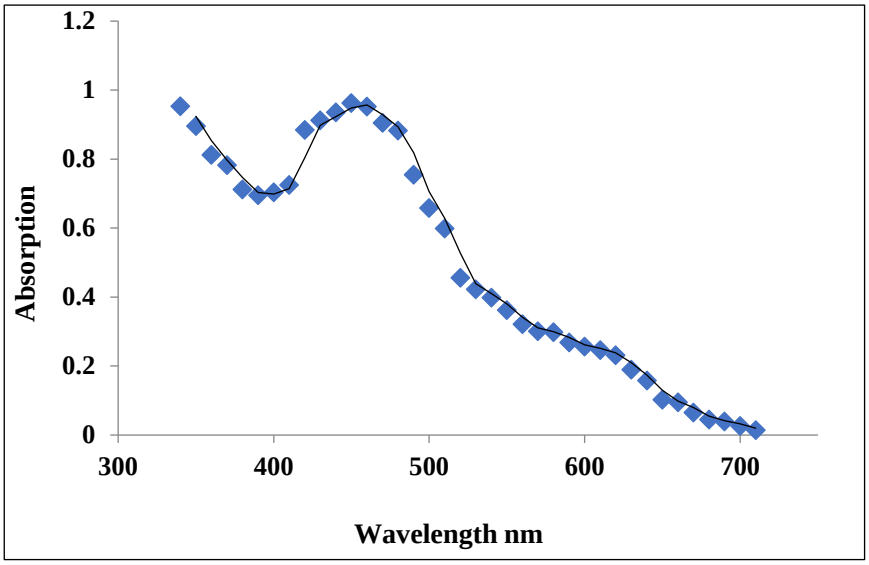
Result and Discussion:

UV–Visible spectroscopy:

The prepared AgNPs showed an absorption peak at 450 nm (Fig. 2), which in accordance with a previous report, where AgNPs exhibits maximum absorption between 410 and 460 nm. The colour of green synthesized AgNPs remained stable for 1 week [16]. The UV–V is absorption spectrophotometric analysis was used to follow and

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

investigate the formation of the green-synthesized Ag NPs, as reported previously [12-14], considering that the small spherical AgNPs give a surface plasmon resonance (SPR) band extended in the range from 350 to 500 nm. The optical response of the green-synthesized AgNPs due to their intense SPR band in the spectral region mentioned above



confirmed the efficient formation [16]. of these NPs [15].

Fig. 2. The UV–V is absorption spectra of the green synthesized Ag NPs

Antimicrobial studies:

The Antimicrobial activity is determined by using the human pathogenic e-coli and bacillus and also using standard disc diffusion method. Mackonkey broth medium was used to sub culture bacteria and were incubated at 37°C for 24h fresh overnight cultures were taken and spread on the MacConkey agar plates to cultivate, bacteria. sterile paper discs of 5 nm diameter saturated with flower extract, silver nanoparticle and double distilled water (as control) were place in plate and incubated again at 37°C for 24 h and the antibacterial activity was measured based on the inhibition zone around the disc impregnated with flower extract and synthesized colored silver nanoparticle (Fig.3).

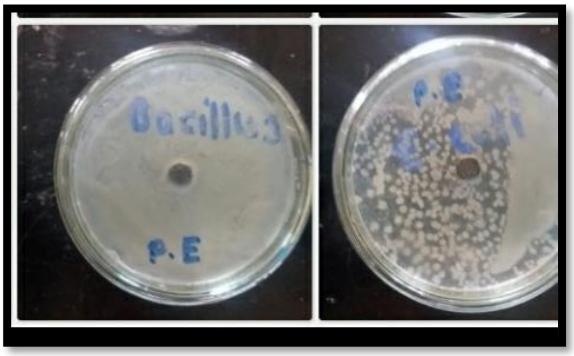


Fig. 3 Antimicrobial activities against Basillus and E-coli of prepared Ag NPs

Conclusion:

It is concluded that nanomaterials snow fascinating and useful properties; they have variety of applications in diverse fields. Many of the studies were reported that leaves were used to prepare the silver particles while very some of the reports of the flowers. In present study Calotropis Gigantea flowers were utilized to prepare silver nanoparticles with greener way. Prepared silver nanoparticles were confirmed with UV-Visible spectrophotometry which showed maximum absorption at 450nm. Prepared materials were applied for the antimicrobial activities for bacillus and e-coli in which for e-coil it showed good results. Finally, it may conclude that its greener and economical way to prepare silver nanoparticles.

Acknowledgment:

Author is thankful to the Principal, Balwant College, Vita, Head Department of Chemistry, Head Department of Microbiology for their support to complete this work.

References:

1. Parvathy Ajith, Aswathy Murali, Sreehari H, Bindhya Vinod, Amrita Anil, Smitha S; 2019 Green Synthesis of Silver Nanoparticles using Calotropis gigantea extract and its Applications in Antimicrobial and Larvicidal activity Materials Today: Proceedings 18, 4987–4991.
2. Netai Muchanyereyi, Cecilia Gusha, Munyaradzi Mujuru, Upenyu Guyo, Stephen Nyoni; 2022 Synthesis of silver nanoparticles using plant extracts from Erythrina abyssinica aerial parts and assessment of their anti-bacterial and anti-oxidant activities Results in Chemistry 4, 100402, 1-7.
3. Jasmeet Kaur Sohal, Ashish Saraf, Kamlesh Kumar Shukla; 2017 Green Synthesis of Silver Nanoparticles (Ag-NPs) Using Plant Extract for Antimicrobial and Antioxidant Applications: A Review Inter. J Adv Res Sci Eng 6, 10, 766-777.
4. Aroosa Habib, Yamin Bibi, Iqra Qayyum, Muhammad Farooq; 2024 Hierarchical plant extracts in silver nanoparticles preparation: Minuscular survey to achieve enhanced bioactivities Heliyon 10, e24303.
5. MR Shaik, M Khan, M Kuniyil, A Al-Warthan, Hamad Z. Alkhathlan, M Rafiq H. Siddiqui, J P. Shaik, A Ahamed, A Mahmood, M Khan, S FAdil 2018 Plant-Extract-Assisted Green Synthesis of Silver Nanoparticles Using Origanum vulgare L. Extract and Their Microbicidal Activities, Sustainability 10, 913.
6. T. Sivaranjani, A. Asha, P. Thirunavukkarasu, S. Asha; 2016 Silver Nanoparticle Synthesis from Plant Extracts and its Application – A Review Inter J Adv Res Physical Sci. 3, 3, 5-8.
7. Njud S. Alharbi, Nehad S. Alsubhi, Afnan I. Felimban 2022 Green synthesis of silver nanoparticles using medicinal plants: Characterization and application J Rad Res Appl Sci, 15,109–124.

8. Saba Pirtarighat, Maryam Ghannadnia, Saeid Baghshahi 2019 Green synthesis of silver nanoparticles using the plant extract of Salvia spinosa grown in vitro and their antibacterial activity assessment, J Nanostructure Chem 9, 1–9.
9. Alok Giri, Biswajit Jena, Bhagyashree Biswal, Arun Pradhan, ManoranjanArakha, Saumyaprava Acharya, Laxmikanta Acharya; 2022 Green synthesis and characterization of silver nanoparticles using Eugenia roxburghii DC. extract and activity against bioflm-producing bacteria, Scientific Reports 12, 8383.
10. Chhangte Vanlalveni, Samuel Lallianrawna, Ayushi Biswas, Manickam Selvaraj, Bishwajit Changmai, Samuel Rokhum, 2021 Green synthesis of silver nanoparticles using plant extracts and their antimicrobial activities: a review of recent literature RSC Adv., 11, 2804-2837.
11. Tarun Kumar Dua, Simran Giri, Gouranga Nandi, Ranabir Sahu, Tapan Kumar Shaw, Paramita Paul 2023 Green synthesis of silver nanoparticles using Eupatorium adenophorum leaf extract: characterizations, antioxidant, antibacterial and photocatalytic activities Chemical Papers 77, 2947–2956.
12. Diego Rosales, Adalberto Ojeda, Oscar Maldonado, Morelia Reyes, Georgina Padilla, Edgar Naranjo, Víctor Mayo, Gilberto Juárez; 2022 Green Synthesis of Gold and Silver Nanoparticles Using Leaf Extract of Capsicum chinense Plant Molecules, 27, 1692, 1-20.
13. Adewumi Dada, Folahan Adekola, Fehintoluwa Dada, Adunola Adelani-Akande, Micheal Bello, Chidiogo Okonkwo, Adejumoke Inyinbor, Abimbola Oluyori, Adeniyi Olayanju, Kolawole Ajanaku, Charles Adetunji; 2019 Silver nanoparticle synthesis by Acalypha wilkesiana extract: phytochemical screening, characterization, influence of operational parameters, and preliminary antibacterial testing, Heliyon 5, e02517.
14. Jimoh Igbalayea, Adesegun Adeyemoa, Adetola Adenubia, Oladejo Ahmodua, Basit Shodimua, Faizat Hazeeza, Suliat Hassan; 2024 Silver Nanoparticles Synthesized Using Ageratum conyzoides Leaf Extract Exhibit Antioxidant, Anti-inflammatory and α-Glucosidase Inhibitory Properties, Asian J Green Chem 8, 25-38.
15. Majid Sharifi-Rad, Hazem Elshafie, Pawel Pohl 2024 Green synthesis of silver nanoparticles (AgNPs) by Lallemantia royleana leaf Extract: Their Bio-Pharmaceutical and catalytic properties, J Photochem Photobio A: Chem 448,115318.
16. Ronak Chaudhari, Priyanka Shah1, Pranav Shrivastav; 2023 Green synthesis of silver nanoparticles using Adhatoda vasica leaf extract and its application in photocatalytic degradation of dyes, Discover Nano 18, 135.
17. Hemlata, Prem Raj Meena, Arvind Pratap Singh, Kiran Kumar Tejavath; 2020 Biosynthesis of Silver Nanoparticles Using Cucumis prophetarum Aqueous Leaf Extract and Their Antibacterial and Antiproliferative Activity Against Cancer Cell Lines, ACS Omega 5, 5520−5528.

The Pharmacological Benefits of Medicinal Plants

Prakash Ramrao Kadlag
Samarth Rural Educational Institute's Belhe
Email: *prakashkadlag63@gmail.com*

Article DOI Link https://zenodo.org/records/11218708
DOI: 10.5281/zenodo.11218708

Abstract:

Thousands of years ago, people utilized plants as a source of medicine to heal various illnesses. In the medical systems of India, Egypt, China, Greece, and Rome, there is ample evidence supporting the use of plants as medication to cure various ailments. Pharmacognosy, which may eventually result in the creation of new drugs, is the study of medications obtained from natural sources, primarily plants. Recent years have seen an increase in global activity related to the discovery, extraction, and screening of biological variety, including microorganisms, herbs, spices, and other natural resources. Bioactive substances found in plants that are naturally present and principally responsible for biological activity are called phytochemicals. Alkaloids, phenols, saponins, carbohydrates, terpenoids, steroids, flavonoids, and tannins, among other essential chemical substances, are found in plants.

Keywords: pharmacognosy, biological activity, phytochemicals, and medicinal plants

1. Introduction:

Man has been in close relationship with nature and has relied on it for survival since the beginning of time. Man depends on the environment for fundamental requirements (food, fiber, shelter, clothes, and gum) as well as for healthcare, sustenance, and livelihood. Plants not only supplied his basic needs but also his need for medicine. In addition to plants, man has begun to prepare medicine utilizing animal products and other naturally occurring bioresources. As a result, many traditional medical systems have developed depending on the social and cultural context, as well as the environment, for each ethnic group in various nations [1, 2].

Worldwide, plants are used as important natural resources in both traditional and contemporary medical systems. Plants and plant-derived products have been used for medicinal purposes for thousands of years. Many records from Babylonia, Egypt, China, Greece, Rome, and other ancient cultures have knowledge about the therapeutic uses of many plants. Previous writings by Hippocrates (460–370 B.C.), Theophrastus (370–287 B.C.), Aristotle (384–322 B.C.), and Dioscorides (50–100 A.D.) show that Greeks and Romans were familiar with many of the plant medicines used today. More than 700 medications are listed in the Egyptian pharmaceutical record, which spans the country's medical history from 1500 BC. The earliest Chinese herbal records that are known to exist, Erh-ya (300 BC), Svu-ching (1000 BC), and Ben-tsao (1250 AD), list over 600 therapeutic plants [3]. The earliest known uses of plants in Asia were noted approximately 1700 BC on clay tablets from Mesopotamia. Ancient Indian writings such

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

as the Charka Samhita (ca. 100–800 B.C.), Sushruta Samhita (ca. 800–700 B.C.), Rigveda (ca. 1400–1800 B.C.), and Atharva-veda (ca. 4500–2500 B.C.) also mention herbal medicines and health care products. The foundational source of Vedic knowledge for comprehending the medicinal qualities of plants is Ayurveda (1000 BC). As an age-old medical system, Ayurveda is derived from the compilation of Charka Samhita, Sushruta Samhita, and Ashtanga Hridaya Samhita [4].

Siddha and Unani, two more traditional medical systems that offer information on plant-based medications used in India, complement Ayurveda. Greek medicine gave rise to the "Unani" system, which was brought to India by Arabs and Persians following the discovery of a sea passage. The "Sidda" medical system, which developed in southern India between the tenth and fifteenth centuries, is comparable to the Ayurvedic system [5].

The phytochemical components of a herbal preparation determine its therapeutic activity. The phytochemical analysis of the medicinally significant plants ought to be done since it would help with herbal medicine standardization, quality evaluation, and efficacy. Pharmacognosy is therefore regarded as a crucial instrument for the identification, validation, and standardization of medicinal plants [6, 7].

2. The bioprospecting of therapeutic herbs:

Nowadays, one of the most popular global activities is biodiversity prospecting, often known as bioprospecting of medicinal plants. Finding commercially significant genetic and biochemical resources through the exploration, extraction, and screening of biological variety and indigenous knowledge is known as biodiversity prospecting. Bioprospecting initially concentrated mostly on plants found in the forest ecosystem. However, other types of biodiversity, like microbes, algae, and insects, have been studied recently and have shown significant promise [8].

The development of novel medications, agrochemicals, cosmetics, and other bi-products from biological diversity has been the focus of this endeavor in recent years [9]. This is done through the application of enhanced technology. Research on the metabolic response of living systems, genetic alteration, and innovative drug discovery through bioprospecting may now be done effectively thanks to sophisticated techniques and instruments, as well as advanced technology. The pharmacological effects of a variety of bioactive compounds have been investigated and identified [10].

3. The pharmacognosy of therapeutic plants

Schmidt, an Austrian physician, was the first to invent the term "pharmacognosy" in 1811. A dry, raw natural substance derived from plants, animals, or minerals that is utilized as a medication is referred to as a "crude drug." Greek terms pharmakon (drug) and gnosis (knowledge) are the roots of the English word pharmacognosy.

Pharmacognosy is the study of drugs obtained from natural sources, primarily plants, which may eventually result in the creation of novel drugs. Biologically active

natural chemical components of plants, such as sugar, amino acids, protein, chlorophyll, alkaloids, flavonoids, steroids, tannins, and so on, are known as phytochemicals (the word "phyto" means "plant"). Phytochemicals are active substances that have medicinal qualities and are categorized as drugs or medicines.

Over 4,000 phytochemicals have been categorized based on their physical, chemical, and defensive properties; 150 of these phytochemicals have undergone in-depth research [11]. According to recent research, most phytochemicals have positive effects on the body, including antimicrobial, antimalarial, anti-diabetic, anti-arthritic, and anti-cancer properties. These days, the use and investigation of plant resources is aided by the medical, biological, and pharmacological value of phytoconstituents. The development of excellent herbal medications would be further enhanced by the chemical knowledge of plants combined with their therapeutic characteristics and other biological activities [12].

Physico-chemical analysis is also regarded as a crucial factor in the assessment and identification of crude drugs during pharmacognostic research. Prior to moving further with additional research, macroscopic and microscopic analysis is required for the identification of adulterants, pollutants, and quality assessment in herbal drugs. The solubility and extractive values can be used to assess the dry yield of a certain chemical component in various solvents. The examination of ash value is helpful in identifying unrelated materials (soil and sand) that are stuck to a plant's surface [13].

A crude drug's moisture content must be considered while assessing its stability. The consistent use of fluorescence analysis can help standardize crude pharmaceuticals. Under the right lighting conditions, the various chemical constituents in the plant extract displayed distinctive fluorescence. In order to achieve fluorescence, certain chemical compounds that do not naturally fluoresce be treated with an alternative reagent [14].

4. Medicinal plants' phytochemicals

The existence of a large class of active components—mostly alkaloids, triterpenoids, essential oils, and phenolic compounds, among others—is what gives medicinal plants their curative qualities. The secondary metabolites of plants with discernible pharmacological activity are called alkaloids. Plants with alkaloids are commonly found in their roots, leaves, bark, and seeds. The alkaloids are typically found as tartaric, acetic, oxalic, and citric acid salts. The majority of them are non-polar, colorless, and soluble in water in nature.

Alkaloids have a variety of pharmacological effects, including cardiac depressant, nerve stimulant, antihypertensive, anti-leukemic, analgesic, and local anesthetic. There are six isoprene units in a triterpene. The main types of triterpenes are cardiac glycosides, saponins, and steroids. The roots of Glycyrrhiza glabra, Asparagus racemosus, and Smilax glabra are among the medicinal plants that contain saponins. Sterols are often found in animals, but they have also recently been found in plants. The main plant-derived sterols include campesterol, β-sitosterol, stigmasterol, and ergosterol.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

The presence of volatile or essential oils in glandular hairs, lysigenous or schizogenous cavities, or specialized tubes gives numerous plants their distinctive odor.

Many plant parts, including nutmeg seeds, camphorwood, clove flower buds, cinnamon bark, and lemongrass leaves, produce volatile oils. Phenols, phenolic acids, coumarins, phenyl propanoids, flavonoid pigments, anthocyanins, flavonols, flavones, and tannins are among the soluble phenolic compounds [15].

5. Current status of herbal medicine:

According to estimates from the World Health Organization, 80% of people in underdeveloped nations still get their primary medical care from plant-based medications. The World Health Organization's survey indicates that those who practice traditional medicine roughly 8% of patients in India, 85% in Burma, and 90% in Bangladesh are treated by the system. 2.4% of the world's total land area is made up of India. With about 49,000 plant species, 4,900 of which are indigenous, the nation contributes, on average, 8% of the total biodiversity of the world [16]. Less than half of the about 2,65,000 species of seed plants that are known to exist on Earth have had their chemical makeup and potential therapeutic uses thoroughly investigated [17].

The majority of medications on the market today are straightforward semi-synthetics made from materials that are found naturally. Nowadays, up to half of the authorized herbal medications are made either directly or indirectly from natural sources, such as fungus, animals, microbes, and plants. An estimate states that around 25% of pharmaceutical drugs sold worldwide have a substantial indigenous origin, accounting for a market share worth over $2 trillion [18].

The proportion of people who have tried herbal medications at least once varies among industrialized nations: 48% in Australia, 70% in Canada, 42% in the USA, 38% in Belgium, and 75% in France. Malaysia invested US$ 500 million a year on herbal medicine as opposed to US$ 300 million on allopathic medication. An estimated US$ 2700 million is spent annually in the USA on conventional medications. The anticipated yearly expenditures for herbal medicine in Australia, Canada, and the United Kingdom are US$ 80 million, US$ 2400 million, and US$ 2300 million, respectively. The market for herbal medicines is not only large but expanding quickly in a number of regions of the world [19].

Allopathic medicine is dangerous and has adverse consequences on people. Both in industrialized and developing nations, there has been a widespread tendency toward the substitution of herbal remedies for synthetic ones as people have become aware of the toxicity and side effects of allopathic drugs [16]. The two most crucial aspects of herbal medication are its inexpensive cost and lack of adverse effects. Thus, consuming an excessive amount of herbal medicine or the incorrect medication by mistake does not have any negative effects on the body.

6. Need of conservation of medicinal plants

Since medicinal plants are the primary source of raw materials for the

pharmaceutical industry and are used to extract compounds with therapeutic value, it is necessary to conserve and propagate valuable, rare, and endangered medicinal plants using cutting-edge biotechnology techniques. This is because, due to the overuse of medicinal plants by humans and the advancement of science and technology, medicinal plants have become overly valuable [20].

Plants are an essential part of the healthcare system and a valuable natural resource. Therefore, maintaining natural habitats and the wild population is the most effective way to achieve species conservation. Medicinal plants typically either don't produce seeds at all or produce seeds that are too small. Ex-situ techniques can be employed in conjunction with in-situ procedures to overcome these obstacles, and in certain cases, they may be suitable for a particular species. Therefore, ex-situ, or outside of the natural ecosystem, is a viable method for conserving medicinal plants. This can be achieved by producing and sustaining plants through the long-term preservation of plant propagules in plant tissue culture repositories [21]. Because they are more effective than other methods, in vitro procedures are being used more and more for germplasm conservation and mass propagation. For this reason, it is imperative to preserve the biodiversity of medicinal plants for both the current and future generations by implementing the right conservation techniques and suitable strategies [22, 23]. Some institutes and organizations in India have recently focused on various areas of medicinal plant conservation and drug discovery from natural resources. The Central Drug Research Institute (CDRI), the Regional Research Laboratory (RRL), Jammu and Kashmir, and the Council of Scientific and Industrial Research (CSIR) have established initiative effort aimed at discovering novel bioactive molecule from plants, fungus, microorganisms, etc. Golden Triangle Partnership (GTP) is working with the CSIR, ICMR, and Department of Ayush to validate traditional ayurvedic medicine as a viable drug development method. The Department of Biotechnology and the Government of India established two Micropropagation Technology Parks at the Tata Energy Research Institute (TERI) in New Delhi and the National Chemical Laboratory (NCL) in Pune over the past few decades.

Conclusion:

Plants have been used as a primary source of medicinal medicines for ages. In addition to providing treatment, medicinal plants play a significant role in global trade. The commerce in medicinal plants has grown significantly in the last several years due to the accessibility of herbal medications at reduced costs and with fewer adverse effects [25]. The ability of plants to heal stems from their complex chemical components, each having unique compositions and biological roles.

Herbal medicine is widely used around the world and is said to be both economical and effective. Eco-friendly and bio-friendly plant-based products have garnered a lot of attention lately as potential treatments for many human illnesses. The need for pharmaceuticals has increased globally during the past few years. The biological variety of plants is in jeopardy because of the growing demand for plants as

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

raw materials in the pharmaceutical industry. Therefore, with the use of improved screening techniques from plants and other natural sources, research for the development and characterization of natural medications must be advanced. But scientific verification of medicinal plants is common, as is the search for a natural medication that is both safe and effective in treating illnesses [26].

References:

1. Daniel EV. The pulse as an icon in the Siddha medicine. In: E.V. Daniel and J.F. Pugh, Contribution to Asian studies, E.J. Brill-Leiden, The Netherlands. 1984; 115-119.
2. Thomas B and Rajendran A. Less Known Ethnomedicinal Plants Used by Kurichar Tribe of Wayanad District, Southern Western Ghats Kerala, India. Bot Res Int. 2013; 6 (2): 32-35.
3. Adhikari PP and Paul SB. History of Indian traditional medicine: a medical inheritance. Asian J Pharm Clin Res. 2018; 11(1): 421-426.
4. Katiyar CK. Safety aspects of Ayurveda: International conclave on traditional medicine, Department of AYUSH, Ministry of Health and Family Welfare, Government of India, New Delhi, and NISCAIR, CSIR, New Delhi. 2006;299-306.
5. Raju YR, Yugandhar P and Savithramma N. Documentation of ethnomedicinal knowledgeof hilly tract areas of East Godavri District of Andhra Pradesh, India. Int J Pharm Pharm Sci. 2014; 6(4): 369-374.
6. Kokate CK, Purohit AP and Gokhale SB. Drugs containing glycoside. In: Pharmacognosy, 21st edition, Pune, Nirali Prakashan. 2009; 158-239.
7. Dinesh Kumar, Zulfiqar AB, Vijender Kumar I A, Chashoo NA, Khan MY. Pharmacognostical and phytochemical evaluation of Angelica Archangelica Linn., Int J Drug Dev & Res. 2011; 3(3): 173-188.
8. Kumar P and Tarui N. Identifyng the contribution of indigenous knowledge in bioprospecting for conservation stategy. In Bridging scales and Epistemologioes Conference, March 2004. Alexandrea, Egypt. 2004.
9. Artuso A. Bioprospecting, Benefit Sharing and Biotechnological Capacity Building. World Development.2002; 30(8): 1355-1368.
10. Juan B. Bioprospecting and Drug Development, Parameters for a Rational Search and Validation of Biodiversity. J Microbial Biochem Tech. 2017; 9:1 1000 e128.
11. Sharma M and Kumar A. Pharmacognostial Characterization of Some Selected Medicinal Plants of Semi-Arid Regions. J Pharmacogn Phytochem.2013; 1(6); 216-228.
12. Vivekraj PS, Vinotha A, Vijayan and Anand GV. Preliminary Phytochemical Screening and GC-MS Analysis of Methanolic Extract of Turnera subulata Smith (Passifloraceae). J Phytopharmacol. 2017; 6(3): 174-177.
13. Kumar D, Bhat ZA, Kumar V, Chashoo IA, Khan NA, Shah MY.

Pharmacognostical and phytochemical evaluation of Angelica Archangelica Linn., Int J Drug Dev &Res.2011; 3(3): 173-188

14. Roy P, Mandal P, Panda S, Mitra S, Subba A. Pharmacognosy and Phytochemical Screening of some Plant Derived Medicine to Treat Dysmenorrheal Pain by the Rajbanshi Community. Pharmacog J. 2018; 10(4):38-46
15. Divya R. Ethnobotanical survey of traditional medicinal plants of Jhunjhunu (Rajasthan) and its neighbourhood. Thesis submitted to Shri Jagdish Prasad Jhabarmal Tibrewala University, Rajasthan, 2017.
16. Gireesha J and Raju NS. Ethno botanical study of medicinal plants in BR Hills region of Western Ghats, Karnataka. Asian J Plant Sci Res. 2013; 3(5):36-40.
17. Sathiyaraj R, Sarvalingam AA, Balachandran A and Reddy RK. Diversity of Ethnomedicinal Plants in Bodamalai Hills Eastern Ghats, Namakkal District, Tamil Nadu. J Plant Sci. 2015; 3(2): 77-84.
18. Jones CE and Jones C. Indigenous knowledge and bioprospecting; International conference, 2002 April 21-24; Maquarie University, Sydney, Australia. 2002.
19. WHO. Inter-regional Workshop on Intellectual Property Rights in the Context of Traditional Medicine, Bangkok, December 2000.
20. Akshay KR, Sudharani N, Anjali KB and Deepak TM. Biodiversity and strategies for conservation of rare, endangered and threatened medicinal plants researchand reviews. J pharmacogn phytochem. 2014; 2 (3): 12-20.
21. Michael RW, Rands WM, AdamsLB, Stuart HM, et al. Biodiversity Conservation: Challenges Beyond. Science.2010; 329: 1298-1303.
22. Ashok KP and Tripathi YC. Ethnobotany and its relevance in contemporary research. J Med Plants Studies. 2017; 5 (3): 123-129.
23. Sharma S and Thokchou R. A review on endangered medicinal plants of India and their conservation. J Crop and Weed. 2014; 10(2):205-218. 11 Medicinal Plants and Its Pharmacological Values DOI: http://dx.doi.org/10.5772/intechopen.99848
24. Giday MZ, Asfaw and Woldu Z. Ethno medicinal study of plants used by Shekoethnic group of Ethiopia. J Ethnopharmacol.2010; 132:75-85.
25. Durairaj P and Kamaraj M. Ethnobotanical Studies on Plant Resources of Trichirapalli District Tamilnadu, India. Int J Human Art Med Sci. 2013; 1(3); 17-30.
26. Shah A, Bharati KA, Ahmad J and Sharma MP. New ethnomedicinal claims from Gujjar and Bakerwals tribes of Rajouri-Poonch districts of Jammu and Kashmir, India. J Ethnopharmacol.2015; 166:119-128.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Ecosystem services of birds: Documentation and Indexing in an integrated farming system

S. Devi Thangam[1]
Department of Zoology, MES College of Arts, Commerce and Science,
Malleswaram 15th Cross, Bangalore-560075, Karnataka, India.
C. B. Soumya[2]
Scientist, Multiplex Biotech Pvt Ltd., Kasava Hobli,
Nelamangala Taluk, Bengaluru 562123, Karnataka, India
Rashmi MA[3]
CEO and Scientist, Rashvee-International Phytosanitary
Research and Services Ltd., Hebbal, Bangalore-560024, Karnataka, India.
Abraham Verghese[4]
CEO and Scientist, Rashvee-International Phytosanitary
Research and Services Ltd., Hebbal, Bangalore-560024, Karnataka, India.

Article DOI Link: https://zenodo.org/records/11219135
DOI: 10.5281/zenodo.11219135

Abstract:

Birds play an important role in all kinds of agroecosystems as pollinators, predators, seed dispersal etc. To highlight the regulatory role of birds in an agroecosystem especially as pest control, documentation of birds in 36-acre mixed farm was studied. Weekly once sampling was done to document the birds. This study showed the bird diversity is an important component of ecosystem diversity and can contribute significantly towards pest control thereby over usage of pesticide can be controlled, which can reduce the risk of pesticide resistance and increase the other beneficial biotic groups.

Keywords: Birds, ecosystem services, indicators, diversity

Introduction:

Ecosystem services are the services rendered by the biotic components of an ecosystem for the well-being of human life. They are broadly classified into four types *viz*.,

(i) Support
(ii) Provisioning
(iii) Regulation
(iv) Cultural Services

Birds are one of the important groups in an ecosystem rendering all the types of ecosystem services and are important for the proper functioning of an ecosystem and they also increase the economy. They provide Support (Nutrient cycling, seed dispersal) Provisioning (Poultry In the form of meat and eggs) Regulation (Pollination, control of pests, weeds, rodents, removal of carcass) Cultural Services (Recreation- Birds as pets

and tourism). The ecosystem services rendered by the birds.

In all agro-ecosystems, be it arid or highly irrigated, irrespective of crop types birds play many roles, including as predators, pollinators, scavengers, seed dispersers, seed predators, and ecosystem engineers (Sekercioglu 2006). They also become victims of many farm operations like clearing natural vegetation, mechanization, use of pesticides and fertilizers etc. These impinge on their food, nesting and roosting. Sensitive birds are pushed out, while tolerant birds adapt to the changes. Urbanization is also another factor pushing birds out of peri-urban system. Encouraging the regulatory role of birds is important since it has now been realized that despite tremendous increase in pesticide use, the pest damage levels continue to escalate (Pimentel et al., 1992; Oerke, 2005).

Strategies for enhancing the pest control services by birds to agriculture would require understanding predator ecology to ensure that pest predators have suitable food and habitat resources throughout their lifecycles (Landis et al., 2000). This study is a preliminary documentation of birds in a 36-acre mixed farm that follows an Integrated Farming System (IFS)

Materials and Methods:

Sampling and documentation of birds:

The Main Study Area (MSA) measuring approximately 36 acres is situated in Bangalore Rural District. It consists of organic, non-organic fields, fodder zone, dairy unit, organic manure production, vermicompost, natural wild grasslands, scrub jungle, roads lined with tall trees like Teak *Tectona grandis*, silver oak *Gravellea robusta*, *Pongamia* sp., Neem *Azadirachta indica* etc. Small mixed orchards consisting of mango *Mangifera indica*, pomegranate *Punica* spp., mulberry *Morus* spp., papaya *Carica papaya*, banana *Musa paradisica* etc. All the trees are being scientifically documented. The farm has tall semi wooded areas around the borders conducive for bird roost and nest.

A standardized transect was followed for survey by foot in the MSA. Birds were documented once a week, using a 8 X 40 DPS I pair of binoculars. These were tabulated and mean sightings/ month was calculated. The data of the birds in MSA were subjected to analysis by calculation of Shannon-Weiner Index (SWI) Shannon-Weiner Evenness Index (E_H), Simpson's D and Species richness. The bird species sighted were also categorized in terms of ecosystem service into five groups *viz* Insectivorous, Omnivorous, Frugivorous, Gramivores and Nectarivores and the percentage of species in each category was computed (Fig.1).

Results and Discussion:

The diversity indices calculated for the months between March and December of 2018 are presented in Table 1. The table shows that SWI generally ranged from 2.36-3.38. The highest diversity was in July 2018, and the diversity continued to be higher till December. This was reflected by the corresponding higher evenness from July onwards. The Simpsons index values ranged from 0.90 to 0.97 from March to December while the

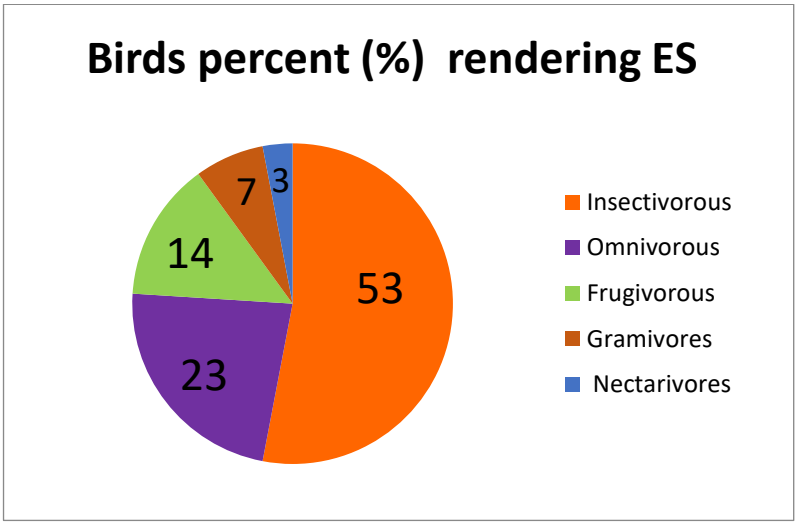
ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Shannon-Weiner Evenness ranged from 0.53-0.76 during the corresponding period. Species richness values showed wide differences during the different months and ranged from a low of 17 in March to a high of 51 in November.

Table 1. Diversity Indices of birds during March – December, 2018

Diversity indices	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Shannon-Weiner (H)	2.36	2.87	2.72	2.91	3.38	2.96	2.95	3.12	3.21	2.96
Shannon-Weiner Evenness (E_H)	0.53	0.65	0.61	0.76	0.66	0.67	0.66	0.70	0.72	0.67
Species Richness (S)	17	27	22	24	46	46	40	33	51	32

Fig 1. Proportion of birds in different classes of ecosystem services



The relationships between biodiversity and ecosystem services are complex. However, higher biodiversity is generally associated with higher levels of ecosystem services within a given system (Balvanera et al., 2006; Cardinale et al., 2012). Since birds are an important component of any ecosystem, their higher diversity would naturally be indicative of higher contribution to ecosystem service by them. The Shannon-Weiner index (SWI) values which indicates number of individuals in different species shows that the values were towards the higher side indicating a more or less even number of all the species which is corroborated by the high D values similar evenness

values and low species richness values.

In any ecosystem, birds contribute towards ecosystem service as well as disservice. Farmers have been overwhelmingly concerned about the ecosystem disservice of birds but have failed to realize their ecosystem service value. This can be realized only by a systematic survey and documentation. Therefore, the high proportion of insectivorous and omnivorous bird population observed in the study is significant. The high proportion of insectivorous birds indicates that they would contribute significantly towards pest control. This was also corroborated by damage due to Fall Army Worm (FAW) *Spodotera frugiperda* on sweet corn. It was found that maize crops in the open field had lesser infestation of FAW as compared to polyhouse where birds are excluded.

The beneficial role of birds in insect outbreaks (e.g., spruce budworms [*Choristoneura* spp.], cicadas [*Magicicada* spp.], and Mormon Crickets [*Anabrus simplex*]), has been well documented (U.S. Biological Survey reports, summarized by Whelan et al. 2008). It is one of the simple means of pest control as the bird population can be easily manipulated through cultural practices. Kay et al. 1994 reported that perches around soybean fields increased diurnal raptors and in turn decreased House Mouse (*Mus musculus*) population in Australia. Providing artificial perches have also been reported to attract birds of prey suggesting that it may be an effective practice to enhance or concentrate foraging in potentially beneficial ways (Wolff et al. 1999, Sheffield et al. 2001). The study thus shows that bird diversity is an important component of ecosystem diversity and can contribute significantly towards pest control. However, detailed studies to quantify the ecosystem service and disservice by birds are necessary.

Acknowledgements:

Authors would like to thank the funding agency Bioversity International, Italy to conduct the research and acknowledge the Christ University Students, M. A. Agnishike, Anshitha Das in documenting the birds.

References:

1. Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J. S., Nakashizuka, T., Raffaelli, D., & Schmid, B. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology letters*, *9*(10), 1146-1156. *Ecology letters*, *9*(10), 1146-1156.
2. Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P.& Naeem, S. (2012). Biodiversity loss and its impact on humanity. *Nature*, *486*(7401), 59-67.
3. Kay, B. J., Twigg, L. E., Korn, T. J., & Nicol, H. I. (1994). The use of artifical perches to increase predation on house mice (Mus domesticus) by raptors. *Wildlife research*, *21*(1), 95-105.
4. Landis, D. A., Wratten, S. D., & Gurr, G. M. (2000). Habitat management to conserve natural enemies of arthropod pests in agriculture. *Annual review of*

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

entomology, *45*(1), 175-201.

5. Oerke, E. C. (2006). Crop losses to pests. *The Journal of agricultural science*, *144*(1), 31-43.
6. Pimentel, D., Acquay, H., Biltonen, M., Rice, P., Silva, M., Nelson, J., ... & D'amore, M. (1992). Environmental and economic costs of pesticide use. *BioScience*, *42*(10), 750-760.

The Need for Biodiversity Conservation in the Current Global Ecosystem Crisis

Prakash Ramrao Kadlag
Samarth Rural Educational Institute's Belhe
Email: *prakashkadlag63@gmail.com*

Article DOI Link: https://zenodo.org/records/11219199
DOI: 10.5281/zenodo.11219199

---

1. Introduction:

The biosphere includes human society; the human race is but one of the biosphere's many millions of species. The ecosystem services that the remaining biosphere provides are essential to human existence as well as the health and viability of its society and economy [1]. Although these services guarantee clean air to breathe, self-purification of water and soil, a climatic system conducive to life, and food, a large portion of energy carriers and construction materials are also byproducts of the biosphere's previous functioning. The quantity, biomass, productivity, biological activity, and high biodiversity that sustains the biosphere's adaptability and dependability of living communities in natural and near-natural environments all contribute to the health and capacity of the biosphere to offer services.

The world's overpopulation of people has led to the reduction of natural habitats, altered land use and vegetation coverage, urbanization, and the expansion of low-diversity agricultural areas. These factors have, on the one hand, resulted in a mass extinction of species and a decrease in ecosystem services, but they have also caused additional issues that have resulted in a global ecological crisis and climate change, which have increased risks, socioeconomic dangers, and social and public health issues [2].

The path out of the global ecological catastrophe is the transition to a sustainable civilization [3, 4]. But as of right now, the term "sustainable society" merely refers to a catchphrase rather than an actual way of life, an established economic-social structure, or a well-organized system of modern tools and techniques.
We are aware that in order to create a sustainable global society, the following organizational levels must all undergo changes at the same time:

- Individuals and families leading sustainable lifestyles.
- The sustainable operation of businesses, institutions, churches, social organizations, local governments, and their initiatives promoting families' sustainable way of life.
- Ensuring the legal and coordination conditions of a sustainable society involves concluding international treaties, establishing and strengthening international organizations that implement them, and enforcing laws at the local, regional, continental, and global levels.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

It is well known that the following areas need to be addressed in efforts to address global issues as we move towards a sustainable information society:

- preserving the ecosystem and its habitats;
- preserving the biosphere's functionality and biodiversity;
- safeguarding the climate system and air quality;
- supplying energy and moving towards renewable sources;
- conserving water resources; providing food and ensuring its safety;
- managing waste and recycling
- eradicating poverty, lowering social divides, tensions, and aggression;
- eradicating organized crime, terrorism, corrupt political systems, and war;
- combating diseases (epidemics, environmental harm, civilizational damage);
- guaranteeing social equality of opportunity and legal equality;
- modernizing education

Only globally coordinated initiatives can address global issues. The following (yet-to-be-fulfilled globally) roles must be carried out by the institutional system tasked with macro-level coordination in order to create a future sustainable society:

- The expert decision support system and joint legislation's operation.
- Ensuring widespread dissemination of the thorough information required to make judgements.
- The way the system of international democratic institutions for decision-making functions.
- Ensuring that the decisions made are carried out.
- Ensuring that justice and control are applied to all of this.
- Upholding the universal human interests over regional and social ones.
- Serving as a symbol and embodiment of humanity's collective togetherness.

The evident shared objectives are as follows:

- Maintenance and enhancement of biodiversity and the biosphere's ability to effectively self-regulate.
- Establishing, setting up, and running a sustainable society.

2. Specific duties and levels of reaction related to the preservation of biodiversity

Diverse levels and kinds of environmental conservation initiatives have been required as the worldwide ecological crisis has historically developed. As issues deteriorate, protection measures must also advance and change to meet fresh difficulties. This process of historical adaptation can be divided into seven eras or levels. Nevertheless, the more recent methods can only work in conjunction with and as a foundation for the more established ones—not in place of them.

2.1 Effective in-situ conservation of species

It quickly became clear that passive in situ species protection is insufficient to address the issues in many cases, as the decline in populations and the extinction of species are caused by factors other than direct destruction, such as a reduction in life expectancy and survival during critical times.

By creating artificial nesting sites, summer drinking holes, winter feeding areas, and migration routes, we can more effectively support their active protection in their natural ecosystem.

2.2 In situ protection of species

The prominent decline of huge, mostly predatory animals and old, massive trees was the first indication of habitat loss and increased human hazardous activities. It is evident that the original responses to nature conservation also target the protection of these uncommon and endangered species, mostly through restricting and outlawing activities that intentionally and directly destroy them (such as hunting, cutting, gathering, and trading) in their natural habitat. Even with regard to huge marine and terrestrial mammals, birds, amphibians, reptiles, and uncommon plants, this degree of protection is still crucial.

2.3 Intense protection of ex situ species

Unfortunately, there are an increasing number of examples where the native habitat of some endangered species disappears or shrinks, making it impossible to assure their survival through passive or active means of in situ species preservation. The last specimens of endangered species had to be propagated artificially in zoos and botanic gardens, preserved and maintained in special reserves, gene banks, and then reintroduced after their habitat was restored. In such cases, the means of active ex situ species protection had to be and should be used.

2.4 Protection of in situ environment

It was clear from the beginning of time that protecting a species and its living community is best achieved in the natural habitat in which the species originated. This implies that in the habitat of protected organisms, it is necessary to guarantee the conservation of non-endangered species as well as the association and ecosystem as a whole. Under this idea, the first national parks, nature reserves, biosphere reserves, and habitat protection initiatives were started; nevertheless, this was also the first time that protection against direct human damage (such as logging and hunting) was the only thing done, and often only partially so.

2.5 Vigorous on-site habitat preservation

If detrimental human activity is removed, a varied mosaic of ecosystems in their natural condition can function independently over huge regions. But in many situations, only a small portion of the natural habitat may be preserved in smaller habitat patches that are encircled by agricultural areas and human populations, where the natural self-sustaining processes have already been harmed. Such nature protection areas need to be actively managed since invasive species need to be controlled.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

2.6 Prolonged preservation of biodiversity

These days, it is evident that our best efforts to expand the number and size of national parks and raise the standard of the expert work done in them will not be sufficient to reverse the decline in biodiversity brought on by environmental pollution and overpopulation of humans. By creating buffer zones around protected areas, where agricultural activity should only be permitted in the form of chemical-free organic farming, the spread of urbanization must be halted, and the establishment of mines and industrial areas must be limited, protection activities must also be extended to artificial ecosystems in the immediate vicinity of national parks and protected areas.

In order to maintain biodiversity, it is also necessary to build parks, man-made lakes, green roofs, tree rows, grass areas, and active species protection techniques in settlement areas. In addition to the preservation of the tangible and spiritual legacies of our cultural past, extended biodiversity protection must encompass traditional farming practices, traditional ecological knowledge held by native peoples, and ancient cultivators and livestock. The culture and traditional way of life of the indigenous peoples must be protected in its original form as a shared treasure, in keeping with the principles of a sustainable society.

The tourism industry must also adopt a new mindset in order to achieve any of these goals. For example, ecotourism (along with wildlife management for the sake of nature conservation) can replace trophy hunting tourism. Ecotourism can also be a valuable tool for promoting nature and ethnography knowledge and can be linked to nature photography, forest schools, and other initiatives. Finally, in order to truly realize a sustainable society, we must actually introduce the shift to environmentally friendly, sustainable farming not only in the buffer zones but throughout the planet, as well as the necessity of expanding various biodiversity protection strategies.

2.7 Ex situ habitat protection

Global climate change serves as a reminder that efforts to safeguard biodiversity in national parks and their buffer zones, as well as the broader expansion of biodiversity protection, are inadequate due to certain long-term repercussions of human activity and natural processes. Global climate change alters the boundaries of the climate zones that are suitable for specific ecosystems and communities [5, 6], shifts them in polar or east-west directions, pushes mountains' vertical zonation upward, modifies the effects of the ocean and continent, and alters local weather and groundwater conditions, river and lake water balance, seashore location, and water level.

The objective of nature conservation can only be the preservation of the biosphere's functionality, ability for self-regulation, and biological diversity as opposed to the already practiced "in situ conservation," which is the preservation of current ecological conditions in current ecosystems. This can be accomplished by actively supporting biological systems' natural adaptation processes and preventing negative anthropogenic effects (migration, migration routes, area change). Active nature conservation in the form of "eco-engineering" is necessary to address this issue. There are essentially two little tasks that make up this work:

- providing an escape route for communities of organisms that currently and historically reside in the given area but are unable to adapt to its changing ecological conditions due to climate change, if necessary, through conscious plantings and the establishment of eco-corridors.
- encouraging the creation of natural and close-to-natural communities of organisms that are suitable for (and adapted to) changing (i.e., future) climate of the given conservation area.

Market-friendly solutions can be introduced based on the example of carbon dioxide emissions trading, which could play an important role in climate change mitigation and adaptation. Forest plantations for climate protection purposes, translocation projects for nature conservation purposes, the withdrawal of land from intensive cultivation, or the development of agriculture in accordance with ecological conditions, and the spread of ecotourism can be boosted with the help of these tools.

References:

1. Palliwoda J, Fischer J, Felipe-Lucia MR, Palomo I, Neugarten R, Büermann A, et al. Ecosystem service coproduction across the zones of biosphere reserves in Europe. Ecosystems and People. 2021;17(1):491-506. DOI: 10.1080/26395916.2021.1968501
2. Cafaro P, Hansson P, Götmark F. Overpopulation is a major cause of biodiversity loss and smaller human populations are necessary to preserve what is left. Biological Conservation. 2022; 272:109646. ISSN 0006-3207. DOI: 10.1016/j.biocon.2022.109646
3. Hufnagel L, Pálinkás M, Mics F, Homoródi R. Introductory chapter: The present global ecological crisis in the light of the mass extinctions of earth history. In: Hufnagel L, editor. Changing Ecosystems and Their Services. London, UK: IntechOpen; 2020. p. 141.
4. Bastante-Ceca J, María Fuentes-Bargues L, José Florin-Constantin M, Latu C, et al. Introductory chapter: The need to change the paradigm - sustainability and development at the 21st century. In: María JB-C, Jose LF-B, Levente H, Florin-Constantin M, Corneliu L, editors. Sustainability Assessment at the 21st Century. London, UK: IntechOpen; 2020. p. 185.
5. Garamvölgyi Á, Hufnagel L. Impacts of climate change on vegetation distribution no. 1 climate change induced vegetation shifts in the Palearctic region. Applied Ecology and Environmental Research. 2013;11(1):79-122
6. Hufnagel L, Garamvölgyi Á. Impacts of climate change on vegetation distribution no. 2 - climate change induced vegetation shifts in the new world. Applied Ecology and Environmental Research. 2014;12(2):355-422

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Dairy and the inclusive development goals of India

Mr. Gokul S. Jadhav
Research Scholler, Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar Pune – 05
Dr. Amit E. Sonawane
Associate Professor, Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar Pune – 05
Email: *jadhavgokul41@gmail.com*, *amiteksona@gmail.com*

Article DOI Link: https://zenodo.org/records/11219233
DOI: 10.5281/zenodo.11219233

Abstract:

India produces the most milk (24.64% of global output), placing it top in the world. It is almost unnecessary to emphasize the value of dairying in a nation like India. The Indian economy and socio-economic development are significantly dependent on livestock in general and dairying in particular. The milk output will need to expand at an annual rate of 9.2% in order to reach its projected levels of 254.55 million MT by 2021–2022 and 300 million MT by 2023–2024 from the current 163.7 million MT. As a result, the amount of milk that is currently available per person would increase from 352 grammes per day to 515 and 592 grammes per day in 2021–2022 and 2023–2024, respectively.

As a subset of agriculture, dairying provides a significant source of income for both landless labourers and small and marginal farmers. Therefore, an increase in the proportion of productive animals in the total population of cows and an increase in the productivity level of cows would be essential to have more marketable surplus and, consequently, higher income potential and productivity at the farm level if the nation is to achieve higher farmer income through dairying by 2023–2024. Increased purchasing power, increasing urbanization, changing nutritional and lifestyle preferences, and population growth have all been linked to an increase in milk consumption as a growth goal.

Techniques to combat poverty in the global food production and distribution system have refocused attention on how livestock might help smallholder farmers live better lives. To increase the milk yield through the application of effective breeding programs for buffalo and cattle as well as upgraded scientific feeding methods. The organized sector's market share of all liquid milk has increased from 32% to 41% in the last three years. The dairy business has played a significant role in propping up the rural economy in India.

Keywords: Dairy Development, Inclusive Development, Animal Husbandry, Poverty, Economic Growth, Technological advisement, Sustainable Development.

Introduction:

The National Action Plan for Dairy Development for 2022 was created by the Department of Animal Husbandry, Dairying & Fisheries to close the infrastructure gap needed to handle the increased coverage and milk production. This will help meet the demand for milk and milk products as well as the goal of doubling farmers' income. It makes an effort to improve the endeavor by prioritizing resource usage through the implementation of contemporary technologies and inclusive aims, which will ultimately benefit all parties involved, from the supply chain to the milk producer. With an investment of 10881 crore, the Department of Animal Husbandry, Dairying & Fisheries has introduced the Dairy Processing & Infrastructure Development Fund (DIDF), a new program me aimed at updating the antiquated dairy infrastructure and building brand-new, cutting-edge infrastructure. However, the inclusion process also involves each person and helps them feel important, both of which are critical for the growth of the individual and the society in which they reside.

DIDF advocates for environmental preservation, social progress, and equitable economic growth. As a strategy, it aims to attain equilibrium among the five aspects of sustainability, including people, planet, prosperity, pace, and collaboration. In addition to meeting the demand for milk and milk products, DIDF fills the infrastructural gap needed to manage the increased coverage and milk output and achieve the goal of doubling farmers' income. A National Action Plan on Dairy Development has been established by this department in order to carry out the government's objective. According to the plan, there would be 2.57 lakh villages by 2022, up from 1.86 lakh, and 3.2 lakh villages by 2023–2024. It is projected that the number of farmer members will rise from 16 million to 19 million by 2022 and 28 million by 2023–2024 as a result of the establishment of village-level infrastructure for the procurement of milk, as well as increased capabilities for milk processing, milk product manufacture, and marketing.

The goal Plan to boost organized milk handling from 20% in 2022 to 41% in 2023–2024. Cooperatives are expected to handle 10% more milk than the private sector, which will handle 30% more. The National Action Plan served as the basis for the creation of this vision document. The average in-milk animal productivity would need to increase yearly at a rate of 4.7% to 6.14 kg per day by 2022 and to 6.7 kg per day by 2023–2024 from the current 4.65 kg per day in order to meet the targeted milk production targets. The country's demand for milk and milk products has increased due to factors such as rising per capita income, shifting dietary preferences, lifestyle changes, and growing export potential. On the supply side as well, it is anticipated that milk output would rise by 8.56% year due to the implementation of various breed development treatments and the focused approach that state departments will likely employ for executing various methods of dairy development across the nation.

1. Significance of Indian Dairy Sector:

India currently produces and consumes the most milk in the world, contributing 19% of global milk output and housing 16% of all cattle and 57% of all buffalo

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

worldwide. An important part of the rural economy in India is dairying. In India, the dairy industry has deeper social and economic ramifications beyond just being a company.

Goal	Linked Areas	Impacts
Reducing poverty	To eliminating poverty is partially addressed by India's dairy development strategy, which is built on a smallholder production system connected to an institutional network with substantial contributions from women. A financial safety net against crop failure is provided by dairy income. The NDP primarily covers small and marginal farmers as well as landless workers, helping to elevate their income status above poverty. Additionally, more than 60% of the BPL group has profited from NDP.	Direct impact because dairy growth creates opportunities for households who produce milk, including the impoverished and landless, to increase their income
Improving gender equality	The NDP programs have increased women's participation in dairy activities through a variety of awareness and training initiatives, which have improved women's mobility, status, and recognition in the NDP areas as shown by the NCAER Socio Economic Survey (SES).	Immediate effect since it gives women in rural households the chance to earn a livelihood
Ensuring inclusive economic growth	With improved procurement (VBMPS) and the provision of Bulk Milk Coolers (BMCs) to the District Cooperative Society (DCS), which have created respectable employment possibilities and consequently aided in economic growth, NDP has strengthened the milk industry and increased its significance.	Direct impact since the scheme gives the impoverished and landless people in rural areas the chance to produce milk and earn money.
Preventing rising inequality	As opposed to areas that did not get the interventions, the NDP has helped reduce inequality in the project areas since it has mostly benefited landless, small, and marginal farmers.	Farmers have equal access to dairy cooperatives regardless of the volume of milk they produce.

Despite requiring more effort than growing crops, dairying gives family labour a lucrative outlet. Farmers are encouraged to engage in dairying as a side business to agriculture due to the availability of labour and the limited land base. In addition to giving rural households a source of income, it also guarantees the family's nutritional security by tackling problems like malnutrition.

Increasing the role of farmer-organizers, particularly small- and marginal-farmers, into producer-organizations has shown to be one of the best ways to handle the various issues facing agriculture, chief among them being better access to markets, capital, technology, and inputs. The main socioeconomic changes brought about by dairy cooperative intervention in rural areas include an increase in farmers' income, the creation of jobs, the availability of credit to underprivileged farmers, the empowerment of women, the introduction of better technology, improved nutritional security, etc.

As a goal for growth, there has been an increase in milk consumption that is correlated with people's increased purchasing power, growing urbanization, shifting dietary and lifestyle preferences, and population expansion. The majority of the population in the nation is vegetarian, thus milk, with its many health benefits, is their primary source of animal protein. The expansion of the "milk-consuming population base" has contributed to the increase in milk demand in addition to the rise in per capita consumption. Therefore, it is anticipated that the country's milk consumption will rise significantly in response to continued economic expansion and an increase in per capita income.

2. Challenges, objectives and Goals of Dairy Development:

"Enabling sustainable growth of dairy sector by doubling of farmers' income engaged in dairying, thereby paving way for nutritional security, economic prosperity and livelihood support," reads the Department of Animal Husbandry, Dairying and Fisheries' vision statement. India is now the world's largest producer of milk, but the industry still faces many obstacles that prevent it from growing to its full potential. These obstacles include those related to processing milk and value-added products, getting milk producers access to organized markets, and providing consumers with high-quality milk and milk products.

The National Action Plan (NAP) for 2021–2022 and 2023–2024 considers various factors, including the extent of milk potential villages, the number of farmer members, farmer income, the growth of milk production, the procurement of milk, the presence of milk chilling, the infrastructure for processing with cooperatives and producer companies, consumption patterns, and more. Increasing the number of productive animals (ideally within the size of the current herd) and raising the productivity level of cows would result in more marketable surplus at the farm level.

3. Technological advisement for fulfil Development goals:

The goal of the National Dairy Plan is to close the large gap between milk

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

production and processing, in addition to increasing milk output. The proposed National Action Plan intends to satisfy the predicted need for high-tech processing facilities. On the other hand, Dairy technology is an extensive field of research within food technology that focuses mostly on the packaging, processing, distribution, storage, and transportation of dairy products. The disciplines of nutrition, biochemistry, and bacteriology are used to carry out these tasks.

In light of rising production and demand, the majority of dairy cooperatives' processing capacities require refurbishment and growth as they operate on antiquated technology. Given the foregoing, it is essential that the dairy facilities owned by dairy cooperatives be renovated with new energy-efficient technology and that processing infrastructure for 392.4 million LPD be established by 2023–2024, respectively. Feed and feed supplements would be needed to sustain the increased milk output. Consequently, by 2023–2024, 5638 MTPD capacity cattle feed plants would also need to be built in order to supply farmers at the village level with input services. Based on 80% capacity utilization, the chilling and processing capacity of milk for cooperatives, private firms, and producer companies by 2023–2024 has been estimated.

4. Effect on the Reduction of Rural Poverty:

Reducing poverty and ensuring food security are at the top of the global development agenda. Strategies for reducing poverty within the global food production and distribution system have brought attention back to the potential benefits of livestock for improving the lives of smallholder farmers. Based on this aim, numerous studies conducted in India have shown that the proportional costs associated with dairying are lower than non-dairy expenditures at the household level, and that these costs are inversely correlated with income. Hence, dairying ought to be a crucial component of initiatives aimed at reducing poverty since it has the power to do so at the home level. Income disparity is lessened by the proceeds from dairy production. Additionally, farming puts farmers in a better position to feed their families, send their kids to school, take care of their health, and invest in their future. Farming also gives a consistent source of food and income.

5. Implications of Dairy Sector to Sustainable Development Goals (SDGs):

India's dairy industry is built on a small-holder production system model connected to an institutional network, with a notable female involvement. A considerable section of the population is expected to be more aware of nutrition, and increasing incomes will fuel a favorable growth in the demand for dairy products in India in the upcoming years. In cities, there is a growing need for packaged and processed dairy products. Coordination of high-quality animals, people, technical expertise, land, finance, credit, infrastructure, and other inputs pertinent to the value chain are all part of the dairy industry. The productivity and amount of milk produced by the animals are highly dependent on their quality. To boost the milk yield by implementing efficient breeding programs for cattle and buffalo as well as scientific feeding techniques that

have improved the accessibility and cost of high-quality feed and fodder.

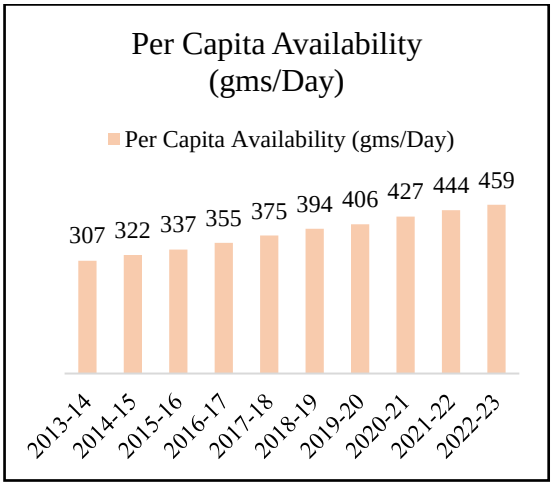
6. Accomplishments of India's dairy development by 2022–2023:

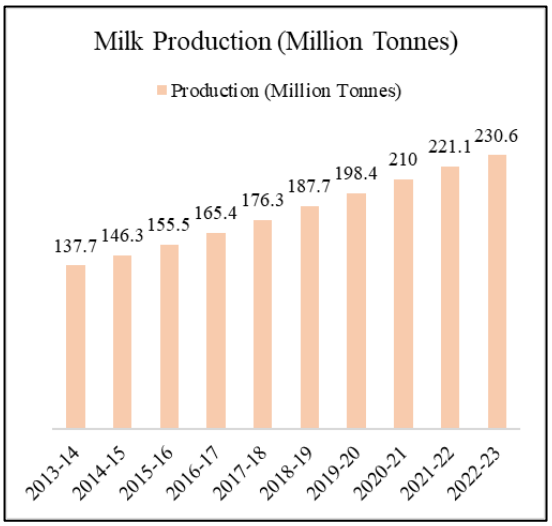
The largest agricultural product, dairy accounts for 5% of the country's GDP and directly employs over 8 crore farmers. India is the world's top producer of milk, accounting for 24.64 percent of the total. Over the last nine years, milk output has increased at a Compound Annual Growth Rate (CAGR) of 5.85%, from 146.31 million tonnes in 2014–15 to 230.58 million tonnes in 2022–2023. In comparison to 2021, global milk production increased by 0.51% in 2022 (Food Outlook June 2023). In contrast to the global average of 322 grammes per day in 2022 (Food Outlook June 2023), India's per capita availability of milk is 459 grammes per day in 2022–2023. The three states that produce the most milk are Madhya Pradesh (8.6%), Uttar Pradesh (14.93%), and Rajasthan (15.05%). The dairy industry in India is expected to increase by 5–6% annually. In 2022, dairy product exports increased by 39%. Bangladesh, United Arab Emirates, Bahrain, Malaysia, Saudi Arabia, and Qatar are important export markets.

7. India's Production of Milk:

Sr. No.	**Financial Year**	**Milk Production (Million Tonnes)**	**Per Capita Availability (gms/Day)**
1	**2013-14**	137.7	307
2	**2014-15**	146.3	322
3	**2015-16**	155.5	337
4	**2016-17**	165.4	355
5	**2017-18**	176.3	375
6	**2018-19**	187.7	394
7	**2019-20**	198.4	406
8	**2020-21**	210	427
9	**2021-22**	221.1	444
10	**2022-23**	230.6	459
Source: Basic Animal Husbandry Statistics, MoFAHD, DAHD, GoI			

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com





8. Dairy Development with Inclusive Development Goals:

India is still the world's biggest producer of milk. The government has launched a number of initiatives to boost animal productivity, which has considerably increased milk production. The amount of milk produced in 2020–21 and 2020–22 is 209.96 million tonnes and 221.06 million tonnes, respectively, indicating a 5.29% yearly rise. In 2021–22 and 2022-23, the daily per capita availability of milk is approximately 444 and 459 grammes respectively. For millions of rural households, dairying has grown to be a significant secondary source of income. It also plays a major role in creating job prospects and revenue-generating options, especially for women and marginal farmers. In 2022–2023, the per capita availability of milk reached a level of 459 grammes per day, which is higher than the estimated global average of 444 grammes per day in 2022 (Food Outlook Nov. 22). The majority of the nation's milk is produced by landless labourers and small, marginal farms.

1. **The importance of dairying economically:** Millions of rural households' socioeconomic development and the Indian economy both heavily rely on the

livestock subsector. In rural areas, livestock is a major source of draught power and supplies milk, meat, eggs, wool, hides and skins, fuel, and dung.

2. **Ratio between supply and output of milk:** In India, producers consume roughly 46% of the milk produced or sell it to non-producers in rural areas; the remaining 54% of the milk is sold to both organized and unorganized parties. The organized sector, which offers a fair and open system of milk collection at the village level throughout the year, is made up of the government, producers' owned institutions (milk cooperatives and producer companies), and private entities.
3. **India's Milk Demand:** India's milk consumption is driven by rising per capita income, urbanization, and population increase. In 2021, the dairy market had a total value of approximately Rs. 13.17 lakh crore. The dairy market has been expanding at a rate of roughly 15% annually over the past 15 years, and the International Market Analysis and Consulting Services Private Ltd. (IMARC) 2021 research projects that the market would be worth roughly Rs. 30.84 lakh crore by 2027. The country's whole dairy market is made up of around half the liquid milk market. Over the past three years, the organized sector's share of the whole liquid milk market has expanded from 32% to 41%.
4. **Present state of cooperative milk unions**: About 172.63 lakh farmers are served by 228 dairy cooperative milk unions, which are a part of 1.96 lakh village-level dairy cooperative societies. The Cooperative Milk Unions procured an average of 461.96 lakh kg of milk per day from January 2022 to November 2022, down from 464.86 lakh kg per day over the same period the previous year, or roughly 0.62% less. The Cooperative Dairies sold around 411.53 lakh liters of liquid milk per day from November 2022 to the end of the 2021–22 fiscal year, up from 373.09 lakh liters per day during the same period in the previous year, representing a 5.49% growth.
5. **Private Dairy Sector:** The preference of the Private Players to purchase milk from vendors has an impact on the farmers' ability to receive a fair price. Nonetheless, a lot of farmers now have access to markets because to the expansion of the private sector. According to FSSAI License’s, there are a total of 1944 Private Dairies (Milk Processing Units) with a capacity of 901.6 LLPD as of May 2019.
6. **Women empowerment in Dairy Sector:** The dairy cooperative movement, which was first carried out under the Operation Flood Program me and then later under the government's Integrated Dairy Development Program me, has been led by women. The dairy industry employs women in the nation at a rate of almost 50% both directly and indirectly, the greatest percentage of any economic sector.

9. Government Initiatives to Boost Dairy Industry:

1. **Rastriya Gokul Mission:** The Rastriya Gokul Mission has been given a five-year extension for execution in order to enhance milk yield and productivity, which will increase farmers’ income from dairying. Farmers now have access to a number of cutting-edge technologies at their doorstep thanks to the mission, including genomic selection, IVF, and sex-sorted semen. If the proposed project is carried out, milk

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

output is expected to increase from 198.4 million metric tonnes in 2019–20 to 300 million metric tonnes in 2024–2025. For every animal, an additional 1,200 kg of milk produced year will directly benefit eight crore dairy farmers.

2. **National Program me for Dairy Development (NPDD):** Since its implementation in February 2014, the National Park and Dairy Development Board (NPDD) has worked to develop or fortify the infrastructure necessary for the production of premium milk, as well as for the acquisition, processing, and distribution of milk and milk products through the State Cooperative Dairy Federation or State Implementing Agency. The program me underwent realignment and revision in July of 2021. The revised NPDD project would be implemented between 2021–2022 and 2025–2026, with a budget of Rs. 1,790 crores. The plan aims to increase the organized market share for procurement, processing, value addition, and marketing while also improving the quality of milk and products generated from it.
3. **Dairy Entrepreneurship Development Scheme (DEDS):** The Department of Animal Husbandry, Dairying, and Fisheries is implementing DEDS to open up prospects for self-employment in the dairy sector. Offering back-ended capital subsidies for bankable projects, it addresses tasks including enhancing milk production, procurement, preservation, transportation, processing, and marketing. The initiative is being run by the National Bank for Agricultural and Rural Development.

10. Challenges in dairy sector:

a) **lumpy skin disease (LSD):** Dairy farmers have suffered financial losses as a result of the 1.9 lakh calves that have died from lumpy skin disease (LSD).
b) **Feed inflation:** ICAR scientists estimate that 70% of the price of milk is related to feed and fodder. A major contributing element to the skyrocketing price of milk is the 30% increase in fodder.
c) **Lack of milk:** Due to changing dietary habits, urbanization, rising affluence, and population growth, demand for dairy products is expanding quickly. Investment: In this capital-intensive industry, supply chains require investment.
d) **Cooperatives:** They transformed the dairy industry, but only in Gujarat and Karnataka have they been successful for a number of reasons.

11. Future Focus of dairy development in India:

Dairy farming in India has a bright future since it embraces sustainability, technology, and market diversification. By incorporating cutting-edge technologies, implementing eco-friendly procedures, and investigating value-

a) **Technological Developments:** Every industry is undergoing a technological revolution, and the dairy industry is no exception. We are seeing the adoption of several cutting-edge technologies in India that are revolutionizing customary dairy practices.
b) **Automated Milking Systems:** Milking is made easier, requires less labour, and produces higher-quality milk thanks to automated milking devices. Robotics is used

in these systems to monitor, milk, and clean cows, guaranteeing uniformity and efficiency.

c) **IoT and Data Analytics:** Dairy farmers can now check milk production, keep an eye on cow health, and improve breeding and feeding procedures thanks to the Internet of Things and data analytics. For increased productivity and animal welfare, farmers may make more informed decisions with the use of sensors, wearable technology, and data-driven insights.

d) **Precision Nutrition and Feeding:** To develop individualized feeding schedules, precision nutrition systems examine data on the productivity, health, and dietary needs of cows. Farmers can maximize environmental effect, cut expenses, and increase milk output by optimizing feed mix and rationing.

12. Conclusion:

The dairy and animal husbandry sectors were the primary sources of income for many rural people in India after Operation Flood. India has been the world's top producer of milk for the past 25 years or so. In the past 20 years, its milk production has doubled. The growth of India's rural economy has been substantially facilitated by the dairy industry. A variety of government efforts aimed at increasing animal productivity have resulted in a notable increase in milk production. In 2020–21 and 2020–22, 209.96 million and 221.06 million tonnes of milk, respectively, were produced; this represents an annual increase of 5.29%. The daily per capita availability of milk in 2021–2022 and 2022–2023 is roughly 444 and 459 grammes, respectively.

This department has created a National Action Plan on Dairy Development to accomplish the government's goal. The plan calls for an increase in the number of villages to 2.57 lakh by 2022 from 1.86 lakh and 3.2 lakh by 2023–2024. It is anticipated that by 2022, there would be 19 million farmer members, and by 2023–2024, there will be 28 million. To attain the intended milk production targets, the average in-milk animal output would need to grow annually at a rate of 4.7%, from the present 4.65 kg per day to 6.14 kg per day by 2022 and 6.7 kg per day by 2023–2024.

References:

1. **Shivagangavva, P.D., G.S. Mahadevaiah and Gaddi, G.M. 2019.** Small Scale Dairy Production Helps in Reduction of Poverty: Anecdotal Evidence. Int. J. Curr. Microbiol. App. Sci. 8(08): 707- 712. doi: https://doi.org/10.20546/ijcmas.2019.808.080.FAO, GDP and IFCN. 2018.
2. **Dairy Development's Impact on Poverty Reduction.** Chicago, Illinois, USA. Licence: CC BY-NC-SA 3.0 IGO.
3. **Saurabh Bandyopadhyay and Laxmi Joshi (2022),** Understanding Implications of Dairy Sector Development to Sustainable Development Goals (SDGs), National Council of Applied Economic Research, Working Paper No.: WP 139.
4. **Annual Report 2022-23,** Department of Animal Husbandry and Dairying Ministry of Fisheries, Animal Husbandry and Dairying Government of India.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Climate Change and Scarcity of Potable Water

Dr Asheera Banu Sangli
MES College Of Arts Commerce and Science
Malleshwara 15th Cross, Bengaluru, Karnataka State
Email: *asheerabs@gmail.com*

Article DOI Link: https://zenodo.org/records/11219295
DOI: 10.5281/zenodo.11219295

Abstract:

Climate change is one of the biggest problems faced throughout the world due to which abnormal seasonal changes, weather pattern, changes in the precipitation, rise in earth's atmospheric temperature leading to extreme weather conditions causing flood or drought and leading to conflicts between states for river water resource occurs. During flood, availability of clean water is not possible as the water bodies gets contaminated with sewage, different types of pollutants and seepage of water with silt, and during drought the river water gets evaporated and supply of drinking or potable water shortage occurs. This potable water shortages leads to rise in the cost of potable water and sometimes unavailability of drinking water for the people. Clean potable water is essential for life and life cannot sustain without water. So potable water availability is important concern. Water supply boards supply water. Many households procure water directly from tap supplied by water boards, supply tanks, bore hole water, well water, filter water plants setup by Government, usage of different types of canned water and bottled water and rainwater harvesting. There are many rivers, lakes, streams, ponds provide water, many of these freshwater bodies are contaminated or encroached leading to shortage of water to human, animals, plants and other living organisms. The aquaculture, fisheries and agriculture which are dependent on freshwater bodies also will be affected. The climate change causes variations in precipitation leading to shortage of potable water so there is a need for conservation of water and avoid climate change.

Key words: Climate change, Potable water, Life sustainability

Introduction:

Water is essential for the life and seventy one percent of the earth's surface is covered with water in form of ice caps, water vapour, rivers, streams lakes oceans, seas, glaciers, permafrost or buried in the ground. Only three percent of freshwater is present on earth and 1.2 percent of it is used as drinking water, Due to man's activity the pollution of air, water and soil is increasing leading to climate change. The climate change has affected potable water availability to human and other living beings on earth.

Water problems in urban cities

Potable water problem is one of the major concerns throughout world, People migrate from one place to another for their livelihood, education and to set up industries. There are many business outlets, hotels and eateries, industries, institutions in the cities

and people migrate here to earn for their livelihood and this leads to increase in water consumption in day today life and the water bodies present in the urban area are been polluted due to human activities, urbanization, chemicals and effluents released by the industries into the water bodies. The per day consumption of water in the household has increased due to increase in the population. There are house service connections and water is stored in ground level reservoirs, overhead tanks and released through pipe connections, there are booster pumping stations which provide water and when there is shortage of water it is also supplied by water tank lorries in urban cities. Bengaluru is one of fastest growing city and has witnessed water shortages there was heavy monsoon rainfall in the year 2021 and 2022 causing flood and in 2023 and 2024 there is a scarcity of water due to very less rainfall (21) Bengaluru city population has doubled to 13 million since 2001 and Bengaluru size has tripled over a decade and in March 2021 there was a shortfall in water supply. In 2021 as estimated by BWSSB 650 million liters of water is consumed per day (**11)**. The demand for urban water has increased as globalization accelerates economic development and water supply challenges have to be meet (12). The usage of water filters to procure clean water for drinking purpose also causes wastage of water and leaking storages or containers causes water wastages. Over usage of groundwater decreases water table.

Impact of climate change in Karnataka

Impact of climate change led to extreme rainfall and flood risk in India and Karnataka state also witnessed flood in different parts of the state, Bhima and Krishna River water caused flood and water was discharged from dams leading to destruction in Kalburgi, Vijayapura Bagalkot, Raichur districts, usually these districts receive less rainfall but in the year 2020 they had heavy precipitation which led to release of dam water causing flood (**20**). Karnataka State Natural Disaster Monitoring Centre gave a report that 156 talukas as drought hit after failed monsoon between October to December 2018, and 107 talukas had severe drought and had negative growth in agriculture sector and north interior Karnataka received 531.5 mm of rainfall which was below the normal of 740.3 mm and from 2016 it is receiving less rainfall. In south interior Karnataka and coastal Karnataka rainfall was more than normal, In Bengaluru there was scarcity of water during 2019 and also in 2023,2024 due to low rainfall. In 2023and 2024 ninety percent of Karnataka state is drought hit nearly 216 talukas have not received rainfall (**22)** Delay in monsoon led to drinking water crisis in 110 villages in outskirts of Bengaluru , Civic body decided to drill additional borewells in the villages to solve drinking water problems , Many are paying hefty prices for tankers , 12,000 liter tanker costs 1800 Rupees, Many borewells in villages have gone dry and under repair (**9**)., Bengaluru urban district recorded 92 percent rain deficiency in August 2023, digging borewells causes over exploitation of ground water (**10**). Due to climate the atmosphere temperature has increased and less precipitation and shortage of water, drying of lake water and leading to drought in Karnataka in the year 2024.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Water and diseases

Contaminated drinking water leads to water borne diseases such as diarrhea, cholera, typhoid, hepatitis A and other gastrointestinal diseases and is responsible for 1.5 million deaths annually. Water is an important factor for sustainability of life and one billion people lack access to clean water and 2.4 billion live without sanitation. Influx of sewage into surface water results in nutrient enrichment and consequently leads to algal bloom **(7).** Many lakes in India receive sewage and are eutrophied and create anaerobic aerobic lagoons (8) Pesticides, effluents, domestic sewage and chemicals enter water bodies and pollute the water bodies **(27)** The usage of polluted water cause diseases for animals, humans and plants. Few cases of Cholera outbreak in 2024 due to drinking of contaminated water was noticed.

Water problems for agriculture, fisheries and aquaculture

The agriculture, fisheries, freshwater aquaculture use canal water supplied by Niravari Nigams, lake water, pond water, streams and river water. Due to drought or flood these professions will be hit and affect the livelihood of the people Water pollution caused due to anthropogenic activities cause fish and aquatic animals kills. And due to heavy rainfall, it was observed that lake water level increased and fishes were found floating on the roads and even affected fish cultivation in different places of Karnataka and heavy loss to the pisciculture and aquaculture. Climate change causes heat stress and affects reproductive organs of aquatic animals and loss of nutrients in edible fish **(26)** Loss of Agriculture crops due to drought and flood occurs in India, the farmers depend on precipitation to grow crops and variation in rainfall decline the crop yield, and during flood, logging of water and damage to standing crops occurs leading to loss of crop yield and during drought water scarcity affects crop yield.

Water and Sustainable Development Goals:

United Nation working group proposed Goal 6.1 according to that by 2030 it is to achieve universal and equitable access to safe and affordable drinking water for all. SDG Goal 6 mentions to ensure availability and sustainable management of water and sanitation for all and it says to improve water quality, reduce pollution, water usage efficiency, implement integrated water resources management at all levels, Protect and restore water related ecosystem, desalination, wastewater treatment, recycling and reuse technology **(23)**

Climate change and water shortages

Climate change increases average global temperature from 1.4^{o}C to 5.8^{O}C by 2100 and decreases precipitation level to varying degrees around the globe, The availability and quality of water will be severely affected and threat to public health due to lack of water (**13**), Climate change leads to rapid migration of people from rural area to cities and they lack necessary resources and many are from low-income group and live in poverty and procuring water can be one of problem. Climate change causes

heatwave and floods leading to migration (**18**) India's rich water resources are unevenly distributed and due climate change has caused water shortage and water resources available per person in India is decreased steadily from 3450cms in 1951 to 1250 cms in1999 and is expected to decline further to 760 cm per person in 2050 **(17**) Bangalore city is becoming warmer in mean maximum and mean minimum temperature in all seasons and months (**19)**) Developing nations like eastern, northern, and west Asia, Central to north eastern Asia do not have financial means to invest in water supply infrastructure and with increase its burden on freshwater sources face water shortages (**16**) Inadequate water supply from public utilities, unequal distribution, leakages , low tariff thriving water markets worsen the scenario (**15**) Chemical changes in water is due to human induced pollution, and there is a decline in the Kolahoi glacier Jammu Kashmir and variation in precipitation in Cherrapunji Meghalaya **(3)(4)(5**) Global warming caused due to rise in local temperature of 1.5 degree centrigrade has affected in Hindukush mountain region of Himalayas **(6)**Cities are facing water crisis and imbalance between supply and demand (**1**) Evaluation of urban governance perspective underlying institutional performance of BWSSB depends on effective legal and policy framework and depends on management capacity , accountability pattern, sustainability and consumer orientation (**2**) In rural areas women and children have to procure drinking water for households and while doing so many children cannot go to school and women cannot go out to work these leads to school dropouts and economically backward (24**) A**cross the globe 3.1 billion people face water scarcity due to climate change **(14).** So the government has to provide clean drinking water for all and in some places water is provided by government under Jal Jeevan Mission by Ministry of drinking water and sanitation. (**24**) Swacch Bharat Mission Gramin and in Karnataka Mane Manege Gange is providing water for the people. The Karnataka government has allocated 800 crores rupees for drinking water facilities. Safe drinking water, sanitation and hygiene are fundamental requirement to improve standards of living for people, The human rights commission has mentioned safe drinking water and sanitation to all and was adopted in 2010 and United Nation resolution calls for safe affordable acceptable available and accessible drinking water and sanitation services for all **(25)**

Conclusion:

Potable water is very important for sustainability of life so there is need to conserve water for our future, polluting the water bodies and encroachments have to be stopped, rejuvenation of water bodies and ground water must be first priority, cultivating the habit of efficient usage of water is a must. Desalination technique and waste water treatment can be done. Planting trees and increasing green belts, reducing air pollution to reduce climate change. And government has to provide clean drinking water for all its citizens along with sustainable developments.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

References:

1. Krishna Raj., Sustainable Urban Habitats and Urban Water Supply: Accounting for Unaccounted Account for Water in Bangalore City. India, Current Urban Studies 1(04):.2013 p 156-165
2. Smitha Kanekanti Chandrashekar Urban governance and Bangalore water supply and sewerage board (BWSSB) Research Gate 2006. www.reasearchgate.com.
3. T Gaayam, Sai Smrita Vinnakota, Venugopal Madhav Anam Das, Water Supply and Sanitation: An Overview Proceeding of 4th ASCE-EWRI International Perspectives on Water Resource and Environment. 2011.
4. Sai Smrita Vinnakota, Mahati Kavuri, Venugopal Madhav Anam Das, Effects of Climate Change on Environmental and Water Resources A Review in the Proceedings of 4th ASCE -WRI International Perspectives on Water Resource and Environment 2011.
5. Tanmoyee Bhattacharya, Shiv P. Aggarwal, Praveen K Thakur, Vaibhav Garg. Water Resources Status and Availability Assessment in Future Climate Change Scenarios for Beas River Basin. 2016
6. Sagar Ratna Bajracharya, Mandira Shrestha, Arun B Srestha, Impact of Climate Change on Water Resources and Livelihood in HKH Region. 2016 https://www.researchgate.net.
7. Durga Madhab Mahapatra, Chanakya Hoysall, T.V. Ramachandra Bioenergy Generation from Components of a Continuous Algal Bioreactor: Analysis of Lipids Spectroscopic and Thermal properties IEEE Conference Proceedings 2013
8. Chanakya Hoysall, T.V. Rama Chandra, Sustainability and Treatment Potentials of Urban Sewage Fed Lake in Bangalore. India In the Proceedings of 17th National Symposium on Advances in Environmental Monitoring May 13-15,2010
9. Demand and Supply Gap in Water Supply in Bangalore City, Severe Drinking Water Crisis in 110 Villages on Outskirts of Bengaluru the Hindu Bureau., August 04 2023.ww.thehindu.com
10. K.V. Aditya Bharadwaj, Deficient Rain in August Worsens Water Crisis in Outer Zones of Bengaluru, The Hindu. www.thehindu August 31 2023
11. Yamini.C.S., Bengaluru Water Crisis What is Causing It? Hindustan times https://www.hindustantimes.com April 13 2022
12. Krishna Raj, Where All the Water has Gone an Analysis of Unreliable Water Supply in Bangalore City, Institute of Social and Economic Change Bangalore., working paper 307, 2013, http://www.isec.ac.in.
13. Erica Denicolams, Omar S Aburizaiza , Azhar Siddique, Haider Khwaja , David O Carpenter, Climate change and Water Scarcity: The Case of Saud Arabia Science Direct 81(3), 2015 p 342-353..

14. Simon Goslings, Nigel Warnell, A global assessment of impact of climate change on water scarcity climate change., Journal Climate Change 134(3), 2018, p371-385 springer .com.
15. Jayashree Vaidyanathan, Urbanization and Water Management in Bengaluru City Karnataka- Issues, Challenges and Possible Solutions, Proceedings of International Conference on Integrated Water Resources Management CWRDM, 2014
16. Renu Emile, John R Clammer, Palak Jayswal and Paribhasha Sharma, Addressing Water Scarcity in Developing Country Contexts – A Socio Cultural Approach. Humanities and Social Sciences Communications,144, 2022, p1-10
17. Muniyandi Bala Subramanian V Dhulasi Birundha, Climate Change and its Impact on India the IUP Journal of Environmental Science Vol 6 (1) ,2012 p31 -40,
18. Vittal Hari, Suman Dharamshala, Aksh Koppa, Subhankar Karmakar, Rohini Kumar, Climate Hazards are Threatening Vulnerable Migrants in Indian Megacities, Nature Climate Change vol 11,2021, p636-638,
19. M Mohapatra Recent trends in climate of Bangalore, Mausam 53. (4):2002, p 425-438
20. P.Gunatha Kurta, O. P. Sreejith, P. A. Menon. Impact of Climate Changes an Extreme Rainfall Events and Flood Risks in India www.ias.ac.in
21. Sneha Ramesh, Bengaluru is Staring at Possible Water Crisis: Report Deccan Herald https://www.deccanherald.com October 18th 2023
22. Drought Hit Karnataka to Release Water for Irrigation One Last Time Before the Next Monsoon, The Indian express Pvt Ltd. The Indian Express .com 7/1/2024
23. Water and Sustainable Development Goals, https://www.un.org
24. **https://www.unicef.org**
25. Guy Hutton and Claire Chase. Water Supply Sanitation and Hygiene – Injury Prevention and Environmental Health, 2017 www.ncbi.nim.nih.gov
26. Asheera Banu Sangli and Shabana Sangli, Impact of Climate Change, Ecology research volume 2 ISBN 9789388901208, Bhumi Publishing, India 2021.p 122-125.
27. Asheera Banu Sangli, Influence of pH on the Lethal Toxicity of Phenol, Para chlorophenol and Pentachlorophenol to Freshwater Fish Gambusia affinis International Journal of Multidisciplinary Research and Analysis 4(3) 2021.p 259-261.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

A review: Scientific Approaches of Categorization, Labeling, & Authenticity of Honey

Rekha Shinde, Indira Patil, Rashmi Morey
Prof Ramkrishna More Arts Commerce and Science College Akurdi, Pune, India
Email: *rjshinde2017@gmail.com*

Article DOI Link: https://zenodo.org/records/11219343
DOI: 10.5281/zenodo.11219343

Abstract:

Honey has nutritional and medicinal value. Any food supplement legitimacy is a major problem in terms of food safety standards. Over recent times, there has been a rise in attention to honey validity in terms of its floral origin or regional basis, as well as interference by mixing any artificial sweetener. Honey seems to be a fully prepared source of nutrition that is abundant in nutrients and provides several beneficial health effects. To prevent typical honey scams such as untruth labeling of honey and impurity with direct or indirect adulteration with any kind of sugar or syrup, it is essential to find honey authenticity in both honeybee farming and industrial sectors. In recent year there are many techniques included to find out honey quality and purity using different approaches. Traditional analysis methods were always employed in conjunction using modern methods as procedure of the initial study. The majority of information coming from studying physical and chemical characters, pollen study, specific marker compounds such phenolic, flavonoids, peptide and genomics etc., and mineral or elemental profiling. From traditional to modern molecular approaches, this paper provides a summary and description of experimental and quantitative various methods in honey authenticity. It may be used as a reference for determining the best approach for honey testing, categorization, and authenticity.

Keywords: Honey, Nutritional value, Authenticity, Analysis, Adulterants etc.

Introduction:

From ancient times it has been found that honey is a natural sweetener and viscous substance produced by honey bees, from a variety of flowers and the sugary secretions of plants. Quality of honey mainly depends on its constituents; it includes sugars, phenolic compounds, flavonoids, amino acids, mineral substances, and vitamins **(Seraglio, S. K. T., et al., 2019)**. Honey composition and properties can be heavily prejudiced by botanical and geographical origin, climatic conditions, seasonal variation, harvesting time, and processing and storage condition of honey **(Lorena Salvador et al., 2019)**. Taking into account the nutritive and therapeutic prominence of honey and its high commercial cost, the occurrence in the market of adulterated product cannot be ruled out. Due to its high price and inadequate availability, honey is often exposed to adulteration. The key concerns related to honey authenticity have been concentrated on the geographical and botanical origins and adulteration practices can be made either directly by mixing with different cheap sugar syrups of (sugar cane or beet, corn, rice,

date, agave, inulin, inverted sugar, glucose and fructose), or indirectly, by nourishing the bees with various sugars and harvesting prior to maturity **(Se, K.W., et al 2019; Wang, S.et al., 2015)**.

Classification of Honey

Honey can be classified as unfloral, multifloral, honeydew, and blossom honey depending on its origin, the method it has been harvested and processed like, unfloral honey is arising mainly from a same plant species and contain more than 45% of a total pollen content and identified such as citrus honey, manuka honey, acacia honey named on from which its being originated. Multifloral honey is known as polyfloral honey. It has several botanical sources none of any particular plant sources, for example, meadow blossom honey and forest honey, Blossom honey is obtained mainly from the nectar of flowers while honeydew produced by bees after they collect "honeydew" from plant sap. Honey is an important, distinct and widely used food product for nutrient, cosmetics and medicinal purposes **(Ballabio et al., 2019; Mada¸s et al., 2019)**.

Honey constituents are closely accompanying with the floral origin and geographic location of production as it having particular type of soil texture and climate which gives rise to the flora for honey bees. **(Silva P.L.M et al., 2017)**. Unifloral honey possess sensory volatile compounds, even-though its small concentration justifies the odor or taste to honey. These VOCs are composite mixture of diverse chemical classes, counting norisoprenoids, monoterpenes, sesquiterpens, alcohols benenzoids, esters, aldehydes and ketones. **(Silva P. M. et al., 2016)** Some volatile compounds profiling may be used as grouping of honey by means of floral source characterization and studied as the precise biomarkers for the botanic origin of the honey **(Karabagias et al/. 2014; Seisonen et al., 2015; Silva et al 2017).**

Honey Labeling

According to Article (2) of Directive 2001/110/EC, the authenticity of honey has been tested by compositional characteristics along with its origin of floral source. Labels must have information the country or countries of origin from honey is harvested. FD & C Act, 403 (I), 21 CFR 101.3 (b). Ingredient content must be specified like as a "blend of EC honey" or a blend of non-EC honeys or "blend EC or non -EC honeys", if honey has more content than corn syrup it should be mentioned like "Blend of corn syrup and honey". According to (Regulation (EEC) No. 2081/92) by recognized expertise honey classification depending on its geographical origin from specific region inside EU bearing, the labels of PDO (Protected Designation of Origin) and PGI (Protected Geographical Identification), processed and prepared in known geographic areas. As like with other products, PDO and PGI honeys can specify region or local environment with natural or human factors. According to Food and Drug Administration 2018, Monofloral honey or on the basis of main floral source and without adding products example, "Clover honey", "Orange blossom honey", "honeydew honey", and "Wild honey" etc. If your honey is added with any flavouring agent for example raspberry flavour then

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

labeling must describe as “raspberry -flaouvred honey”.

Honey authenticity

Honey authentication is principal tool and questionable part as like quality assessment of another foodstuff. In fact, its current situation it has worldwide implications. As a point of consumer protection and quality control, the authenticity is most essential from last some decades. First account on honey adulteration date back to 1970s and since that time the number of cases increased significantly, thus affecting the different honest producers and consumers (**Li, S. et al., 2017; Mahmoudi R. et al., 2016; Tosun, M. 2013)**. According to the Ecuadorian Technical Standard and the Cordex Alimentarius ingredients honey authenticity can be questioned if any foreign matter or flavouring material added in it. Some additional parameters could be used to ensure the honey quality like pH, TSS, moisture, free acidity, EC, Moisture, 5-HMF and major sugars. Type of honeys were described as Monofloral honey from single floral source and multifloral honey from number of floral sources during foraging. Unifloral honeys depends on foraging plant with their typical taste and aroma, and important, although their trade price is noticeably greater than that of mixed honeys. Unifloral honey has more demanded due to its specific essence and odor, and certain pharmacological features, thus amassed its marketable value **(Antonella Verzera et al., 2013).** Due to its superior and inimitable flavor and savor, unifloral, PGI and PDO, honeys are commonly supposed as excellent foodstuffs and, frequently adulterated by mixing with low quality honey and supposed to mislabeling. Additionally, high demanding of increasing population concerns with fitness and welfare and the subsequent rising request for “natural” foodstuff with beneficial and medicinal goods has added to rise their commercial value, so targeted for adulteration. So, honey has been allied with adulteration practices for a lengthy period. Through the past some decades, pointing at advising tools to evaluate the superiority as well as authenticity of honey, protective buyers, and indorsing fair-minded competition among manufacturers. According to standards and legislation **(FAO 2001; Directive 2001/110/EC)** honey quality can be determined by checking some physicochemical characters and microbiological studies.

Analysis methods

Several scientific literatures have been shows adulterated honey samples can be detected using number of modern techniques. Detection of adulterated honeys and the discrimination of monofloral and multifloral honeys were carried out by using high performance liquid chromatography **(Haroon Elrasheid Tahir et al., 2015; Shima Ghanavati Nasab et al., 2020)**, ultra-performance liquid chromatography **(Z. Jandric et al., 2014)**, isotope ratio mass spectrometry **(Elisabeta-Irina Geana et al.,2019; Vensa Vasic et al., 2020)**. Vibrational spectroscopy techniques like mid-infrared spectroscopy **(Chirantan Das et al., 2017; Yang Li et al., 2020)**, NIR **(Latorre CH et al., 2013; Furong Huang et al., 2020)**, FTIR **(Anjos, O et al., 2018)** and NMR for

detecting source of floral origin and classification models **(Ribeiro ROR et al., 2014)**. Another, HS-SPME combined with GC-MS **(Pedro Silva et al 2017)**. ^{1}H NMR Profiling **(Marc Spiterri et al., 2015)**.

Consequently the identification of honeys depending on its source of floral origin were studied by means of certain chemical components or volatile constituents such as phenolic, flavonoids **(Haroon Elrasheid Tahir et al., 2015)**, VOCs **(Pedro Silva et al., 2016)**, terpenes **(M. Moniruzzaman et al., 2014)**, sugars **(Kuan Wei Se et al., 2018)**, amino acids and proteins **(Hao Dong et al., 2016)**, honey volatiles **(Ioannis K. Karabagias et al., 2020 ; Ana Caroliny Vieira da Costa et al., 2017)**, phenolic compounds **(M. Moniruzzaman et al., 2014; Schievano et al., 2013; Ana Caroliny Vieira da Costa et al., 2017)** and trace elements **(Yue-Hong Pang et al., 2021)**.

Chemometric tools

Chemometrics has been given for spectral and chemical analysis of obtained data from nontargeted methodologies or for identification of food adulterants. Basically, Hierarchical Clustering Analysis (HCA), Principal Component Analysis (PCA), and SCIRA used for honey authentication in terms of adulteration point and botanical origin (**M Jose aliano-Gonzalez et al 2019; Elisabeta-Irina Geana et al., 2019)**. For discrimination and classification purposes, Partial Least Squares Discriminant analysis (PLS-DA) **(Shima Ghanavati Nasab et al ., 2020)**, linear discriminant analysis (LDA), k- nearest neighbor (k-NN) **(Ioannis K. Karabagias et al., 2020)**, Orthogonal Partial Least Squares Discriminant Analysis (OPLS-DA), Multiple Linear Regression (MLR), Principal Component Regression (PCR), or Partial Least Squares Regression (PLS-R), Soft independent modeling of class analogy (SIMCA), or Back Propagation Neural Networks (BPNN) **(Schievano et al., 2012**), and ANOVA were applied.**(Haroon Elrasheid Tahir et al., 2015**)

The following work shows the informative literature which mainly emphasizes the different techniques related to honey.

- **Honey authenticity using IR spectroscopy**

IR spectroscopy provides precise absorption spectra generated by chemical groups of organic compounds from sample or adulterants. It is easy to use, less in cost quick and nondestructive nature therefore widely used as model technique for qualitative and quantitative of samples. Furthermore, chemometrics provide reliable results by the analysis of complicated data.

- **IR spectroscopy for detection of adulteration**

Kuan Wei Se et al., (2018) were described quantification of different adulterents like, fructose, glucose, sucrose, cane sugar, corn syrup etc from stingless bee (*Heterotrigona itama*) by the method of FTIR-ATR spectroscopy approach combined with chemometric analysis. **Y. Riswahyuli et al., (2020)** discrimination analysis of wild honeys from Indonesia based on spectral range was studied at the wave numbers of 2933, 1110, and 327cm−1, compared with coconut sugar, cane sugar and aren (*Arenga pinnata*) **Yang Li et al., (2020)** were analyzed high fructose syrup (HFS) added in bas honey by

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

using Mid-Infrared and Raman spectroscopy and improved its accuracy with application of various data fusion strategies. **Chirantan Das et al., (2017)** were studied the sucrose as adulterants in the honey samples of different origin analysed by electrical impedance spectroscopy coupled with FT-MIR. **Daphne Chiara Antonio et al., (2022)** were applied combinations of spectrofluorometric method with multiple chemometric tools for detection of adulterants (polyfloral honey, sugar cane molasses and corn syrup) from Brazil. **Lanzhen Chen et al., (2011)** were detected blossom honey with high fructose corn syrup (HFCS) by NIR, where characteristic spectrum were around 4182 $^{cm-1}$ (CH2 stretching and band of deformation), 4686 cm^{-1} (band of deformation and C–H stretching), 4782 cm^{-1} (stretching bond of C–O and O-H deformation band), 5201 cm^{-1} (O–H stretching and bending) and 6851 cm^{-1} indicates (O–H stretching), 5607 cm^{-1} (CH_2 group) and using DPLS at diverse spectral ranges, it was shows better resolution between adulterated honey from unadulterated honey spectra ranges from 6000–10000 cm^{-1} with a precise sorting rate of 92.13%. **M. S Jose aliano-Gonzalez et al., (2019)** analyzed honey adulterated with various types of inexpensive additives like inverted sugar. Rice syrup, fructose syrup and brown cane syrup by Vis-NIRS combined with different tools like HCA, LDA, and PLS. **Xinhao Yang et al., (2020)** were detected different types of syrups as adulterates and different range of degree of adulteration from manuka honey by NIR spectroscopy coupled with aquaphotomics . Here aquaphotomics demonstrate the result based on wavelength region, number of hydrogen bonds and nature of water molecules, whether structured or unstructured. **Furong Huang et al., (2020)** established the Support Vector Machine (SVM) model for detection of NIR and ATR-FTIR for detection of adulterants from Chinese honey. This applied model applied shows better accuracy, specificity and good sensitivity for identify the natural from adulterated.

- **Physicochemical characterization of honey by IR Spectroscopy**

Lorena Salvador et al., (2019) physicochemical characters like sucrose. water, reducing sugars and EC were measured, 34 pesticides/ metabolic pesticides were determined in honey samples by Raman and IR spectroscopy. **Anjos O. et al., (2018)** were studied Lavandula spp. as monofloral honey by FT-Raman spectroscopy for to study chemical composition of honey as well as studied the physicochemical characters like pH, EC, ash content, total acidity,reducing sugar, reducing sugar, proline, sucrose, total phenol content, total flavonoids and diastase index. **Beril Ozbalci et al., (2013) et al.,** analyzed the glucose, maltose, fructose, sucrose and honey by Raman spectrometer combined with multivariate analysis. **Maria Chudzinska and Danuta Baralkiewicz (2011)** by ICP-MS determined 15 mineral elements from 140 honey samples from Poland and classified of rape, buckwheat and honeydew honey by means of its geographical point. **Marc Spiterri et al., (2015),** NMR were applied to identify contamination by means of two types: (1) Marker sugars added by manufacturer can be identified by NMR or (2) detecting dilution effect of C3 sugars. The difference near about 5% otherwise β-glucose and α-glucose are in equilibrium in solution; To avoid incorrect quantification both forms integration of signals was studied. In another study

they were collected near about 800 honey samples (monofloral and polyfloral) world widely and studied the common adulterations and quality differences by means of ^{1}H-NMR profiling and reported 2 identified signals which were varied from geographical and botanical origin and hypothesized, it may raise because of adulteration of sugar. This method can be used to determine for addition of sugar of 10% or C4 and C3 sugars shows dilution effect 20 % and more than that. **Rebecca Brendel et al., (2021)** comparatively studied MIR spectroscopy (highly reproducible near about 91.3%) versus MALD-ToF-MS (highly sensitive 78.3%) for distinguishing metabolic profile between monofloral and polyfloral honey samples by applying different classification model. For MIR spectra were recorded in 960-3050 cm^{-1} at wavelength with 4 cm^{-1} resolution. **Z. Jandric et al., (2014)** emphasized honey from different floral origin (kamahi, rata, manuka and clover) by the metabolomics (UPLC-QTOF MS), elemental profiling, stable isotope analysis, and NIR, FT-IR and Raman spectroscopic fingerprinting.

- **Gas Chromatography /Liquid Chromatography with Mass Spectrometry for Honey Volatiles Analysis**

With the help of HS-SPME followed by GC/MC investigation, many volatile constituents in honey have been noticed, recognized and measured. **Haroon Elrasheid Tahir et al., (2015)** were observed 69 volatile compounds from different botanically originated honey samples as well as analyzed phenolic, carotenoid, flavonoid, antioxidant contents, FRAP/DPPH assays and spectrophotometer for colour characterization. **Pedro Silva et al., (2016)** determined Sugarcane honey (SCH) by HS-SPME along with GC-MS and the results they found near about 77 volatile organic compounds (VOCs) of different chemical classes**. Antonella Verzera et al., (2013)** assessed the floral source of honey by means use of the chiral volatiles from orange honey with the help of SPME-GC-MS. This method is rapid and can easily determine the floral origin and based on the enantiomer ratio of linalool and its oxides along with - analogous value of flower and honey. **Ioannis K. Karabagias et al., (2020)** were analyzed total 54 VOCs for authenticity of monofloral honey (Citrus, pine, Fir, and Thyme) by HS-SPME coupled with GC-MS. Result founds that dominant class of volatiles were aldehydes and esters with another classes of volatiles like acids alcohols, hydrocarbons terpenoids, ketones etc. Precisely, nine VOCs were used for the floral classification (diether, α-4- dimethyl-3 cyclohexene-1-acetaldehyde, octanoic acid ethyl ester, acetic acid ethyl ester, 2,2,4,6,6-pentamethyl-heptane, methylanthranilate, cis-linalool oxide phenylacetaldehyde, and lilac aldehyde (III isomer). **Xinran Wang et al., (2019)** were studied VOCs by HS-GC-IMS for winter and *sapium* honey with chemometric method. **F.Bianchi et al., (2011) and M. Moniruzzaman et al., (2014)** were described the volatile and semi volatile volatile fraction from sampled honey with the help of HS-SPMDE and GC QTOF MS /GC-MS which were from chemical classes like non-aromatic carboxylic acid ester, benzene derivatives , nitrogenated compounds and terpenes etc. with different elements in their molecules. **Haroon Elrasheid Tahir et al., (2016)** were identified 58 aroma compounds, includes 5 hydrocarbons, 4 terpenes, 2 norisoprenoids, 6 phenols, 7 ketones, 9 acids, 12 aldehydes 7 ketones, 9 acids, and 12

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

alcohols and 22 active compounds by SPME-GC/MS. **Ana Caroliny Vieira da Costa et al., (2017)** extracted volatile compounds by HS-SPME using polydimethylsiloxane/divinylbenzene fibers. 96 different volatile compounds of from melipona honey samples of stingless bees were identified like terpenes, norisoprenoids, alcohol, acids, esters, benzene compounds, hydrocarbons, aldehydes, ketones, furans and sulfur compounds. **L. Castro-Vazquez et al (2014)** were studied monofloral lavender and lavandin Spanish honey samples by GC-MS profiling. Lavandin honey was a monofloral hybrid of *Lavandula angustifolia* and *Lavandula latifolia*. Lavandin unifloral honey samples were recommended as chemical marker like farnesol, nonalactone and acetovanillone, 4-methoxyacetophenone lactones, dehydrovomifoliol and decanal etc. **Patricia A. S. Tette., (2017)** were used synephrine comound as a biomarker from citrus (orange honey range more than 43.8ng/g) honey which doesn't find in non-orange or unifloral honey samples, present in polyfloral wild honey samples (range 9.4-236.5 ng/g) by LC-MS method. **Niculina M. Madas et al., (2019)** were carried out79 volatile compound profiling from acacia honey by SPME ans GC-MS. **Ioannis K. Karabagias et al., (2014)** described 39 pine samples of honey from 4 geographically different areas of Greek with physicochemical parameters such as pH, colour, EC, ash content, free lactonic/ total acidity lactonic/free acidity ratio etc. along with 55 volatile compounds by HS-SPME-GC/MS with application of MANOVA and LDA. **Seisonen s. et al., (2015)** showed volatile profiles of 30 unlike honey samples from 4 plant origins: Raspberry (*Rubus idaeus*), Heather (*Calluna vulgaris*), Alder buckthorn (*Frangula alnus*), Rape (*Brassica napus*) by GC-MS and the odour- active mixtures ere determined with olfactometry. Heather honey was reported by Isophorone and 2-methylbutyric acid. **Hao Dong et al., (2016)** used 12C and 13C by IRMS analyses extracted protein (usually 0.5- 2 mg) and LC for honey. C4 value between -7%- 0% considered as unadulterated, if C4 value more than -7 then it may adulterate. **Yue-Hong Pang et al., (2021)** applied d-SPE MOFs for four kinds of honey samples with recoveries upto 88.1 to 126.2%. for extraction and purification of complex food. Followed HPLc-MS/MS, the edges of detection were 0.073-0.435 ng/g and it reached upto 0.239 to 1.449ng/g for tetracyline, oxytetracycline, doxycycline and chlotetracycline.

- **Physicochemical parameters by HS-SPME with GC/LC- MS**

Sandra Regina Rivellino et al., (2013) were identified several airfacts like HMF, Methyl-furone and furfural from honey volatiles by HS-SPME with two dimentional GC with FID. These compounds were already present in honey and found due to the action of thermal degradation of compounds and result of hydrolysis. **Marisol Juan-Borras et al., (2013)** were determined physicochemical parameters like moisture, EC, diastase activity by Phadebas method, HMF by White method,volatiles and sugar by HPAEC-PAD, GC-MS respectively. **Ioannis K. Karabagias et al., (2014)** were determined physicochemical characters pH, total acidity, free and lactonic acidity, EC, ash content, colour, moisture, lactonic/free acidity ratio and 9 volatile compounds were identified by HS-SPME coupled to GC-MS. **Furong Huang et al., (2020)** determined the value of δ13C of protein and 20 major elements by EA-IRMS and ICP-OES respectively for

honeydew samples which could be the good indicator of botanical origin. Also analyzed 14 sugars and sugar alcohols by HPAEC/PAD. Maria Jose **Aliano-Gonzalez et al., (2020)** described the novel method for discrimination of adulterated and non-adulterated honey the method based on HS-GC-IMS. Five adulterants were used such as brown cane sugar, fructose syrup, and rice syrup, invert sugar at adulteration concentration ranged from 5% to 50%.

- **HPLC for honey Characterization**

Liuwei Zhao et al., (2022) identified the primary pigment hydroxysaffl or yellow A (Safflomin A), in monofloral honey of safflower (MSH) obtained from nectar of *Carthamus tinctorius L.,* Safflomin A concentration approximately Ranged inbetween 0.86 t0 3.91 mg/kg and it can be used as chemical marker for MSH and quantified by UHPLC/Q-TOF Mass spectrometry. **Elisabeta-Irina Geana et al., (2019)** determined physicochemical character like pH, TSS, HMF, EC, Free acidity, major sugars and adulterated samples by HPLC. Further they estimated δ 13C of honey proteins by IRMS. **Shima Ghanavati Nasab et al., (2020)** by using FT-NIR, HPLC-DAD in combination with PLS-DA were developed a method for discrimination of botanical origin of 7 different from Italy honeys where they shows chromatographic data at 280 nm spectra of low intensity or even though absent (phenolic acid, catechins and procyanidnis) , most of the compounds from honeys absorbed at 254 nm wavelength, whereas at 340 nm spectral range shows minimum compounds, (like flavonols, flavones, and hydroxycinnamic acid). **Etil Guzelmeric et al., (2020)** were performed the melissopalynologically which showed characteristic fingerprints of pine, chestnut and sunflower honey. Phenolic characterization was done by HPTLC and quantification with HPLC. Several methods were used for determining antioxidant activity such as DPPH CUPRAC AND FRAP by in-vitro test. **Weijian Jiang et. al. (2020)** firstly reported authenticity of honey based on the major protein from royal jelly (MRJPs) by UPLC-TQMS. IRMS method used for detection of monofloral honey, trypsin digested fragments of major royal jelly proteins then analyzed ny mass spectometry. **Natalia Arroyos-Manzanares et al., (2019)** with HS-GC-IMS differentiated the adulterated and unadulterated honey at different ratio of mixtures of cane sugar or corn syrup with unifloral or multifloral honey.

Conclusion:

To ensure the quality and safety of honey it is important to check the authenticity by its botanical origin or geographically. For better accuracy of investigation, the older techniques may essential to couple with recent methods. For deep analysis, significant data and true research of honey authenticity the analytical methods are necessary. With novel information and evidence of honey authenticity and its origins, there upsurge the requisite to appraise current standards of the Codex Alimentarius and the European Union to integrate fresher data and standardization rules of honey assets with admiration to authenticity. Fresher outlines may contain components like the amino acids, aliphatic organic acids, flavonoids, carbohydrates, volatile components, proteins and phenolic

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

acids in its place of just the sugar composition. Guidelines near judgment of floral and geographical origin can be instigated. This review offers understandings to inspire investigators to supplementary discover new finding knowledges in authentication educations of food resources.

References:

1. Ana Caroliny Vieira da Costaa, Janaína Maria Batista Sousaa , Maria Aparecida Azevedo Pereira da Silvab , Deborah dos Santos Garrutic , Marta Suely Madrugaa. Food Research International, Sensory and volatile profiles of monofloral honeys produced by native stingless bees of the brazilian semiarid region (2018) 105, 110–120.
2. Anjos, O.; Santos, A.J.A.; Paixão, V.; Estevinho, L.M. Talanta , Physicochemical characterization of Lavandula spp. honey with FT-Raman spectroscopy. (2018), 178, 43–48.
3. Antonella Verzera, Gianluca Tripodi, Concetta Condurso, Giovanna Dima, Angela Marra. Food Control, Chiral volatile compounds for the determination of orange honey authenticity (2014) 39, 237-243.
4. Ballabio, D.; Robotti, E.; Grisoni, F.; Quasso, F.; Bobba, M.; Vercelli, S.; Gosetti, F.; Calabrese, G.; Sangiorgi, E.; Orlandi, M.; et al. Food Chem, Chemical profiling and multivariate data fusion methods for the identification of the botanical origin of honey (2018) 266, 79–89.
5. Beril Ozbalci , Ismail Hakkı Boyaci , Ali Topcu , Cem Kadılar , Ugur Tamer. Food Chemistry, Analysis of sugars in honey by processing Raman spectrum using chemometric methods and artificial neural networks (2013) 136, 1444–1452.
6. Bianchi, F.; Mangia, A.; Mattarozzi, M.; Musci, M. Food Chem. Characterization of the volatile profile of thistle honey using headspace solid-phase microextraction and gas chromatography-mass spectrometry (2011) 129, 1030–1036.
7. Chirantan Dasa, Subhadip Chakrabortya , Krishnendu Acharyab , Nirmal Kumar Berac , Dipankar Chattopadhyayc , Anupam Karmakara , Sanatan Chattopadhyaya. Talanta, FT-MIR supported Electrical Impedance Spectroscopy based study of sugar adulterated honeys from different floral origin (2017) 171, 327–334.
8. Codex Alimentarius, Revised Codex Standard for Honey (Rev. 2, 2001).
9. Codex_Alimentarius. Standard for Honey—Codex Stan 12-1981; CODEX: Roma, Italy, (2001) 1–8.
10. Council Directive 2001/110/EC relating to honey FAO 10, (2002) 47-52.
11. Council Regulation (EEC) No. 2081/92 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs.
12. Daphne Chiara Antonio, D´ebora Cristina Sampaio de Assis, Bruno Goncalves Botelho, Marcelo Martins Sena. Food Chemistry, Detection of adulterations in a valuable Brazilian honey by using spectrofluorimetry and multiway classification (2022) 370, 131064

13. Dong, H., Xiao, K., Xian, Y., & Wu, Y. Food Chemistry, Authenticity determination of honeys with non-extractable proteins by means of elemental analyzer (EA) and liquid chromatography (LC) coupled to isotope ratio mass spectroscopy (IRMS) (2018) 240, 717–724.
14. Elisabeta-Irina Geana, Corina Teodora Ciucure, Diana Costinel, Roxana Elena Ionete. Food Control, Evaluation of honey in terms of quality and authenticity based on the general physicochemical pattern, major sugar composition and δ13C signature (2020) 109, 106919.
15. Etil Guzelmeric, Irem Ciftci, Parla Isil Yuksel, Erdem Yesilada. LWT Food Science and Technology, Importance of chromatographic and spectrophotometric methods in determining authenticity, classification and bioactivity of honey (2020) 132, 109921.
16. Food and Drug Administration 2018 Proper Labeling of Honey and Honey Products: Guidance for Industry
17. Furong Huang, Han Song, Liu Guo, Peiwen Guang, Xinhao Yang, Liqun Li, Hongxia Zhao, Maoxun Yang. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, Detection of adulteration in Chinese honey using NIR and ATR-FTIR spectral data fusion (2020) 235, 118297.
18. Haroon Elrasheid Tahir, Zou Xiaobo, Li Zhihua and Zhu Yaodi. Journal of food biochemistry, Comprehensive evaluation of antioxidant properties and volatile compounds of sudanese honeys (2015) 1745-4514.
19. Haroon Elrasheid Tahir, Zou Xiaobo, Huang Xiaowei, Shi Jiyong, Abdalbasit Adam Mariod. Food Chemistry, Discrimination of honeys using colorimetric sensor arrays, sensory analysis and gas chromatography techniques (2016) 206, 37–43.
20. Ioannis K. Karabagias, Anastasia Badeka, Michael G. Kontominas. Microchemical Journal, A decisive strategy for monofloral honey authentication using analysis of volatile compounds and pattern recognition techniques (2020) 152, 104263.
21. Ioannis K. Karabagias, Anastasia Badeka, Stavros Kontakos, Sofia Karabournioti, Michael G. Kontominas. Food Research International, Characterization and classification of Thymus capitatus (L.) honey according to geographical origin based on volatile compounds, physicochemical parameters and chemometrics (2014) 55, 363–372.
22. Karabagias, I. K., Badeka, A., Kontakos, S., Karabournioti, S., & Kontominas, M. G. Food Chemistry, Characterisation and classification of Greek pine honeys according to their geographical origin based on volatiles, physicochemical parameters and chemometrics (2014) 146, 548–557.
23. Kuan Wei Sea, Sib Krishna Ghoshalb, Roswanira Abdul Wahabc, Raja Kamarulzaman, Raja Ibrahimb, Mohd Nizam Lani. Food Research International, A simple approach for rapid detection and quantification of adulterants in stingless bees (Heterotrigona itama) honey (2018) 105, 453–460.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

24. Lanzhen Chen, Xiaofeng Xue, Zhihua Ye, Jinghui Zhou, Fang Chen, Jing Zhao Food Chemistry, A Determination of Chinese honey adulterated with high fructose corn syrup by near infrared spectroscopy (2011) 128, 1110-1114,
25. Latorre CH, Pena RM, GarciaMartin S, Garcia B. Food Chemistry, A fast chemometric procedure based on NIR data for authentication of honey with protected geographical indication (2013) 141:3559-356.
26. Li, S.; Zhang, X.; Shan, Y.; Su, D.; Ma, Q.; Wen, R.; Li, J. Food Chem., Qualitative and quantitative detection of honey adulterated with high-fructose corn syrup and maltose syrup by using near-infrared spectroscopy. (2017) 218, 231–236.
27. Liuwei Zhao, Caijun Ren, Xiaofeng Xue, Huanxian Lu, Kai Wang, Liming Wu. Food Chemistry, Safflomin A: A novel chemical marker for Carthamus tinctorius L. (Safflower) monofloral honey (2022) 366, 130584.
28. Lorena Salvador, Michelle Guijarro, Daniela Rubio, Bolivar Aucatoma, Tanya Guillén, Paul Vargas Jentzsch, Valerian Ciobota, Linda Stolker, Sonia Ulic, Luis Vásquez, Patricia Garrido, Juan Bravo and Luis Ramos Guerrero. Foods, Exploratory Monitoring of the Quality and Authenticity of Commercial Honey in Ecuador (2019), 8, 105.
29. M. Moniruzzaman, I. Rodriguez, M. Ramil, R. Cela, S.A. Sulaiman, S.H. Gan. Talanta, Assessment of gas chromatography time-of-flight accurate mass spectrometry for identification of volatile and semi-volatile compounds in honey (2014) 129, 505–515.
30. Ma Jose Aliano-Gonzalez, Marta Ferreiro-González, Estrella Espada-Bellido, Miguel Palma, Gerardo F. Talanta, Barbero A screening method based on Visible-NIR spectroscopy for the identification and quantification of different adulterants in high-quality honey (2019) 203, 235–241.
31. Mada¸s, N.M.; Marghita¸s, L.A.; Dezmirean, D.S.; Bonta, V.; Bobi¸s, O.; Fauconnier, M.L.; Francis, F.; Haubruge, E.; Nguyen, K.B. Foods, Volatile profile and physico-chemical analysis of acacia honey for geographical origin and nutritional value determination. (2019) 8, 445.
32. Mahmoudi, R.; Ghojoghi, A.; Ghajarbeygi, P. Foods, Honey safety hazards and public health. J. Chem. Health Risks 2016, 6, 249–267.
33. Marc Spiteri, Eric Jamin, Freddy Thomas, Agathe Rebours, Michele Lees, Karyne M. Rogers, Douglas N. Rutledge. Food Chemistry, Fast and global authenticity screening of honey using 1 H-NMR profiling (2015) 189, 60–66.
34. Maria Chudzinska, Danuta Baralkiewicz. Food and Chemical Toxicology, Application of ICP-MS method of determination of 15 elements in honey with chemometric approach for the verification of their authenticity (2011) 49, 2741–2749.
35. María José Aliano-González, Marta Ferreiro-Gonzalez, Estrella Espada-Bellido, Gerardo F. Barbero, Miguel Palma Food Control, Novel method based on ion mobility spectroscopy for the quantification of adulterants in honeys (2020) 114, 107236.

36. Marisol Juan-Borras, Eva Domenech, Magdalenka Hellebrandova, Isabel Escriche, Food Research International, Effect of country origin on physicochemical, sugar and volatile composition of acacia, sunflower and tilia honeys (2014) 60, 86–94.
37. Natalia Arroyo-Manzanares, Maria Garcia-Nicolas, Ana Castell, Natalia Campillo, Pilar Vinas, Ignacio Lopez-Garcia, Manuel Hernandez-Cordoba. Talanta, Untargeted headspace gas chromatography – Ion mobility spectrometry analysis for detection of adulterated honey (2019) 205, 120123.
38. Niculina M. Mada¸ Liviu A. Marghita¸ Daniel S. Dezmirean, Victorita Bonta, Otilia Bobi, Marie-Laure Fauconnier, Frederic Francis, Eric Haubruge and Kim B. Nguyen. Foods, olatile Profile and Physico-Chemical Analysis of Acacia Honey for Geographical Origin and Nutritional Value Determination (2019), 8, 445.
39. Patrícia A.S. Tette, Leticia R. Guidi, Esther M.A.F. Bastos, Christian Fernandes, Maria Beatriz A. Glori. Food Chemistry, Synephrine – A potential biomarker for orange honey authenticity (2017) 229, 527–533.
40. Pedro Silva, Jorge Freitas, Catarina L. Silva, Rosa Perestrelo, Fernando M. Nunes, Jose S. C amara. Food Control, Establishment of authenticity and typicality of sugarcane honey based on volatile profile and multivariate analysis (2017) 73, 1176-1188.
41. Rebecca Brendel, Sebastian Schwolow, Natalie Gerhardt, Jannik Schwab, Peter Rau, Marie Oest, Sascha Rohn, Philipp Weller. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, MIR spectroscopy versus MALDI-ToF-MS for authenticity control of honeys from different botanical origins based on soft independent modelling by class analogy (SIMCA) – A clash of techniques? (2021) 263, 120225.
42. Ribeiro ROR, Marsico ET, Carneiro CS, Monteiro MLG, Junior CAC, Mano S, et al. LWT - Food Science and Technology, Classification of Brazilian honeys by physical and chemical analytical methods and low field nuclear magnetic resonance (LF 1H NMR) (2014) 55, 90-95
43. Sandra Regina Rivellino, Leandro Wang Hantao, Sanja Risticevic, Eduardo Carasek, Janusz Pawliszyn, Fabio Augusto. Food Chemistry, Detection of extraction artifacts in the analysis of honey volatiles using comprehensive two-dimensional gas chromatography (2013) 141, 1828-1833.
44. Schievano E, Morelato E, Facchin C, Mammi S. Food Chem, Characterization of markers of botanical origin and other compounds extracted from unifloral honeys. J Agric (2013) 61, 8, 1747–55.
45. Se, K. W., Wahab, R. A., Syed Yaacob, S. N. & Ghoshal, S. K. J. Food Compos. Anal., Detection techniques for adulterants in honey: Challenges and recent trends (2019) 80, 16–32.
46. Seisonen, S., Kivima, E., & Vene, K. Food Chemistry, Characterisation of the aroma profiles of different honeys and corresponding flowers using solid-phase microextraction and gas chromatography–mass spectrometry/olfactometry (2015), 169, 34–40.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

47. Seraglio, S. K. T., Silva, B., Bergamo, G., Brugnerotto, P., Gonzaga, L. V., Fett, R., & Costa, A. C. O. Food Research International, An overview of physicochemical characteristics and health-promoting properties of honeydew honey (2019), 119, 44–66. S
48. Shima Ghanavati Nasab, Mehdi Javaheran Yazd, Federico Marini, Riccardo Nescatelli, Alessandra Biancolillo. Chemometrics and Intelligent Laboratory Systems, Classification of honey applying high performance liquid chromatography, near-infrared spectroscopy and chemometrics (2020) 202, 104037.
49. Silva, P. L. M., Lima, L. S., Caetano, I. K., & Torres, Y. R. Food Research International, Comparative analysis of the volatile composition of honeys from Brazilian stingless bees by static headspace GC-MS (2017).
50. Silva, P. M., Gauche, C., Gonzaga, L. V., Costa, A. C. O., & Fett, R. Food Chemistry, Honey: Chemical composition, stability and authenticity (2016), 196, 309–323.
51. Tosun, M. Food Chem. Detection of adulteration in honey samples added various sugar syrups with 13c/12c isotope ratio analysis method (2013), 138, 1629–1632.
52. Vesna Vasic, Sladana Durdica , Tomislav Tostia , Aleksandra Radoicicb, Drazen Lusicc , Dusanka Milojkovic-Opsen , zivoslav Tes , Jelena Trifkov. Food Chemistry, Two aspects of honeydew honey authenticity: Application of advance analytical methods and chemometrics (2020) 305, 125457.
53. Wang, S. et al. Food Chem., Detection of honey adulteration with starch syrup by high performance liquid chromatography (2015) 172, 669–674.
54. Weijian Jiang, Meirong Ying, Jinjie Zhang, Zongyan Cui, Qi Chen, Yong Chen, Jiajun Wang, Fang Fang, Lirong Shen. Journal of Food Composition and Analysis Quantification of major royal jelly proteins using ultra performance liquid chromatography tandem triple quadrupole mass spectrometry and application in honey authenticity (2021) 97, 103801.
55. Xinhao Yang, Peiwen Guang, Guoze Xu, Siqi Zhu, Zhenqiang Chen, Furong Huang. LWT, Manuka honey adulteration detection based on near-infrared spectroscopy combined with aquaphotomics (2020) 132, 109837.
56. Xinran Wang, Shupeng Yanga, Jinna Hee , Lanzhen Chena, Jinzhen Zhanga, Yue Jina, Jinhui Zhoua, Yongxin Zhangf. Food Research International, A green triple-locked strategy based on volatile-compound imaging, chemometrics, and markers to discriminate winter honey and sapium honey using headspace gas chromatography-ion mobility spectrometry (2019) 119, 960–967.
57. Y. Riswahyuli, Abdul Rohman, Francis.M.C.S. Setyabudi, Sri Raharjo. Heliyon, Indonesian wild honey authenticity analysis using attenuated total reflectance-fourier transform infrared (ATR-FTIR) spectroscopy combined with multivariate statistical techniques (2020) 6, 03662.
58. Yang Lia, Yue Huangb, Jingjing Xiaa, Yanmei Xionga, Shungeng Mina. Vibrational Spectroscopy, Quantitative analysis of honey adulteration by spectrum

analysis combined with several high-level data fusion strategies (2020) 108, 103060.

59. Yue-Hong Pang, Zhi-Yang Lv, Ji-Cheng Sun, Cheng Yang, Xiao-Fang Shen. Food Chemistry, Collaborative compounding of metal–organic frameworks for dispersive solid-phase extraction HPLC–MS/MS determination of tetracyclines in honey (2021) 355, 12941.
60. Z. Jandric, S.A. Haughey, R.D. Frew, K. McComb, P. Galvin-King, C.T. Elliott, A. Cannavan. Food Chemistry, Discrimination of honey of different floral origins by a combination of various chemical parameters (2015) 189, 52–59.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Climate Change and Natural Disasters in Karnataka.

Dr Asheera Banu Sangli
Department of Zoology
MES College of Arts Commerce and Science
Malleshwaram, Bengaluru, Karnataka
Email: ***asheerabs@gmail.com***

Article DOI Link: https://zenodo.org/records/11219642
DOI: 10.5281/zenodo.11219642

Abstract:

The need and greed led to the over exploitation of natural resources causing harm to environment leading to climate change. Extreme environmental changes like extreme heat waves, cold spells, storms, floods and droughts have deleterious effects on human and livestock as they cause destructions of the property, dwellings, loss of livelihood and health. Climate change in Karnataka led to heavy torrential rainfall and drought in some districts, this affected agriculture, increased vectors, pest population, vector borne diseases, water borne diseases, air borne diseases, upsets hydrological cycles and famines leading to death of human and livestock. This also leads to migration of human and live stocks and rehabilitation problems. In Karnataka 21 districts received excess rainfall in the year 2022 led to natural disasters like floods, deadly landslides, overflow in water bodies, dams leading to fish kills and other aquatic animals. Some districts faced drought and this leads to scarcity of water affecting agriculture. Variations in seasons were noticed.

Key words: Climate change, Karnataka, Natural disasters, Drought, Flood

Introduction:

Climate is the long-term average of the weather in a given place which includes type, frequency, duration, intensity of weather and seasonal variations. Climate change develops over longer periods or decades to centuries. (www.apha.org). International Panel on Climate Change has reported that drought, flood, melting of glaciers occurs and affects human health and death., Greenhouse effect caused by greenhouse gases leads to Global warming. (Anubha Kaushik and C.P. Kaushik 2010) Increased temperature on the earth surface is due to various anthropogenic activities leads to Global warming (Melissa Denchak 2017).

Climate change and its effects:

Climate change causes drought frequency, severe precipitation, warming, globally land and ocean temperature anomalies, surface temperature change (Donald Wuebber., David.W. Fahey, Kothy A Hibbard., 2017). Many people get displaced due climate change are called as climate refugees seen in India and many countries. People are depended on fishery, aquaculture, agriculture, poultry, piggery and it also affects dairy farming (Mary Pittman 2018) and other natural resources for their livelihood and

these professions depend on the climatic conditions of that particular places and any change in the climate conditions causes loss to livelihood of these people and they get displaced.

Climate change and precipitation in Karnataka:

India is the seventh most affected country by climate change in 2019 globally (Hindustan times 2019). It was reported in 2019 monsoon continued for a month longer than normal in India , flooding caused by heavy rain was responsible for 1800 deaths across 14 states and displacement of 1.8 million (www.edrf,org.climate/india) Heavy rains of 127mm in coastal Karnataka and major landslides of 3 kilometer caused damage to the property, houses and death of the people in Belthangady and nearly 230 people were shifted to relief camps. The people lost their livelihood and they have to migrate and rehabilitation problem occurs. (Coastal digest .com news August 10th 2020).

Landslides in Karnataka:

Heavy rains cause landslides (Climate NASA Febraury2020) and due to landslides in Bhatkal many people died (Economic Times August 2022) Landslides near Bottoppa, Kodagu, Chamundi ghat near Chikkamangalur, Dalerhalli and flood wreak in Udupi district was noticed.

Rise in river water level in Karnataka:

Rising of water in Krishna and Cauvery River blocked major roads causing flood (Times Now Digital August 7th ,2020). Heavy rain water logging disrupted normal life of the people which made people to displace. Impact of climate change led to extreme rainfall and flood risk in India. (P.Gunathakurta, O.P.Sreejith A.Menon www.ias .ac in) Bhima and Krishna river water was discharged from dams leading to destruction in Kalburgi, Vijayapura , Bagalkot, Raichur districts, usually these districts receive less rainfall but in the year 2020 they have heavy precipitation (Deccan Herald October 16th 2020) .

Flood in capital city of Karnataka:

Flood in Bengaluru was caused due to more extreme weather patterns caused by long-term global climate change. Change in land cover such as removal of vegetation increased flood risk. Extreme floods can be triggered by intense precipitation, longer duration, close repetition of precipitations or a combination of these. (3rd March 2020 UNEP). Bruhath Bengaluru Mahanagara Palike has to protect the lakes but is turning encroacher and many lakes have dried up and fish killings could be seen (Deccan Herald, July 13, 2022) In September 2022 Bengaluru witnessed heavy and repeated precipitation and many land areas were flooded with water logging. (BBC news 12th September 2022)

Climate change and Drought in Karnataka:

Karnataka State Natural Disaster Monitoring Centre gave a report that 156 talukas as drought hit after failed monsoon between October to December 2018, 107

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

talukas were severe drought and had negative growth in agriculture sector and north interior Karnataka received 531.5 mm of rainfall which was below the normal of 740.3 mm and from 2016 it was receiving less rainfall. In south interior Karnataka and coastal Karnataka rainfall was more than normal, In Bengaluru there was scarcity of water during 2019 due to low rainfall. This data is available in SKYMET 2019.The map of Karnataka showing drought hit districts is given below. Drought in Karnataka in 2024 has caused water scarcity and drinking of contaminated water has led to waterborne diseases and 223 talukas have been drought hit and agriculture sector has faced the problems and state has claimed for NDRF relief fund.

Forest fires in Karnataka:

Natural disaster like forest fire occurred in Bandipura forest area. Rapid growth of dry grass and lantana due to climate change was observed and it was estimated that 23lakhs acres of green cover is under the threat of forest fire (Deccan herald 2019, Kannada NDTV February 25th 2019) The current drought focuses India is vulnerable to climate change brought by global warming (Robert S Eshelman August 2012).

Fish kills in lakes:

Due to water pollution, anthropogenic activities and release of industrial effluents in lake water of Bengaluru fish kills were seen, and due to heavy rainfall, lake water level increased and fishes were found floating on the roads and even fish cultivation in different places of Karnataka were at heavy loss

Photographs referred from different sources regarding drought, flood forest fire, rainfall pattern, fish kills in lakes are given below.

Conclusion

Climate change is due to human activities which alters the nature's natural cycle leading to abnormal precipitation and drought in different places leading to variations in seasons causing disasters and affecting human and environment with deleterious consequences and death.

References

1. www.apha.org. Topics and Issues.
2. Anubha Kaushik and C.P. Kaushik,2010 Environmental studies, New Age International publishers
3. Melissa Denchak 23rd Feb 2017 Global Climate Change: What you need to know. www.nrdc.com
4. Donald Wuebber, David.W. Fahey., Kothy.A. Hibbard: 3rd Nov 2017. EOS Science News by AGV, how will climate change affect the United State in decades to come
5. Mary Pittman 2018: Impact on climate change on dairy farming, www.futurelearn.com/into/courses/climate-smart.

6. India is most seventh affected by the devastating impact of climate change in 2019 www.hindustantimes.com/india-indianews
7. India: Development while fighting climate change. www.edrf.org.climate/India-development. com.in
8. Rain continues to lash coastal Karnataka major landslides near Beltagandy. coastal digest .com news network. August 10th 2020
9. Climate change could trigger more landslide in high mountain Asia Febraury 11th 2020. Climate.nasa.gov.news2951.
10. Impact of climate change on agriculture 19th July 2019 172 IST pol.gov.in/newsite/print. release.aspro
11. https://economictimes.indiatimes.com/news/india/six-persons-killed-in-landslides-in-karnataka/articleshow/93301163.cms August 20 2022.
12. Landslides, flood wreak havoc in Karnataka Udupi Dakshina Kannada braces for another bout of torrential rain, times now digital August.7th. 2020
13. Impact of climate changes an extreme rainfall events and flood risks in India by P Gunatha Kurta, O.P.Sreejith, P.A.Menon. www.ias.ac.in
14. https://www.unep.org/news-and-stories/story/how-climate-change-making-record-breaking-floods-new-normal 3rd March. 2020
15. Trusted to protect lakes, BBMP turns encroacher, Deccan Herald. July 13th 2022.
16. Deccan Herald October 16th 2020
17. https://www.skymetweather.com/content/weather-news-and-analysis/drought-worsens-in-karnataka-while-bengaluru-faces-water-crisis 2019
18. https://www.deccanherald.com/state/23l-acres-of-karnataka-forests-prone-to-fires-study-790663.html
19. https://www.ndtv.com/karnataka-news/karnataka-continues-to-battle-wildfire-in-bandipur-forest-area-1998877 Feb 25th 2019.
20. https://www.bbc.com/news/world-asia-india-62849937 , Bengaluru floods: how families struggle to find help as India's IT capital drowned, 12th September 2022, BBC news.
21. Robert s Eshelman, the current drought brings into focus India's vulnerabilities to change brought by global warming, Scientific American www. Scientific American article Indian.as., Climate Wire on August 2012

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Drought in Karnataka 2019

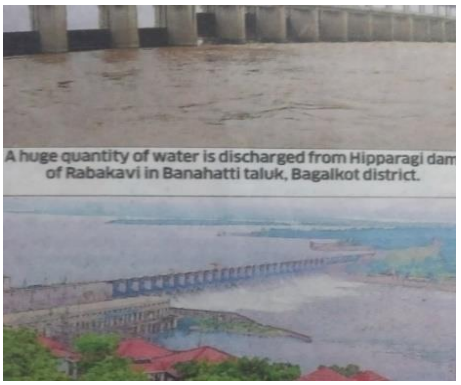
Bandipura Forest Fire 2019

Landslides in Bhatkal Karnataka

Flood in North Karnataka in 2020

Flood in Bengaluru 2022

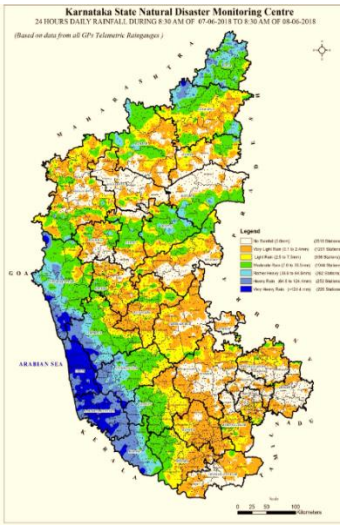
Heavy rainfall and Dam water is released



Leading to flood in surrounding land area

Encroachment of lake for building construction

Fish kills in lakes



Rainfall and drought hit areas in 2018

Heavy rainfall in 21 districts of Karnataka in July 2022

Drought in March 2024 in Karnataka

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Discourse on Covid-19 and Its Impact on Educational System

Punam Mehta
Government PG College Narsinghgarh Dist.- Rajgarh
Ankur Pauranik
Research Scholar Mansarovar Global University, Bhopal
***Email**: punampauranik007@gmail.com*

Article DOI Link: https://zenodo.org/records/11219760
DOI: 10.5281/zenodo.11219760

Abstract:

Outbreak of Covid 19 has covered almost all sphere of life around the world.lt has crushed the economy of almost all the countries in the world. Even superpowers were helpless in front of a tiny virus. This paper presents a detailed study of disease corona caused by noval coronavirus. It deals with the deadly nature of noval coronavirus, its mode of transmissions, laboratory diagnosis, preventions to stop it's spread, possible treatments and researchers' efforts for development of vaccine around the world. Along with this, it emphasizes on impact of Covid 19 on educational system also. It discusses how education system mold itself, to continue the education in the time of crisis and how the learning community has turned the situation of crisis by evolving collaborative teaching learning strategies. Thus, this paper will be helpful for policymakers, researchers, teachers and other stakeholders to get insight into the importance of topic, to get acquainted with barriers in teaching learning scenario and planning their future strategy effectively and efficiently.

Keywords: Covid 19, Laboratory Diagnosis, Education System, Modes of Transmission.

Introduction:

On December 31, 2019 China informed the WHO of a cluster of cases with pneumonia like disease of an unknown cause in Wuhan city in Hubai province, WHO issued the statement saying that the Chinese researchers have made preliminary identification of the virus as a noval coronavirus.[1]

As it rapidly spread and covers whole world with its nuisance like huge data recorded of daily deaths, shut down worldwide, scarcity of fundamentals, lockdown worldwide. Countries faced economic crisis and lack of morals of people. Researchers around the world put their all efforts to develop the vaccine for it and slowly slowly the countries ate moving back on daily routine. Being an integral part of the society, the Education system is also adversely affected by its spread. Schools and College were forced for shutdown to stop the spread of virus .Inmidst ,online teaching learning evolved as a ray of hope which helped in continuing the academic activities.

Modes of transmission of Virus

Covid19 disease is basically a droplet infection. It mainly spreads through sneezing,

coughing of a person infected with corona virus. It can spread through surfaces contaminated due to coronavirus infected persons. Sometime the symptoms of Covid19 are not visible in infected person. Such infected person can work as a carrier of corona virus. Eyes, mouth, nose are main entry gate for coronavirus so it is always advised to properly sanitize hands before touching these entry gates.

Laboratory Diagnosis [2-4]

Main diagnosis techniques utilized for coronavirus detection are as follows

1. **RT-PCR (Reverse Transcriptase Polymerize Chain Reaction**)

It is a Molecular diagnostic technique in which the sample from upper or lower respiratory tract are taken in viral transport medium so that the viral RNA remains preserved while preventing other contaminants. The sample is then transported to the virology lab where RNA extraction for coronavirus is done. After the extraction of RNA, the RT PCR is carried out to identify CT values (cycle threshold) to detect whether sample is positive or negative for covid.

2. **ICT (Immuno Chromatographic Techniques)**

It is an Antigen test for Covid19 can be carried out by using card test or ICT. This test is mainly carried out for screening of covid 19.

3. **Antibody Test**

It is a CB NAAT cartridge based nucleic acid amplification test.

Prevention Methods

To stop the spread of coronavirus following measures found useful.

1. Avoiding going out unnecessarily.
2. Eating vitamin C, protein, Zinc enriched diet.
3. Drinking proper amount of fluid.
4. Taking Green tea with herbs like as black pepper, ginger, cinnamon etc.
5. Drinking Hot water.
6. Taking Steam.
7. Using proper Sanitization process.
8. Using masks in public places.
9. Keeping proper distance between personnel.

Possible Treatment

1. Proper Vaccination.
2. Use of Oxygen cylinder in an emergency.
3. Quarantine infected people.

Vaccine Development [5]

Many firms worked in the direction of vaccine development and after clinical trials, many of these got approval by the countries and WHO. Some of which are as follows

1. Bharat biotech developed Covaxin

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

2. Serum Institute of India developed Covishield and COVOVAX
3. Moderna developed Spikevax
4. Zydus Cadila developed ZyCov-D etc.

Impact On education System

Education is a never-ending process and it evolved in a new nature during pandemic. Whole academic community molded itself during crisis time and continued the process of teaching learning. Few changes are in listed below from the point of view of the different stakeholders of the field.

How Learners Evolved

Learners are the focus of the education process and they have changed their learning styles during the crisis for accessing the knowledge available from different sources mostly online in nature. Some of the changes are as follows:

1. New Learning Mode

As Learning is a continuous process, Pandemic invokes the need for the new learning mode to be developed. So Online learning (New mode of learning) is called upon as per the need of the time which now became the integral part of academia. Now most of the Learners from primary grades to higher education, are able to learn through different online methods like online discussion, flipped classroom, blended learning etc. [6]

2. Availability of World Class Lecture

In the crisis of pandemic study move on through different online platforms like SWAYAM. Professors of IITs and other top institutes prepared courses which are available online. These courses are free and registered students can appear in the proctored exam to earn credit/certificate.[7]

3. Learning through Simulation Work and Virtual Labs

Many instruments which are costly enough and not available through local resources, now available through virtual labs. Learners can make their account on vlab and can perform simulation study on different instruments. These sites (Amrita Vishwa Vidyapeeth vlab) are made so simple and instructions are quite obvious that anyone with little computer knowledge can do experiments.[8]

4. **Virtual Tour**

Learners are now able to go virtually to the places of their interest. Many museums, forts, institutes offer 360-degree views which provide in-depth knowledge of the topic of interest.[9]

How Teachers Evolved

Teachers moved from the traditional brick room classes having board, chalk and duster towards the online classes so that they can continue their work of delivering the knowledge uninterruptedly. Following are few changes from their point of view which took place during the crisis.

1. **Teaching**

Since students were not able to come to school regularly during the pandemic, the teaching faculties evolved in a new form. They started to prepare themselves for online lectures and it gave birth to a new type of bonding between teacher and learners via synchronous and asynchronous study. New terms in teaching came into picture like hybrid learning, blended learning, flipped classroom, Recorded Video, online discussion boards. Through online courses available on SWAYAM, SWAYAMPRABHA,Spoken tutorial and many more ,teachers helped the learner to receive education digitally by sitting at their home.[10]

2. **Self-Learning**

Pandemic put teachers into a turbulent situation where they evolved in a new form-more aware and more curious. Teachers update themselves as per the need of the time through various faculty development programs, short term training program, e-conference, webinar etc. [11]

3. **Experimental Facility**

Academic institutes like IITs through their central research facilities listed their available experimental facilities online. The process of accessing the facilities is now simplified as per users need. Teaching facilities can take benefit of these to improve their academic knowledge. All these aims to boost researches and develop a transparent research ecosystem.[12]

4. **Collaboration**

Because of Crisis academic community understood the need for collaborative teaching and learning. Academia makes the digital pool for sharing their resources and develops an alternative system for uninterrupted learning. Many MoU have been signed to nurture the teaching learning process.[13]

5. **Assessment**

Assessment took a new form as per the need of the time. Now online tests came into picture which may be both objective or subjective in different assessment tools are available like kahoot, Quizlet, Google forms, Moodle, Test Gorilla etc. Aldo the crisis open up new way the f evaluation of answer sheets digitally.[14]

6. **Online Library**

Because of the pandemic, access to physical library was difficult. In such situations online libraries emerged as breathtaking in dry conditions. Teachers used contents such as images, text, audio video etc. available on it for teaching learning process. In India, national digital library (NDL) is successfully providing the digital resources on engineering, humanities, literature, science etc.[15]

How Administration Evolved

1. **Interactive meeting app**

Apps like Google meet Zoom, Microsoft Teams helping Administration in conducting meetings effectively without bothering about distance.

2. **Online Management of Human Resources**

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

Now Employee profile, Attendance, Leave, Salary, Grievances etc. are online which helps management in proper management and such practices which evolved due to necessity are now helping management a lot.

3. Fast Circulation of Information

Higher authorities can convey their orders to all levels very easily through different online apps like WhatsApp groo, telegram groups, or by posting orders on official websites.

4. **Preparation for Long Run**

Academic institutes are now preparing themselves to face the upcoming challenges. Strategies like uploading data on online servers.

Barriers in Teaching Learning

1. Digital Divide
2. Lack of resources
3. Lack of face-to-face learning benefits
4. Lack of concentration of learners
5. underdeveloped Fundamental reading writing skills and numeracy
6. Lack of discipline
7. Wastage of time because of online gaming and videos
8. Increased Dropout rate
9. Lack of overall development.

Relevance of Present Study

Hard time have passed but has given valuable lessons to all the humanity that blind race of getting more and more money and luxury is worth less. Most valuable jewel is relationship and togetherness. Education can play important role in developing such egalitarian mindset among people. Through it all will enjoy the necessary resources as per their need and can lead to formation of a equitable society. It also validate the old proven of taking necessary actions at time, can do a lot of time, money and other resources. If the outbreak of virus would be reported earlier by the concerned authorities, then may be its spread could be controlled more easily. It also teaches that in future all the dignitaries must develop a sense of accountability for prevention of any future awkward situations. Awareness programs may play important role in such situations.

Conclusion:

Outbreak of noval coronavirus drastically changed our learning environment. Proper vaccination initiated by GoI helped in controlling the spread of virus. Educational community evolved in a new manner to cope up with the need of the time. Online collaborative teaching learning create a new interactive paradigm which brought whole academic community around the world on one platform. Barriers are always present and there is a urge to be unite and overcome these obstacles of teaching learning process so that the youth can be made future ready with all necessary skills. Along with this ,it is

also necessary to spread awareness about sustainable development practices like quality education waste, cleanliness, proper sanitation through a strong transparent relationship, among industries, academic, citizens and government .All these will certainly create a path for a knowledge driven empathetic society and definitely it will lead India to become a world leader and make people global citizens.

References:

1. Archived: WHO Timeline covid 19 (2020) Last accessed on 20/04/24 https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.who.int/news/item/27-04-2020-who-timeline---covid-19&ved=2ahUKEwjnr7LSlNCFAxXeT2wGHVXkBqYQFnoECCQQAQ&usg=AOvVaw0QEsMGfDQBkuEEsweV23GL
2. Covid-19 diagnostic testing *Mayo Clinic* Last accessed on 20/04/24 https://www.mayoclinic.org/tests-procedures/covid-19-diagnostic-test/about/pac-20488900#:~:text=For%20a%20COVID%2D19%20diagnostic,Nose%20or%20throat%20swab.
3. Singh M. (2021) Quicker, Costlier than RT-PCR All you need to know about CBNAAT covid test *India Today last* accessed on 20/04/24 https://www-indiatoday-in.translate.goog/coronavirus-outbreak/story/cbnaat-covid-test-rtpcr-1793293-2021-04-21?_x_tr_sl=en&_x_tr_tl=hi&_x_tr_hl=hi&_x_tr_pto=tc&_x_tr_hist=true
4. Sharma SN; Singh S K (2020) Journal of communicable diseases vol.52 no.1 challenges and threats due to deadly corona virus in India and dealing it with social vaccine (the online weapon) last accessed on 20/04/24 https://medical.advancedresearchpublications.com/index.php/Journal-CommunicableDiseases/article/view/289
5. Vaccines approved for use by in India *Covid 19 vaccine tracker India* last accessed on 20/04/24 https://covid19.trackvaccines.org/country/india/
6. Park S(2016) Virtual avatar as an emotional scaffolding to promote interest in online learning environment *Science direct* last accessed on 20/04/24 https://www.sciencedirect.com/topics/psychology/online-learning
7. SWAYAM *Ministry of Education Government of India* last accessed on 20/04/24 https://swayam.gov.in
8. Value @Amrita Amrita Vishwa Vidyapeetham last accessed on 20/04/24 https://vlab.amrita.edu
9. India's virtual tour to take now by *South travel India* (2020) last accessed on 20/04/24 https://soultravelindia.com/india-virtual-tours/
10. Sharma V (2023) Education system in the era of covid 19 pandemic Reader's blog Times of India last accessed on 20/04/24 https://timesofindia.indiatimes.com/readersblog/lexworld/education-system-in-the-era-of-covid-19-pandemic-52786/

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

11. Barron M,Cobo C,Muniz-Nazar A,Ciarrusta I S (2021) the challenging role of teachers and technologies amidst the covid 19 pandemic:key findings from a cross country study *World Bank…blogs* last accessed on 20/04/24 https://blogs.worldbank.org/en/education/changing-role-teachers-and-technologies-amidst-covid-19-pandemic-key-findings-cross
12. IIT Delhi launches online platform for resechers to access it's central research facility by Education Desk (2021)*The Indian Express last accessed on 20/04/24* https://www.google.com/amp/s/indianexpress.com/article/education/iit-delhi-launches-online-platform-for-researchers-to-access-its-central-research-facility-7539886/lite/
13. Benefits of collaborative teaching (2015) *Inclusives School Network* last accessed on 20/04/24 https://inclusiveschools.org/resource/7-benefits-of-collaborative-teaching/
14. Neendoor S (2024) 10 best digital assessment tool that are useful for both students as well as teachers *hurix digi*tal last accessed on 20/04/24 https://www.hurix.com/best-digital-assessment-tools-that-are-useful-for-both-students-as-well-as-teachers/
15. National Digital Library of India last accessed on 20/04/24 https://ndl.iitkgp.ac.in/

Effects of Meditation on Psychological Well-Being of Teachers

Dr. Sunanda Waghmare
Dept. of Psychology
Shri Shahu Mandir Mahavidyalaya, Parvati, Pune
Email: helkarsr@gmail.com

Article DOI Link: https://zenodo.org/records/11219873
DOI: 10.5281/zenodo.11219873

Abstract:

In the current situation, teachers have to go through multiple responsibilities. The stress from these responsibilities affects their work. Teachers, those are happy in their roles produce greater work and provide better support for their students. There is a gap in the understanding of what constitutes well-being amongst teachers, therefore concerns about their wellbeing continue to exist in educational environment. The stressors and their relationship to the psychological health of teachers working in college are mapped out in this scoping review. It is necessary to have good mental health. So teachers need meditation. Furthermore, to determine the approach and strategies employed in lowering teachers' stress levels and their significance for their psychological well-being.

Key Words: Meditation, Psychological Well-being, Teacher

Introduction:

According to World Health Organization (WHO), psychological well-being means “a state of complete physical, mental, and social well-being”. Diener et al. (2010) is the pioneer researcher in psychology who examined on subjective well-being” which represents subjective life satisfaction.

A state of happiness and health, as well as the wellbeing or quality of life, are referred to as well-being. Higher quality work, classroom self-efficacy, and improved student support are all correlated with instructors' well-being. The psychological health of teachers is a growing concern in many nations. In their allocated workspace, teachers have a crucial role in molding the next generation, which directly impacts societal well-being. Thus, our research contributes to the understanding of the stressors faced by educators and how those factors affect their mental health. Different stress-reduction strategies may also assist stakeholders and policymakers by encouraging them to embrace appropriate initiatives that will advance the teaching profession.

Everyday classroom and student management issues are faced by college teachers. In the provided learning environment, they must oversee the pedagogy used with a variety of student types, their own identity, and informal student interactions. They get emotionally drained and lethargic as a result, which lowers their energy levels. According to research, these elements cause school instructors to become burned out and consider quitting their jobs.

Many of them struggle to manage the stress at work, which can result in health

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

issues linked to stress. Additionally, compared to other professionals, they perceive much less control over their autonomy, authenticity, social connections, and resilience, which contributes to their inferior psychological well-being. Because they had to manage many tasks during the Covid-19 pandemic, college teacher's psychological health was particularly affected. Research undertaken during the pandemic indicated that school teachers' mental health and well-being were impacted by uncertainty, workload, a bad impression about their job, health issues, and having to play several roles. For many Indian school and college teachers, the abrupt introduction of distance learning presented challenges, including the need to adapt new technologies, revise pedagogy, and change the mode of evaluation in order to effectively deliver online education.

Meditation:

Meditation is an ancient practice that is believed to originate in India several thousand years ago. Hundreds of studies have been done on the physiological and psychological effects of meditation, making it one of most intensively studied area of knowledge in the field of human development. In general, meditation is a difficult neurocognitive exercise. It frequently corresponds with changes in the body's physiological and psychological parameters. Meditation, described as a practice of body and mind self-regulation, is characterized by a set of techniques that train the focalization of attention. Also known as a mental training, this practice characterizes a technique capable of producing psychosomatic effects

Meditation is a practice in which an individual uses a technique such as mindfulness, or focusing the mind on a particular object, thought, or activity to train attention and awareness, and achieve a mentally clear and emotionally calm and stable state.

In addition to improving tranquility, perception, self-concept, and wellbeing, meditation may dramatically lessen tension, anxiety, despair, and pain. To learn more about how meditation affects various aspects of health, including psychological, neurological, and cardiovascular health, research is still being conducted. Different definitions and characterizations of meditation have been found in contemporary psychology research. Many research studies highlight the significance of attention and describe meditation as an effort to transcend the reflexive, "discursive thinking "in order to reach a more profound, pious, or peaceful state.

What is Psychological Well-Being:

Psychological well-being refers to an individual's emotional health and overall functioning. It consists of positive social relationships, autonomy, environmental mastery, self-acceptance, a sense of purpose, and personal growth.

Andrew and Whitney (1976) have defined psychological well-being as a person's evaluative response to his or her life either in the form life satisfaction i.e. cognitive evaluation or affective balance i.e. the level of positive affect surpasses the level of negative effect.

According to Alam and Rizvi (2012), well-being is a sense of contentment, of one's role in work environment, happiness and satisfaction with day-to-day matters. It is a perception of achievement, belongings, utility and absence of dissatisfaction, worry and distress.

The term "well-being" describes a condition of optimal functioning marked by the existence of happy feelings, a noticeable lack of unhappy feelings, and a sense of fulfilment in life.

It is an essential component of a person's general well-being and standard of living. A sense of purpose, personal development, environmental mastery, self-acceptance, autonomy in thoughts and actions, and positive interpersonal relationships are the six main dimensions of psychological well-being. Psychological well-being is a fundamental aspect of human life and encompasses various dimensions of an individual's psychological functioning.

Higher psychological well-being is associated with a stronger sense of purpose in life, an openness to personal development, confidence in influencing one's surroundings, acceptance of oneself, the maintenance of positive relationships with others, and independence in thought and behavior.

It has been discovered that psychological well-being plays a critical role in encouraging teachers' work engagement. Research indicates that educators who experience more psychological well-being also exhibit better levels of work engagement, which is characterized by a greater degree of passion, interest, and commitment to their jobs.

Meditation Effects:

A subfield of neuroscience research focuses on the processes and effects of meditation. Neurological responses during meditation have been observed using modern scientific techniques like MRI and EEG. The quality of meditation research has been questioned, regarding factors like the characteristics of those who frequently participate. Along with a slight decrease in blood pressure, meditation reduces stress hormones, lactate levels, heart rate, oxygen consumption, breathing frequency, and sympathetic nervous system activity (linked to the fight-or-flight response). But it was discovered that people who had been meditating for two or three years already had low blood pressure. Over the first three minutes of meditation, there is an average 10–20% drop in oxygen usage. For example, during the course of four or five hours of sleep, oxygen consumption drops by about 8 percent. After years of practice, the breath rate can decrease to three or four breaths per minute, and the "normal beta (seen during waking activity) or alpha (seen during normal relaxation) brain waves slow down to much slower delta and theta waves"

Clinical psychology and psychiatry have been using meditation techniques for a variety of psychological problems since the 1970s.In psychology, mindfulness practices are used to treat mental and physical ailments like anxiety, stress, and depression. Despite the low caliber of the studies, mindfulness is also utilized in the treatment of

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

drug addiction. Research indicates that meditation can effectively relieve pain to a considerable extent. There is not enough proof to support the claim that meditation improves mood, focus, eating patterns, sleep quality, or body weight.

Meditation can help increase happiness. Researchers have discovered that the more that a person meditates in their daily life, the happier they are (Campos et al., 2015). Individuals with higher mindfulness and self-compassion levels tend to experience greater happiness, as self-compassion and happiness are positively correlated, as noted by Campos et al. (2015).

Meditation positively impacts life satisfaction, as evidenced by a study comparing regular and non-regular meditation practice among individuals (Agarwal & Dixit, 2017).

Meditation offers the power of forgiveness, leading to peace in life, and various types of practices have been utilized among college teachers.

Mood disorders and depression are very impactful for those who suffer from them. There are several possible treatments available for them, and meditation is one possible solution.

Meditation offers numerous benefits, including relaxation, and a study investigated the brain areas associated with relaxation to determine if meditation can activate them.

Chu (2010) found that meditation increases emotional intelligence, reduces perceived stress, and lowers negative mental health, indicating a positive correlation between meditation and stress reduction.

Ress's review of 40 studies found transcendental meditation, mindfulness, and progressive muscle relaxation as the most promising for reducing stress, a common emotional challenge, and offers hope for addressing these issues.

The Mindfulness-Based Stress Reduction (MBSR) program, developed by Tacón et al. (2003), was tested on women with heart disease to reduce anxiety. The program involved weekly group meetings and daily audio tapes, teaching participants to be aware of their body, breath, surroundings, and movement. Results showed significant improvement in anxiety and emotional control.

Meditation can reduce anxiety, even without prior experience, with more experienced individuals showing lower levels. Studies show that mindfulness activities can significantly decrease anxiety in college teachers and students, with some studies even examining its effects.

Meditation improves psychological well-being by reducing stress, strengthening emotional resilience, improving cognitive function, improving sleep quality, and mitigating anxiety and depression symptoms. It also lowers blood pressure, manages pain, boosts immune defenses, and slows aging processes.

Conclusion:

It is necessary to consider the mental health of teachers. That is why it is necessary to give training of any method of meditation to all the teachers. Teachers can

do excellent work only if they remain mentally competent. They will be able to do the work of making good citizens of the country and handle the responsibilities that come with them. Many studies have shown that meditation has a positive effect on mental health.

Teachers and other education professionals can benefit greatly from meditation because of these physiological impacts. Improved soft skills like confidence, empathy, and emotional resilience may be among these advantages. Additionally, meditation can help with aspects specifically related to classroom practice, such as patience, focus, and thoughtful communication. Meditation enhances wellbeing, classroom management, job performance, and student engagement, making educators more present and influential. Meditation can improve mental wellbeing by reducing symptoms and increasing happiness. It can also prevent mental health issues by preventing them from arising. While it may not completely eliminate symptoms, consistent practice can lead to improved emotional resilience.

Better wellbeing leads to easier handling of challenging situations, reduced absenteeism, and increased job effectiveness. This positive cycle of confidence and wellbeing fosters a positive work environment.

Seriously, teachers need a practical, sustainable method of self-care. Observing breath and mindfulness of thoughts and emotions can significantly influence teachers' responses and stress levels.

References:

1. Bodhi prasiddhinand, P. (2024). Buddhist ethics for improving health and well-being during pandemics like COVID-19 with special references to modern scientific experiments. *Religions*, *15*(4), 511. doi: https://doi.org/10.3390/rel15040511
2. Kalous, E. (2023). *A single session compassion meditation program works to reduce anxiety – despite the odds* (Order No. 30248659). Available from Publicly Available Content Database. (2812309811). Retrieved from https://www.proquest.com/dissertations-theses/single-session-compassion-meditation-program/docview/2812309811/se-2
3. Kanekar, A., & Sharma, M. (2020). COVID-19 and mental well-being: Guidance on the application of behavioral and positive well-being strategies. *Healthcare*, *8*(3), 336. doi: https://doi.org/10.3390/healthcare8030336
4. Menezes, C. B., & Dell'Aglio, D. D. (2009). Meditation effects on scientific research in psychology: Literature review. *Psicologi: Ciencia e Profissao*, *29*(2), 276-289. doi: https://doi.org/10.1590/S1414-98932009000200006
5. Patel, N. S., Patel, N. K., Chaudhari, M., & R, P. N. (2024). Effect of yoga on pulse rate and blood pressure. *National Journal of Physiology, Pharmacy and Pharmacology*, *14*(3),425-428. doi: https://doi.org/10.5455/njppp.2023.13.03144202304082023.

ISBN- 978-81-970663-6-8, Contemporary Studies in Arts, Humanity, Commerce, Science and Social Science. (CSIAHCSS-2024) Pub. Date: 30/04/2024 Web: https://naturelightpublications.com

ABOUT THE EDITORS

Prin. Dr. Vilas V. Patil

He is currently working as Incharge Principal and Professor at Akhil Bhartiya Maratha Shikshan Parishad's Shri Shahu Mandir Mahavidyalaya, Parvati, Pune-411009 (MH). He received his Ph.D. from Savitribai Phule Pune University, Pune. His scientific interests area is geomorphology, population and settlement, and GIS. He has published 38 research papers in UGC-CARE and peer-reviewed international Journals, 07 Books and 03 book chapters. He was published five books and Six book chapters. He is a recognized PG teacher and Ph.D. Guide at SPPU in Pune. He Supervised four Ph.D. students. He has given 20 expert addresses as invited lecturers and resource individuals. He has presented over 28 research articles at international and national conferences, seminars, and symposia in India. He was completed one Minor Research Project which is funded by UGC.

Dr. Sandeep S. Panari

He is working as Officiating Principal and also working as Head of the Department and Assistant professor in commerce at Anandi Shikshan Mandali's Padmashri Dr. G. G. Jadhav Mahavidyalaya, Gaganbavada, having more than 15 years of teaching experience. Ph.D. in Business Law from Savitribai Phule Pune University, Pune. He has authored seven books on Commerce and Management, He has also contributed chapters in study material published by Distance Education Center of Shivaji University, Kolhapur. He has published 17 research articles in reputed UGC Care List/ International/ National journals. He is a recognized Research guide and post-graduate teacher by Shivaji University, Presently Three students registerd for Ph.D. under his guidance. He has worked as the co-ordinator of NAAC Steering Committee at the college since 2015 and handled the A/A exercise in 2018. He has contributed to the college through various statutory and non-statutory committees such as IQAC, Examination, Anti-Ragging, AISHE, MIS, College Research Committee, Internal Evaluation Committee, Lead College Workshops, Commerce Association, etc. He has organized International National Conferences.

Dr. Asha B. Kadam

Dr. Asha B. Kadam, M.Sc. Ph.D. Assistant Professor, Research Centre and P.G. Department of Botany at Dada Patil Mahavidyalaya, Karjat, Ahmednagar, Maharashtra.Dr. Asha B. Kadam completed her graduation and post-graduation in Botany from New Arts, Commerce and Science College, Ahmednagar affiliated to Savitribai Phule Pune University, India. She has completed ber Ph. D. degree from Pane University.Dr. Asha Kadam, contributed lot in research field also, she published more than 28 Research Papers with high impact factors. She published 8 books and 11 book chapters so far, granted one Indian patent on "Herbal Oral Contraceptive Formulation" and published one Indian Patent on "Designing a New Dressing Bandage to the Fractured Wound Especially in Diabetic Patients". She is recognized as research guide in Botany by Savitribai Phule Pune University, Pune. She completed two research projects on plant sciences. She got different national and international awards as Innovative & Dedicated Teaching Faculty Award, Best Woman Scientist Award and Best Teacher Research Award from the reputed Research institutes. Till date, she has delivered more than 14 guest lectures on different topics.She has wider research and teaching experience at various levels in academics. Her major field of research interest is traditional contraceptive plants and their authentication. She has formulated a contraceptive drug and tested in experimental animals. She has presented several research papers in various symposia and conferences in India and abroad.

Mr. Agastirishi B. Toradmal

He is presently Research Scholar at Prof. Ramkrishna More Mahavidyalaya, Akurdi, Pune- 411044 affiliated to Savitribai Phule Pune University, Pune. He have 10 year experience as Assistant. Professor, Department of Geography at Rayat Shikshan Sanstha's Dada Patil Mahavidyalaya, Karjat, Dist. Ahmednagar. He has qualified SET examinations. His area of research is Groundwater Hydrology, Geomorphology and GIS. He has published 15 research papers in UGC-CARE and Peer-reviewed international journals, 05 Books and 04 book chapters. He has delivered 04 expert talks as invited lectures and as resource persons. He is recognized Co-ordinattor of IIRS- ISRO outreach Programme. He has presented more than 10 research papers through various international and national conferences, seminars and symposia.

Nature Light Publications

309 West 11, Manjari VSI Road, Manjari Bk.,
Haveli, Pune- 412 307.
Website: www.naturelightpublications.com
Email: naturelightpublications@gmail.com
Contact No: +91 8625060096 / 9922489040

ISBN: 978-81-970663-6-8

Price- 720/-