AGRIALLIS

SCIENCE FOR AGRICULTURE AND ALLIED SECTOR

A Monthly "e" Magazine

VOLUME 5, ISSUE 12

DEC. 2023

Online ISSN 2582-368X

www.agriallis.com

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AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04284

A BEGINNER'S LOOK AT CLIMATE CHANGE NEGOTIATIONS

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The human race, in its years of evolution, has sped up the aging of the earth itself. In their endless greed for development, the impact will inescapably be on the human race. Global warming and pollution have caused a significant shift in the climate all around the world. Climate change is an important issue now more than ever. The fact that the ozone layer has been recovering due to active cooperation between humans is proof enough that when bold actions are taken by aligning principles, outstanding results are achieved. For such actions to be taken, a platform for discussing and deciding upon the actions is to be established. A platform for the negotiators representing their countries and their positions on the various agreements that are to be enacted was necessitated.

Why is the Multilateral Environmental Agreements (MEAs) Important?

For the achievement of such multifaceted agreements among the diverse developed and developing countries, whose interests might be contradictory, the Multilateral Environmental Agreements (MEAs)—the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC)—are the two major forums that overlook such discussions. The UNFCCC is a forum for science-based global action, basing its decisions and conclusions on scientific research. While the IPCC conducts and publishes assessment reports on global climatic and environmental conditions. The latest assessment reports published in 2022 reported that climate change poses a serious threat to the agriculture sector, which will inevitably affect the economic and social aspects of life. Two important MEAs have been accepted since the first assessment report, viz., the Kyoto Protocol (KP), 1997, and the Paris Agreement (PA), 2015. In the Kyoto Protocol, emissions levels were quantified, and developed countries were to reduce their levels of emissions. While in the Paris Agreement, all the parties agreed to increase their efforts in

adopting the decisions, and Nationally Determined Contributions (NDC) efforts were also made by the parties included.

The UNFCCC has three types of governing bodies: i) Governing Bodies; ii) Constituted Bodies; iii) Entities of Financial Mechanism.

i) The Governing Bodies are the main decision-makers of the UNFCCC. The governing bodies established are:

1. Supreme bodies are headed by the President. Only decisions adopted by these bodies, i.e., a) the Conference of Parties (COP), b) the Conference of the Parties serving as the Meeting of Parties to the Kyoto Protocol (CMP), and c) the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA), are legally binding to the parties.

2. Subsidiary bodies are led by the chair. They complement and provide assistance to the Supreme Bodies.

3. The secretariat is headed by the executive secretary. Their main objective is to provide organizational and technical expertise to the negotiation and decision-making bodies.

ii) Constituted bodies are established to provide input to the negotiations. They have no official negotiation roles.

iii) Entities of Financial Mechanism have provision for funding grants or concessions, even for the transfer of technology.

In negotiating and reaching agreements, parties organize themselves into groups. According to the UNFCCC, a party is 'any country that has ratified, approved, acceded to, or adopted the Kyoto Protocol or the Paris Agreement'. Even though they are not parties, non-party nations are nonetheless able to watch the proceedings. Observers can make statements and may participate in some negotiation meetings, but they cannot negotiate. They can indirectly impact the negotiations by influencing the negotiators. An observer can be any national, international, governmental, or non-governmental agency or body. The only people who have the authority to negotiate, decide, and be elected to various bodies are the parties. Parties can be formed by nations with comparable interests. Participants can fortify their stance by becoming members of a 'Group of Party'. Smaller nations have more chances to defend themselves and make their opinions known. While some groups adhere to customary

processes that are not legally obligatory, others have their own set of standards for cooperation. Throughout time, the members of the Group of Parties are free to associate with any group that best represents their shared interests. In 2022, there are 15 active groups of parties. India is a member of BASIC (Brazil, South Africa, India, and China) and Like-Minded Developing Countries (LMDC). A country can be a member of multiple groups as well.

Negotiation and Negotiator

Negotiations are conversations between two or more people, where each is trying to convince the others of the merits of the arguments they are presenting. There are three aspects to negotiations: i) communications; ii) purpose; and iii) common interest. A good negotiator is both a good talker and a good listener. He or she knows when to hold his words. A negotiation happens for a purpose; without engaging the other party in a discussion, an agreement cannot be reached. The parties should share some common interests.

Unlike a normal conversation, a multilateral negotiation carries the political weight of a country. A skilled negotiator knows when and how to show interest. Instead of expressing their interest, a negotiator must take a position in order to defend it. Positions are the outward declarations of a person or group; they represent "what" the negotiator claims to be seeking. Interests serve as the "why" behind the negotiators' stated desires, whilst values and motivations serve as the underlying causes. A skilled negotiator will choose the correct time to reveal more of their underlying interests to increase their chances of successful negotiations. They recognize that when more parties are involved, a web of different interests may be created. They also have to rely on their own soft and hard skills to understand the interests of their counterparts.

A good negotiator will have two types of skills: i) Soft skills, also called People skills. It relates to how each person interacts with other people. They can be developed through coaching and practice. It includes verbal and non-verbal communication skills. ii) Hard skills are competencies that can be proven by producing certificates, degrees, or work experience. It relates to technical knowledge on the subject matter of negotiations. While negotiating, both skills come in handy and are a requirement for a successful negotiation.

Conclusion

Negotiating and coming to an agreement about the environmental and climatic interests between developed and developing nations is a challenging process. But in the long run, it is for the sustenance of the earth and its life forms as a whole. It is imperative that countries and organizations stay open to discussions on the matter. And only cooperation and coordination among the countries can lead to a better and more fruitful future. The participating countries have to provide skilled negotiators to stand up for their interests and also be integrated with the collective agreements taken by the forums. Therefore, multilateral negotiation at the UN level allows for the successful conduct of proceedings, and the negotiators are to be abundant in the proper skills to achieve both their interests and the overall goals of the forums.

Reference

Food and Agriculture Organization. (2023). Climate Change Negotiations for Agriculture Stakeholders. [MOOC]. FAO elearning Academy. https://elearning.fao.org/mod/scorm/player.php?scoid=1957&cm=5984&mode=review&display=popup

United Nations Environment Programme. (2023, January 9th). Ozone layer recovery is on track, helping avoid global warming by 0.5°C. UNEP. https://www.unep.org/news-and-stories/press-release/ozone-layer-recovery-track-helping-avoid-global-warming-05degc#:~:text=If%20current%20policies%20remain%20in,the%20rest%20of%20the%20world.

Article Id
AL04285

AGRICULTURAL INVESTMENT AND THE AOI: A PATH TO SUSTAINABLE DEVELOPMENT

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The importance of Target 2.a in the context of Sustainable Development Goals (SDGs) cannot be overstated. Target 2.a specifically addresses the need to increase investment in agriculture to enhance productive capacity in developing countries. This commitment is crucial for achieving food security, promoting sustainable agricultural practices, and realizing the overarching goal of Zero Hunger. The article delves into the various sources of investment in agriculture, emphasizing the role of both private and public flows. It highlights the significance of Indicator 2.a.1, the Agriculture Orientation Index (AOI), as a key metric for evaluating government expenditure's alignment with the agricultural sector's contribution to the economy. The AOI not only provides insights into economic structures but also serves as a valuable tool for policymaking, risk management, and international comparisons.

Why is Target 2.a So Crucial?

Agricultural investment is crucial for decreasing hunger and advancing sustainable agricultural output. The African Union established goals in the Maputo and Malabo Declarations to boost public investment in agricultural and rural development as well as productivity in the sector. However, as this graph shows, agricultural investment is declining in our nation. In order to accomplish the Zero Hunger Goal and guarantee food security for our people, we must halt this detrimental trend.

Sources of Investment in Agricultural

A number of players are essential to the financing of the agriculture industry. Their contributions to the industry vary in scope and objectives.

There are essentially four sources of investment in agriculture:

- **Private flows-**
  - Domestic (Private equity and credit)
  - Foreign (Direct investment)
- **Public flows-**
  - Domestic (Government expenditure)
  - Foreign (Development flows)

1. Private Flows

a) Domestic (Private equity and credit)

In many nations, domestic private financing, spearheaded by agricultural stakeholders, serves as the main source of funding for agriculture. In order to manage high risks resulting from uncertainties in elements like price volatility, pests, illnesses, and disasters that alter the timing and outcomes of agricultural investments, this involves reinvested savings (private equity) and credit from financial institutions.

b) Foreign (Direct investment)

International firms engage in private foreign financing of agriculture through foreign direct investment, with the goal of achieving long-term management control. Positive effects include market growth and the transmission of information, but negative effects include land grabbing and social and environmental issues.

2. Public flows

a) Domestic (Government expenditure)

Government spending in agriculture is essential to addressing market imperfections, fostering private investment, and assisting in the redistribution of income to the most vulnerable farmers. For projects like soil enhancement, irrigation, and animal health management—which the private sector would overlook—public subsidies are essential. Furthermore, government support is necessary to protect smallholders who are exposed to significant risks and unstable incomes.

b) Foreign (Development flows)

The main players in the public foreign sector of agriculture investment are foreign government agencies, bilateral donors, and multilateral organizations. The goal of these flows—better known as Other Official Flows (OOF) or Official Development Assistance (ODA) is to advance the welfare and socioeconomic advancement of developing nations.

Target 2.a Indicators

Countries have pledged to increase investment in order to increase the productive capacity of agriculture in developing nations through Target 2.a of the SDGs. Two indicators that track the flow of public funding to agriculture are used to track success toward this goal.

1. Indicator 2.a.1

The Agriculture Orientation Index (AOI) for Government Expenditures

- It refers to the public domestic flows (government expenditure) in agriculture and compares the government's contribution to the agricultural sector with the sector's contribution to Gross Domestic Product (GDP).
- The custodian agency for this indicator is FAO.

2. Indicator 2.a.2

Total official flows (official development assistance plus other official flows) to the agriculture sector.

- The custodian agency for this indicator is the Organization for Economic Co-operation and Development (OECD).

Indicator 2.a.1

The indicator 2.a.1, the Agriculture Orientation Index for Government Expenditures (AOI), is a currency-free measure, calculated as the ratio of two shares:

$$AOI = \frac{Agriculture\ Share\ Of\ Government\ expenditure}{\text{Agriculture Value added as share of GDP}} = \frac{\frac{Government\ Expenditure\ on Agriculture}{Total\ Government\ on\ Agriculture}}{Agriculture\ Value\ added/GDP}$$

- The International Monetary Fund (IMF) Statistics Department collects data on government expenditures from countries using an annual questionnaire. The FAO Statistics Division then supplements this data with data gathered from official government publications and websites, or it can be compiled using the Government Finance Statistics Manual 2014 (GFSM 2014) methodology.
- The System of National Accounts is the source of the GDP value addition data related to agriculture.
- The FAOSTAT Government Expenditure on Agriculture database contains the information and the indicator.

The AOI conveys the orientation of the government expenditure – current and capital outlays - to the agricultural sector compared to its contribution to the total economy.

Different-different Conditions of AOI

- **Condition 1.** If **AOI > 1,** It means higher orientation of the government expenditure to the agricultural sector compared to its contribution to the total economy.
- **Condition 2.** If **AOI < 1,** It means lower orientation of the government expenditure to the agricultural sector compared to its contribution to the total economy.
- **Condition 3.** If **AOI = 1,** It means neutrality in government's orientation to the agricultural sector.

Advantages of Agriculture Orientation Index

The AOI provides valuable insights into a country's economic structure and its dependence on agriculture.

Here are some advantages of using the Agriculture Orientation Index:

a) **Economic Structure Assessment:** The AOI is useful in assessing a nation's or region's economic structure. It shows how significant agriculture is in relation to other economic sectors. An economy with a high AOI is thought to be mostly agrarian, whereas one with a low AOI is thought to be more diversified.

b) **Development Planning:** The AOI can be used by governments and policymakers to help them decide which economic development initiatives to pursue. A high AOI, for instance,

can indicate that diversification is necessary to lessen economic susceptibility to changes in agriculture productivity.

c) **Risk management:** An economy that depends significantly on agriculture is frequently more susceptible to external variables like pests, weather, and changes in the price of commodities. Policymakers can detect and manage the dangers related to this reliance with the aid of an AOI.

d) **Investment Decisions:** The AOI can be used by domestic and foreign investors to determine whether it is desirable to make an investment in a specific area or nation. A diverse economic structure and a more favourable investment climate may be indicated by a low AOI.

e) **Policy Formulation:** Strategies and policies pertaining to commerce, agriculture, and rural development can be shaped by the AOI. Governments can use it as a guide when putting policies into place that balance or assist the agriculture sector in the overall economy.

f) **Tracking Progress:** The AOI can be used to track alterations in a nation's economic structure over time. The AOI may decline as economies grow and diversify, indicating progress in lessening reliance on agriculture.

g) **International Comparisons:** The AOI makes it possible to compare the economic systems of several nations internationally. This index can be used by institutions and researchers to examine patterns and distinctions in the contribution of agriculture to different national economies.

h) **Sustainability and the environment:** Because of intensive farming techniques, high AOI values may suggest a higher degree of environmental impact. This can be used to promote sustainable practices and raise awareness of the negative environmental effects of agriculture.

i) **Rural-Urban Development:** The degree to which rural communities rely on agriculture for their livelihoods can be evaluated using the AOI. When creating policies and initiatives for rural development, this information is invaluable.

j) **Research and Analysis:** By examining the AOI's correlations with other economic indicators and factors, researchers can conduct in-depth analysis and modelling in economic and agricultural studies.

Conclusion

Target 2.a's emphasis on increasing agricultural investment is paramount for achieving food security and sustainable development. The Agriculture Orientation Index (AOI) serves as a vital metric, offering insights into economic structures and guiding policy decisions. As nations strive to meet SDG commitments, the AOI proves invaluable in assessing economic vulnerabilities, informing development planning, and fostering international comparisons. Its multifaceted advantages, from risk management to sustainability considerations, underscore the AOI's significance in shaping a resilient and balanced global agricultural landscape.

References

International Monetary Fund (2014). Government Finance Statistics manual 2014. *International Monetary Fund Publication services*, Washington DC, U.S.A.https://www.imf.org/external/pubs/ft/gfs/manual/2014/gfsfinal.pdf

European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank (2009*). System of National accounts 2008*. New York, U.S.A. https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf

FAO (2012). The state of Food and Agriculture. Rome, Italy. https://www.fao.org/3/i3028e/i3028e09.pdf

European Commission (2011). Manual on sources and methods for the compilation of COFOG Statistics. *EU Publication Office*, Luxembourg. https://ec.europa.eu/eurostat/documents/3859598/5917333/KS-RA-11-013-EN.PDF.pdf/2eb9714a-ee4b-49fe-baab-e9af5ca457b1?t=1414781763000

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04286

BEYOND GREEN: THE SURPRISING DIVERSITY OF PLANT PIGMENTS AND THEIR ROLES

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Plants, the primary producers, utilize sunlight in the photosynthesis process, converting it into chemical energy. Key to this conversion is chlorophyll, a green pigment that captures light energy and kick-starts carbohydrate synthesis. However, plants boast a wide array of pigments beyond chlorophyll, each with distinct properties and roles. These pigments lend vibrant hues to flowers, fruits, and leaves, enhancing the natural world's visual appeal(Lee, 2017). Plant pigments serve multiple functions—they regulate photosynthesis, plant growth, and development, attract pollinators like insects, birds, and animals, aid in seed dispersal, and shield plants from UV and visible light damage(Lev-Yadun, 2016). Many pigment-rich fruits are integral to the human diet. Chlorophylls, carotenoids, flavonoids, and betalains constitute major plant pigments. While chlorophylls drive photosynthesis, the other three act as supplementary pigments and secondary metabolites, offering diverse structures and functions in plants[5]. For more insights into these pigments, explore further at this link.

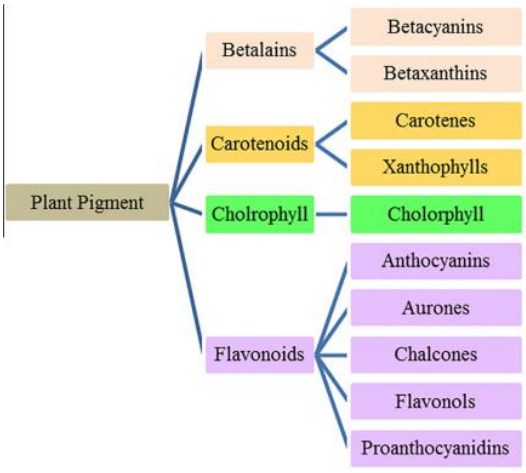

Fig.1: Types of plant pigment system

i. Chlorophylls

Chlorophyll, the vibrant green pigment nestled within plant chloroplasts, serves as the cornerstone of photosynthesis, the remarkable process enabling plants to harness sunlight and convert it into vital chemical energy. Acting as nature's solar panels, chlorophyll molecules absorb light, particularly in the red and blue spectrums, while reflecting the green wavelengths that give plants their distinctive color(Scholes, Fleming, Olaya-Castro, & Van Grondelle, 2011). This absorbed light energy initiates a transformative journey within plants, powering the intricate dance of photosynthesis. Chlorophyll plays a pivotal role in this process, facilitating the conversion of light energy into usable chemical forms, essential for the production of glucose from carbon dioxide and water. Its involvement in splitting water molecules releases oxygen into the atmosphere, a crucial byproduct supporting life on our planet. Beyond sustaining plant growth and development, chlorophyll acts as a health indicator, with its presence and quantity reflecting a plant's vigor(Swoczyna, Kalaji, Bussotti, Mojski, & Pollastrini, 2022). Sensitivity to temperature changes and its role in photoprotection further underscore its significance in ensuring plant vitality. Chlorophyll's profound function extends far beyond its role as a pigment, it's a key player in the intricate web of life, fueling the very foundation of our ecosystems and sustaining life as we know it.

ii. Carotenoids

Carotenoids, found in plants, are crucial pigments that perform various essential functions beyond providing vibrant colors to fruits and vegetables. These compounds serve as key players in photosynthesis, complementing chlorophylls by capturing light across a wider spectrum. This aids in efficient energy production for plants. Additionally, carotenoids act as powerful antioxidants, shielding plant cells from damage caused by excess light and reactive oxygen species. They also contribute to hormone synthesis vital for plant growth and help plants endure stressful conditions(Swapnil, Meena, Singh, Dhuldhaj, & Marwal, 2021). Nutritionally, carotenoids offer valuable benefits, serving as precursors to essential vitamins and supporting human health. Their diverse roles underscore their significance in plant biology, ecosystem resilience, and human nutrition.

iii. Anthocyanins

Anthocyanins, a subgroup of flavonoids, are vibrant pigments responsible for the red, purple, and blue colors seen in various parts of plants, such as leaves, flowers, fruits, and

stems. Beyond their visual allure, anthocyanins play diverse and essential roles in plants. These pigments act as a defense mechanism against various environmental stresses, including UV radiation and extreme temperatures. They function as antioxidants, helping plants combat oxidative stress caused by factors like high light intensity or pollution. Anthocyanins also attract pollinators and seed dispersers through their vivid colors, aiding in reproduction(Liu et al., 2018). Moreover, they contribute to regulating plant growth and development, impacting traits like leaf coloration, fruit ripening, and even resistance to pathogens. Their multifaceted role in plant physiology highlights the significance of anthocyanins not only in adding visual beauty to the natural world but also in ensuring plant health, resilience, and successful reproduction(Pervaiz, Songtao, Faghihi, Haider, & Fang, 2017).

iv. Betalains

Betalains represent a unique class of pigments found in some plants, primarily in the order Caryophyllales, and are responsible for providing vibrant red, violet, and yellow hues to various plant tissues, such as flowers, fruits, and stems(Khan & Giridhar, 2015). Unlike other common plant pigments like chlorophylls and carotenoids, betalains do not coexist with them in the same plant tissues. These pigments possess antioxidant properties, aiding in protecting plant tissues from oxidative stress induced by environmental factors like excessive sunlight or pollutants. Additionally, betalains are believed to play a role in the plant's defense mechanisms against pathogens and herbivores, although further research is ongoing to elucidate their precise functions in this regard. Moreover, betalains have attracted attention due to their potential health benefits for humans. Some studies suggest that betalains may possess anti-inflammatory, antioxidant, and potentially even anti-cancer properties(Rahimi, Abedimanesh, Mesbah-Namin, & Ostadrahimi, 2019). Consequently, certain betalain-rich fruits and vegetables are considered valuable additions to the human diet, contributing to overall health and well-being.

v. Flavonoids

Flavonoids, a diverse class of plant secondary metabolites, play multifaceted roles in the physiology and defense mechanisms of plants. These compounds are renowned for their vibrant pigmentation, contributing to the rich colors of flowers, fruits, and leaves. Beyond their visual allure, flavonoids serve pivotal functions in plants. They act as UV filters, shielding plants from the harmful effects of ultraviolet radiation, thus preventing DNA damage and cell degradation. Additionally, flavonoids participate in plant defense against

various stresses, including pathogens and herbivores, by acting as antioxidants and antimicrobial agents. Their antioxidant properties help neutralize harmful free radicals, protecting plant cells from oxidative stress. Moreover, flavonoids aid in signaling processes, influencing plant growth, development, and reproduction(Samanta, Das, & Das, 2011). They also play a role in regulating auxin transport, affecting plant hormone levels crucial for growth and organ development. Furthermore, these compounds contribute to plant-pollinator interactions, attracting beneficial insects and animals for pollination and seed dispersal through their appealing colors and scents. Overall, flavonoids showcase a remarkable versatility in plants, offering protection, support in growth and reproduction, and fostering ecological interactions essential for plant survival and propagation.

vi. Phycobilins

Phycobilins, pigment molecules found in certain photosynthetic organisms like cyanobacteria, red algae, and some cryptophytes, serve pivotal roles in photosynthesis. These pigments play a crucial role in capturing light energy in regions of the spectrum where chlorophylls are less efficient, such as in deep water or low-light environments. They absorb light wavelengths that chlorophylls cannot, transferring this energy to chlorophyll for photosynthesis. Phycobilins also act as antenna pigments, funneling captured light energy towards the photosystems within cells, enhancing the overall efficiency of photosynthesis in these organisms(Stadnichuk & Kusnetsov, 2023). Additionally, their unique spectral properties make them valuable tools in various scientific fields, including fluorescence microscopy and biotechnology applications. These pigments, by expanding the range of light absorption and energy transfer in photosynthetic organisms, contribute significantly to their survival and productivity in diverse environmental conditions.

Conclusion

The diverse array of plant pigments reveals their critical roles beyond adding vibrant colors to our natural world. Chlorophyll, the cornerstone of photosynthesis, powers plants' conversion of sunlight into chemical energy, sustaining life as we know it. Carotenoids complement chlorophylls, contributing to energy production, acting as antioxidants, and supporting plant growth. Anthocyanins, vibrant pigments in red, purple, and blue hues, offer defense against stress, aid in reproduction, and regulate growth. Betalains, known for their striking colors, safeguard plants from environmental stress and potentially provide health benefits for humans. Flavonoids, versatile compounds, protect against UV radiation, defend

against pathogens, and aid in signaling and pollination. Phycobilins, found in specific photosynthetic organisms, optimize light capture and energy transfer, essential for survival. These pigments collectively underscore the intricate balance and resilience of plants, influencing ecosystem dynamics, human nutrition, and scientific advancements. Understanding their roles unlocks the potential for sustainable agriculture, ecological preservation, and innovative applications in various fields.

References

Khan, M. I., & Giridhar, P. (2015). Plant betalains: Chemistry and biochemistry. *Phytochemistry*, *117*, 267-295.

Lee, D. (2017). *Nature's Fabric: Leaves in Science and Culture*: University of Chicago Press.

Lev-Yadun, S. (2016). *Defensive (anti-herbivory) coloration in land plants*: Springer.

Liu, Y., Tikunov, Y., Schouten, R. E., Marcelis, L. F., Visser, R. G., & Bovy, A. (2018). Anthocyanin biosynthesis and degradation mechanisms in Solanaceous vegetables: A review. *Frontiers in chemistry*, *6*, 52.

Pervaiz, T., Songtao, J., Faghihi, F., Haider, M. S., & Fang, J. (2017). Naturally occurring anthocyanin, structure, functions and biosynthetic pathway in fruit plants. *J. Plant Biochem. Physiol*, *5*(2), 1-9.

Rahimi, P., Abedimanesh, S., Mesbah-Namin, S. A., & Ostadrahimi, A. (2019). Betalains, the nature-inspired pigments, in health and diseases. *Critical reviews in food science and nutrition*, *59*(18), 2949-2978.

Samanta, A., Das, G., & Das, S. K. (2011). Roles of flavonoids in plants. *Carbon*, *100*(6), 12-35.

Scholes, G. D., Fleming, G. R., Olaya-Castro, A., & Van Grondelle, R. (2011). Lessons from nature about solar light harvesting. *Nature chemistry*, *3*(10), 763-774.

Stadnichuk, I. N., & Kusnetsov, V. V. (2023). Phycobilisomes and Phycobiliproteins in the Pigment Apparatus of Oxygenic Photosynthetics: From Cyanobacteria to Tertiary Endosymbiosis. *International Journal of Molecular Sciences*, *24*(3), 2290.

Swapnil, P., Meena, M., Singh, S. K., Dhuldhaj, U. P., & Marwal, A. (2021). Vital roles of carotenoids in plants and humans to deteriorate stress with its structure, biosynthesis, metabolic engineering and functional aspects. *Current Plant Biology, 26*, 100203.

Swoczyna, T., Kalaji, H. M., Bussotti, F., Mojski, J., & Pollastrini, M. (2022). Environmental stress-what can we learn from chlorophyll a fluorescence analysis in woody plants? A review. *Frontiers in Plant Science, 13*, 1048582.

Article Id
AL04287

FOOD SECURITY: FUELING COMMUNITIES AND SUSTAINING NATIONS

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Food is the most fundamental need for maintaining human life. People would still survive even if they have no clothing or a roof over their heads but receive a healthy diet. It is impossible to overestimate the significance of food in human life. The vital vitamins, minerals, and nutrients that our bodies require to function effectively are found in food. A balanced diet is essential for avoiding malnutrition, preserving good health, and lowering the chance of developing a number of diseases. Food also serves as our primary source of energy that is required for our daily activities. Proper nutrition can positively impact mental health. Adequate nutrition during childhood and adolescence is crucial for growth and development.

Food is not only essential for human survival, but it's also essential to human health, culture, economy, and cohesiveness in society. A thriving and healthy global society depends on recognizing the significance of food and ensuring that every individual has access to nutritious and safe food. Therefore it is essential to ensure access to sufficient, safe, and nutritious food for individual as well as societal well-being.

The Concept of Food Security

Based on the 1996 World Food Summit, food security is defined when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Food security is a concept that refers to the condition in which all individuals in a society have consistent access to sufficient, safe, and nutritious food to meet their dietary requirements and preferences for an active and healthy life. Food security is a critical global issue that intersects the fields of social welfare, agriculture, economics, and nutrition. It stands for the capacity of individuals, communities, and nations to guarantee steady access to safe, nutritious food that satisfies their dietary requirements and preferences for an active and healthy lifestyle. Achieving food

security involves more than just producing enough food; it also includes making sure that everyone, everywhere, has consistent access to the nutrition they need, regardless of socioeconomic background or location.

The term "**Food and nutrition security**" is used to combine the aspects of food security and of nutrition security as well as to point out the idea that they are related. It is a condition when adequate food in terms of quantity, quality and safety is available, accessible and satisfactorily utilized by all individuals at all times.

Dimensions of Food Security

There are four vital dimensions of food security that are used for assessing and understanding the overall state of food security in a particular area or population. These dimensions offer a comprehensive perspective of the multiple aspects of food security.

- **Physical availability of food:** Food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels and net trade.
- **Economic and physical access to food:** An adequate supply of food at the national or international level does not in itself guarantee household level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets and prices in achieving food security objectives.
- **Food utilization:** Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals are the result of good care and feeding practices, food preparation, diversity of the diet and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.
- **Stability of the other three dimensions over time:** Even if your food intake is adequate today, you are still considered to be food insecure if you have inadequate access to food on a periodic basis, risking a deterioration of your nutritional status. Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status.

Each of these dimensions is related to the others and adds to the total evaluation of food security. Policymakers and organizations can more effectively design strategies and

interventions to address challenges related to food security by having a better understanding of the strengths and vulnerabilities within each dimension. To provide a comprehensive picture of the state of food security and direct initiatives to increase food security for communities and populations, food security analysis takes into account a variety of indicators and data sources related to these dimensions.

Procedure to Conduct a Food Security Analysis

The methodical process of analyzing and assessing the state of food security in a particular area, community, or population is known as food security analysis. It involves evaluating a range of elements and aspects pertaining to food stability, availability, access, and use in order to assess the general well-being of people and communities. Analyzing food security makes it easier to pinpoint obstacles, weak points, and chances to create effective plans and actions.

At the very outset there should be a clear description of the purpose and scope of the analysis. According to the purpose of analysis relevant data, such as household surveys, agricultural statistics, market prices, nutritional data, etc. should be collected from a wide range of sources, like local communities, NGOs, government agencies, and international organizations. To measure and assess the different dimensions of food security, significant indicators related to food security, such as food availability, availability, utilization, stability, and vulnerability should be identified and selected. To assess the food availability situation, food production of the particular area, including crop yields, livestock, and fisheries should be recorded. To assess the economic and physical access to food, variables such as income levels, food prices, employment opportunities, market accessibility, transportation infrastructure, and the presence of food outlets should be considered. To assess the food utilization, the population's consumption patterns and diets for nutritional quality should be analysed considering dietary variety, micronutrients consumption, and the frequency of malnutrition, including undernutrition, wasting, and stunting. To assess the food stability over time, capacity of the area to sustain food access during economic volatility, climate-related issues, natural calamities, and rivalries should be determined. Along with these dimensions, segments of the population that are at risk, including women, children, the elderly and underprivileged groups and their ability to handle crises and adaptability to food insecurity are to be determined.

When sufficient data on different aspects are collected, appropriate statistical and analytical tools are to be applied in order to process and interpret the data. The collected data and indicators are to be analysed in order to draw conclusions regarding the area's state of food security. The underlying causes of food insecurity and possible solutions are also to be determined.

Conclusion

Food security is not just increasing food production, but ensuring that every person has steady access to safe and nutritious food. It is a vital human right and a major sign of a healthy society. Food insecurity can result in hunger, malnutrition, and a number of different health and social problems. For human progress, economic stability, and international peace, food security is a must. It involves an interdisciplinary strategy that tackles production, distribution, and equality concerns. To create a sustainable and food-secure future every individual should work together to address these issues. Global food security is a challenge that calls for an amalgamation of social policies, economic development, equitable distribution, and efficient agricultural practices. It is especially crucial in context of the world's expanding population and affects of climate change on food production. Thus analysing the food security situation is extremely necessary to tackle the food security related issues. A food security analysis is a complex process that involves investigating a number of variables and indicators to determine the condition of food security in a particular area or population.

References

Pangaribowo, E. H., Nicolas, G. and Maximo, T. (2013): Food and nutrition security indicators: A review. *ZEF Working Paper Series*, University of Bonn, Center for Development Research (ZEF), Bonn. DOI: http://dx.doi.org/10.2139/ssrn.2237992

Shakeel, A., Jamal, A. and Zaidy, N. (2012). A regional analysis of food security in Bundelkhand region (Uttar Pradesh, India). Journal of Geography and Regional Planning, 5(9): 252-262

World Bank (2023). What is Food Security? https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security. Accessed on 2 November 2023.

Article Id
AL04288

FOSTERING SUSTAINABLE AGRICULTURE: A SYNERGISTIC APPROACH TO PROMOTING YOUTH EMPLOYMENT AND REDUCING CHILD LABOUR

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The agricultural sector, serving as a linchpin for the economies of many developing nations, faces a conundrum marked by the coexistence of youth unemployment and child labor. This writeup undertakes a comprehensive exploration of these two intertwined challenges, elucidating their distinctions and unraveling the intricate linkages between them. Moreover, we will delve into the potential of initiatives designed to concurrently reduce child labor and promote youth employment, offering a cohesive pathway for sustainable agricultural development.

Understanding the Differences Between Youth Employment and Child Labour

Youth employment and child labor, though distinct, share a complex relationship that necessitates a nuanced examination. Youth employment encapsulates individuals aged 15-24 involved in economic activities, formal or informal, with the objective of sustaining a livelihood. Conversely, child labor involves the exploitation of children under 18 through work that deprives them of their childhood, interferes with regular schooling, and poses mental, physical, social, or moral harm.

Critical to note is that not all forms of youth employment equate to child labor. Many young individuals engage in legitimate work, positively contributing to agricultural activities without compromising their well-being. Recognizing these differences lays the groundwork for formulating effective strategies that support youth development while simultaneously eradicating exploitative child labor practices.

Understanding the Linkages

Youth unemployment is intricately linked to the prevalence of child labor within the agricultural sector. The scarcity of opportunities for young people, coupled with limited access to education and vocational training, creates an environment conducive to child labor.

In situations where youth struggle to secure employment, families may resort to sending their children to work, intending to augment household income.

This cyclical relationship exacerbates as child labor perpetuates a cycle of limited education, restricting the skills and opportunities for future employment. Breaking this intergenerational cycle necessitates a comprehensive understanding of the root causes, urging an integrated approach that addresses both youth unemployment and child labor concurrently.

Initiatives to Reduce Child Labour and Promote Rural Youth Employment

Numerous global initiatives have been implemented to tackle child labor and promote youth employment within agriculture. One notable approach involves substantial investments in education and skills development for both children and young adults. Enhancing access to quality education and vocational training equips youth with the skills necessary for gainful employment within the agricultural sector.

Additionally, targeted programs offering financial support to vulnerable families can alleviate economic pressures that drive child labor. Conditional cash transfer programs, for example, can incentivize families to keep their children in school rather than sending them to work in the fields.

A synergistic approach entails integrating efforts to reduce child labor with initiatives focused on creating viable employment opportunities for youth in rural areas. This can be achieved through the development of agricultural value chains that provide diverse employment options, including agribusiness, agro-processing, and sustainable farming practices.

Conclusion

In summary, addressing the challenges of youth unemployment and child labor in agriculture demands a holistic and integrated approach. Understanding the distinctions between these two phenomena is crucial, as is recognizing the linkages that intertwine them. Initiatives aimed at reducing child labor and promoting rural youth employment can collaboratively create a sustainable and inclusive agricultural sector.

Investments in education, skills development, and targeted financial support can break the cycle of poverty driving child labor. Concurrently, fostering an environment that promotes youth employment through diversified agricultural activities ensures a brighter and

more sustainable future for both individuals and communities. Through collaborative efforts and a commitment to addressing these challenges at their roots, we can pave the way for a more prosperous and equitable agricultural sector.

References

Promoting youth employment and reducing child labour in agriculture. (n.d.). FAO Elearning Academy. https://elearning.fao.org/course/view.php?id=389

White, B. (2012). Agriculture and the generation Problem: Rural youth, employment and the future of farming. IDS Bulletin, 43(6), 9–19. https://doi.org/10.1111/j.1759-5436.2012.00375.x

Miller, M. E., & Lee, B. C. (2014). Developing a model policy on youth employment in agriculture. Journal of Agromedicine, 19(3), 249–257. https://doi.org/10.1080/1059924x.2014.887487

Article Id
AL04289

CLIMATE SMART FISHERIES AND AQUACULTURE

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In addition to sustaining human well-being and livelihoods, conserving ecosystems, and offering priceless natural services, aquatic systems are home to an extensive number of species.

Communities that are close to freshwater and the seashore especially need these systems. It provides them food and employment in sectors like transportation, recreation, fishing, and aquatic farming. 10–12 percent of people on the planet are guaranteed a living because of this industry.

Over 71 percent of our globe is covered with water, which includes:

• Maritime resources, such as seas, deltas, and oceans
• Freshwater assets, such as lakes and rivers

International recognition of the significance of freshwater and marine resources has been established.

Humans also benefit significantly from the natural services that aquatic systems provide, such as:

- Oceans are the main climate regulators and a significant sink for greenhouse gases.
- Sea grass and phytoplankton, microscopic marine algae, which reside on the water's surface and in its column, help to produce oxygen.
- Since the 1980s, the seas have probably absorbed 20–30% of all anthropogenic carbon dioxide (CO_2) emissions.
- Freshwater and coastal regions serve as home to a wide range of aquatic creatures, including fishery resources.

- Mangrove forests lessen the effects of storms and create natural barriers in coastal areas, which help to prevent natural disasters.

Many populations, especially those in developing nations and Small Island Developing States (SIDS), rely heavily on the marine, coastal, and freshwater ecosystems for their livelihoods and food security.

Many internationally agreed-upon development targets have been created to address SIDS vulnerabilities and to build resilience and sustainability since SIDS were defined as a unique group during the 1992 Earth Summit.

Security of Food And Nutrition Employment & Economy

Millions of people worldwide rely on fisheries and aquaculture for a significant portion of their food security. With the exception of aquatic plants, the sector's total global production reached a peak of 172.6 million tonnes in 2017, with 46% coming from aquaculture and 54% from capture fisheries.

Food fish consumption increased from 9.0 kg in 1961 to 20.3 kg in 2017 per person. In many coastal, riverine, insular, and inland regions, fisheries and aquaculture activities provide a vital source of income. Fisheries and aquaculture constitute the primary sector, employing an estimated 60 million people. Approximately 19% of workers in the primary sector are women, and if the secondary sector is included, the percentage rises to over 50% notably enhancing the security of food globally. Transportation, the extraction of oil and gas, dredging for ports and other facilities, and the tourism and recreational industries are some of the other economic sectors that depend on aquatic systems for employment.

Subsectors of Fisheries And Aquaculture

1) Inland capture fishery- The practice of harvesting out of living aquatic creatures from artificial or natural inland waters and includes dams, inland canals, lakes, rivers, brooks, streams, ponds, and other landlocked freshwater bodies.

2) Aquaculture- Raising aquatic life in freshwater or saltwater through aquaculture. Aquaculture products that are commonly farmed include fish, crustaceans, molluscs, and aquatic plants.

3) Marine capture fishery- The act of extracting living aquatic organisms from marine waters which include adjacent saltwater areas and oceans however, certain countries classify coastal lagoons or deltas as inland waters.

Value Chain

All economic endeavours and subsectors that either directly or indirectly support the fisheries and aquaculture industry are included in the value chain.

- Pre harvest- Activities include building boats, making gear, and producing fish feed before fish are harvested or captured.
- Harvest -Activities that are done when harvesting, capturing and landing fish.
- Post harvest -Activities carried out following the harvesting, capturing, and landing of fish, such as:

• Processing: This category includes tasks like freezing, salting, filleting, smoking, and cleaning.

• Marketing: This category includes retail and sales activities.

However, the global mean temperature has significantly increased over the last 150 years, along with modifications to precipitation patterns and an increase in the frequency and severity of extreme weather events which is referred to as Climate change.

The ultimate consequence of rising greenhouse gas (GHG) concentrations in the atmosphere as a result of human activity intensifying the greenhouse effect, the increased sun heat is held in reserve warming the Earth's surface and atmosphere.

Effects of Climate Change

Earth's global temperatures rise as a result of global warming which affects oceans, coastal regions, and inland areas, including air and sea surfaces hydro bodies leading to melting glaciers, increasing average sea level worldwide, modifications to river discharge and hydrology, modifications to the patterns of precipitation that result in droughts or floods, an increase in the frequency of extreme weather events like tropical cyclones

Numerous ecosystems, both inland and marine, are consequently being impacted.

In marine waters, sea water warming and acidification which leads to coral reef bleaching and increasing the rate of fish mortality. While in inland waters, the increase in temperature leads to changes in habitat and reproduction.

Climate change also harshly impacts the vulnerable people and threatens the food security of the nation. The population of the world is predicted to reach 9.7 billion by 2050. According to FAO estimates, there will be a 50% increase in agricultural demand by 2050 compared to 2013.

Climate Smart Agriculture (CSA)

In order to effectively support sustainable development and ensure food security in the face of climate change, food production systems must be transformed and reoriented. This is achieved through the use of the CSA approach. Increased productivity, climate change adaptation and mitigating or eliminating greenhouse gas emissions are the three challenges that CSA tackles.

Four Sustainable Development Goals (SDG) are associated with CSA

- End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition, promote sustainable agriculture
- Take urgent action to combat climate change and its impacts
- Conserve and sustainably use the aquatic resources for sustainable development

Climate Smart Strategies

In order to implement CSA, an environment that is conducive to change must be established. This can be done by implementing sound policies, building strong institutions, securing funding, and disseminating contextually appropriate practices and technologies. As a result, strategies are built upon a mix of:

- Local initiatives like raising fish that are more resilient to environmental change
- Landscape and value chains like Integrated crop-fisheries systems
- Enabling environment , for instance, social safety nets and water tenure

Thematic Areas

The goal of CSA is to minimize any potential negative trade-offs between the related factors of climate change adaptation, mitigation, and increased productivity and income. The three primary thematic areas of climate-smart agriculture are listed below:

- Reducing and/or removing emissions of GHGs, where possible
- Adapting and building resilience to climate change
- Sustainably increasing agricultural productivity and incomes

Future Development and Challenges

Good practices and instruments are still being developed and adjusted to account for climate variability and change. As these continue to be refined and more knowledge about climate-smart practices and policies is acquired, more detailed instructions will be given.

Nonetheless, creating quick fixes for climate change in the fishing and aquaculture industries and integrating climate-responsive methods is an important operational and strategic move.

A number of limitations frequently prevent the creation of useful advice including

- Insufficient data and information to support specific decisions.
- Traditional methods of confirming evidence won't always work.
- Requirement for developing experience via an action-based, adaptive management process
- Learning involving many participants and information exchanged between stakeholders.
- To investigate the nature of climate change vulnerability in more detail.

Facilating The Transition to CSA

The general routes and mechanisms for advancing towards more robust and resilient systems are known, notwithstanding the uncertainties and lack of experience with CSA practices, as mentioned below:

- Capacity-building
- Multisectoral incentives

- Long-term planning
- Low-cost local adaptations
- Market support
- Public and private investment
- Improved management

Conclusion

Both freshwater and marine aquatic ecosystems support coastal ecosystems and processes and are essential to many vulnerable communities' food security and means of subsistence, especially in developing nations.

However, the production of food is impacted by these systems due to climate change including the dependent communities' security, health, and incomes. Therefore, it is imperative to offer sufficient responses to the threat posed by climate change. Furthermore, fisheries are vital for trade, food, and livelihoods, but their potential is limited by the condition of the resource base.

The goal of Climate Smart Agriculture (CSA) is to create policies that will effectively support sustainable development and guarantee food security in the face of climate change by transforming and reorienting food production systems. It comprises of establishing change-friendly conditions (such as financing and policy), as well as the propagation of regional customs

The implementation of these strategies with diligence will lessen the effects of climate change, enhance the sector's potential for mitigation, and boost the resilience of producers, supply chains, and communities. However, it should be noted that optimizing all CSA variables simultaneously is unlikely to be feasible, and it might not even be necessary. The context and goals of the fisheries and aquaculture sector in a particular area, as well as the production system overall, will determine which actions should be prioritized. Practical measures must be developed to guarantee that the most vulnerable states, production systems, communities, and individuals have the ability to develop and implement sound CSA approaches.

References

Food and Agriculture Organization .(2020).Climate-smart fisheries and aquaculture. FAO elearning Academy. https://elearning.fao.org/course/view.php?id=579

Article Id
AL04290

NEW PERSPECTIVES ON THE UTILIZATION OF INSECTS AS A FEED SOURCE IN AQUACULTURE

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Aquaculture plays a pivotal role in global food security by producing a significant portion of the world's fish and seafood. However, challenges such as soaring prices of conventional feed ingredients and the over-exploitation of natural resources hinder its production. To address these challenges, innovative strategies, particularly the use of non-conventional feed ingredients, are being explored in aquaculture. This includes incorporating plant-based products, algae, single-cell protein, and insect meal to ensure sustainable food production. Among these alternatives, insects show substantial promise as a substitute for fishmeal. The vast amount of food and agriculture waste, approximately 1.3 billion tons from the supply chain, poses a significant environmental threat. Insects, being small organisms, can thrive on organic waste, offering a solution for bioconversion and nutritional up-cycling. With the ability to recover nutrients from waste aquaculture products and the natural inclination of many fish species to feed on insects, incorporating insects into aquaculture practices emerges as an environmentally friendly approach. This article provides insights into emerging non-conventional feed ingredients, with a particular focus on insects. It delves into the nutritional value of insects, the factors influencing it, potential insect species suitable for aquaculture, the physiological response of fish to insect meal, techno-functional properties of insect meal, and innovative approaches to address potential drawbacks. The review concludes by suggesting avenues for further research into these inventive fishmeal replacements.

Environmental Benefits of Incorporating Insects into Fishmeal Diets

Global environmental challenges, such as the excessive use of natural resources, loss of biodiversity, and escalating pollution levels, have a direct impact on the Earth's climate. This reality is substantiated by scientific reports and data spanning the last few decades

(Almond et al., 2020). Diverse strategies have been implemented to address these environmental issues, with the bioeconomy concept emerging prominently. Bioeconomy is centered on the utilization of food waste or algae (Fraga-Corral et al., 2022). The rapid growth of the world population necessitates a continuous supply of protein while minimizing environmental repercussions (Tilman & Clark, 2014). Recent research indicates that adopting insect-based meals could have a positive environmental impact when carefully selecting the diet. For instance, integrating yellow mealworms into the rainbow trout diet led to a decrease in net primary production use, although it did not alter land use, global warming potential, eutrophication, or energy demand. Conversely, the inclusion of *Hermetia illucens* in the arctic char diet demonstrated notable reductions in environmental impacts, specifically abiotic depletion, global warming potential, acidification, and land use. These findings highlight the potential of insect-based diets to mitigate environmental concerns in aquaculture.

Nutrient Content of Insects

Globally, there exist approximately one million insect species, playing indispensable roles in maintaining the balance of food chains and ecosystems. Despite the prevailing perception of insects as pests among the majority of Europeans, these creatures serve as a dietary staple in 100 countries (De Castro et al., 2018). Insects, constituting the largest class of arthropods, have a rich history as a human food source, with certain species, such as silkworms and honeybees, being successfully domesticated (Lecocq, 2019). Recognized for their high protein content, insects are increasingly considered a valuable alternative to fishmeal, especially as aquaculture production continues to expand. In addition to their protein richness, insects offer a well-balanced amino acid composition and high digestibility, making them suitable substitutes for fishmeal in the aquaculture industry. While numerous insect species have the potential to serve as food, only a select few have been successfully domesticated. The protein content in insects varies from 25 to 75 percent (DM) and is characterized by a favourable amino acid profile (Finke, 2015; Oonincx et al., 2011). The protein factor calculated by multiplying nitrogen content by protein, is established at 6.2, providing a reliable measure for determining crude protein content in insect-based meals. Overall, insects emerge as an excellent protein source for aquaculture, aligning with the increasing demand for sustainable alternatives to traditional feed sources like fishmeal.

Functional Characteristics of Insect Meals

Insect proteins exhibit numerous favourable characteristics that make them suitable for both food and feed applications. However, a crucial step in their integration into food and feed is the assessment of their functional properties (Gravel & Doyen, 2020). The techno-functional properties of insect protein, encompassing solubility, water and oil holding capacity, gelling, and emulsification, dictate the application of various food processing methods to enhance the overall quality of insect-based food products (Villaseñor et al., 2021). Numerous studies have explored strategies to improve the functional properties of insect protein through suitable processing methods (Gravel & Doyen, 2020). Commonly employed techniques include drying, defatting, and extraction, all aimed at enhancing the functional attributes of edible insect proteins (Kim et al., 2022). Fractionation processing, which increases the protein content, has been identified as a method to enhance the functionality of insect proteins, as reported by Kim et al. in 2020 for *Tenebrio molitor*, *Protaetia brevitarsis*, and *Allomyrina dichotoma*. Additionally, enzymatic hydrolysis stands out as another important method for augmenting the functionality of insect proteins (Gravel and Doyen, 2020; Purschke et al., 2018). These processing approaches play a pivotal role in optimizing insect proteins for various food and feed applications by improving their functional characteristics.

Potential Insects Used as Fishmeal

Over the past two decades, numerous studies have aimed to reduce the reliance on fishmeal, fish oil, and their by-products in the aquaculture sector. This effort has led to an increased utilization of plant-derived ingredients in fish feed. However, when compared to diets based on fishmeal, the inclusion of these components in aquafeeds puts greater strain on water and land resources and results in increased waste generation. Various protein alternatives have been explored for fish feed, with insect meal and fishery by-products emerging as promising candidates to meet the protein requirements of aquafeed in the coming decades. The successful substitution of fishmeal with insect meal in the diets of numerous freshwater and marine fish species has been extensively reviewed for several aquatic species (Villaseñor et al., 2021).

Use of Insects as Potential Feed Ingredient

The utilization of insects as fish feed ingredients represents a relatively novel approach in the aquaculture sector. Currently, a diverse array of insect species is employed in aquaculture practices, including rat tail maggots (*Musca domestica*), black soldier flies (*H. illucens*), silkworm pupae (*Bombyx mori*), grasshoppers, termites, and mealworms (*T. molitor*), among others. The broader availability across various taxa, coupled with high protein content and favorable lipid profiles, positions insects as promising candidates for replacing traditional fish meal. The potential replacement of fish meal with insect-based diets hinges on the nutritional profile of insects. Insect diets typically exhibit protein contents ranging from 50-82% on a dry matter basis, aligning with the protein content found in fish meal. Insect meal is particularly rich in essential amino acids such as lysine and methionine, with slight variations depending on the insect taxon. Notably, insect meal contains compounds like taurine and hydroxyproline, which are often deficient in plant-based diets. The lipid composition of insects is characterized by a higher concentration of polyunsaturated fatty acids (PUFA) n-6 compared to fish meal. Numerous studies have demonstrated positive outcomes when fish are fed with insect-based diets. These include increased growth rates and higher protein efficiency ratios, as observed in fish fed with *Zophobas variegatus*. Additionally, improved antioxidant activity and recovery from lesions, evident through enhanced haematological parameters like red and white blood cell counts, have been reported in fish fed with insect diets. It's important to note that results may vary based on factors such as fish and insect species, inclusion rates, and processing methods.

Challenges in Utilizing Insects as Fish Meal Alternatives

The exoskeleton of insects is primarily composed of the polysaccharide chitin. Despite the presence of chitinase enzymes, chitin in insects often remains indigestible for most fishes, leading to challenges in utilizing it as a feed ingredient. There have been reports of bioaccumulation of pesticides in fish through the consumption of insects. Additionally, the low content of PUFA in terrestrial insects diminishes their suitability as feed for marine fish. The mass production of insects for aquaculture is still in a developmental stage, emphasizing the need for future studies focused on technological advancements to enhance insect production and better understand the impact of insect meal on fish health. A significant limitation in using insects is the presence of toxic compounds that can adversely affect fish physiology, potentially leading to reduced growth and alterations in hematological

parameters. However, substituting fish meal and fish oil with *H. illucens* meal has shown promise in reducing the levels of certain potentially toxic elements, such as Ni, As, and Pb, in fish feed, ensuring that harmful chemical concentrations remain below permissible limits (Truzzi et al., 2022). Furthermore, the successful incorporation of insect meal into aquaculture practices depends on the acceptance of both aquaculture producers and consumers. Without consumer acceptance, the widespread adoption of insects in the aquaculture sector becomes challenging. Another substantial challenge is accurately evaluating the factors involved in insect production, particularly transitioning from the wild catching of potential edible insects to their large-scale cultivation.

Conclusion

The incorporation of insect meals in fish nutrition represents a promising and sustainable avenue for addressing the challenges associated with traditional feed sources in aquaculture. Through extensive scientific investigation, it is evident that insect-based diets offer a viable alternative that not only meets the nutritional requirements of fish but also mitigates environmental concerns associated with conventional feed production. The diverse array of nutrients provided by insects, coupled with their efficient conversion rates and reduced ecological footprint, positions them as a key player in the quest for more sustainable aquaculture practices. As research in this field continues to evolve, it is anticipated that the integration of insect meals into fish diets will play a pivotal role in fostering a more resilient and ecologically responsible approach to aquaculture, contributing to the long-term health of both aquatic ecosystems and global food security. The ongoing research in this field is expected to yield further insights into optimizing insect-based diets for different fish species, improving production efficiency, and ensuring the economic viability of this alternative feed source.

References

Almond, R. E. A., Grooten, M., & Petersen, T. (2021). Living planet report 2020-bending the curve of biodiversity loss. *Natural Resources & Environment*, 35(3), 62-62.

de Castro, R. J. S., Ohara, A., dos Santos Aguilar, J. G., & Domingues, M. A. F. (2018). Nutritional, functional and biological properties of insect proteins: Processes for obtaining, consumption and future challenges. *Trends in Food Science & Technology*, 76, 82-89.

Fraga-Corral, M., Ronza, P., Garcia-Oliveira, P., Pereira, A. G., Losada, A. P., Prieto, M. A., & Simal-Gandara, J. (2022). Aquaculture as a circular bio-economy model with Galicia as a study case: How to transform waste into revalorized by-products. *Trends in Food Science & Technology*, 119, 23-35.

Gravel, A., & Doyen, A. (2020). The use of edible insect proteins in food: Challenges and issues related to their functional properties. *Innovative Food Science & Emerging Technologies*, 59, 102272.

Kim, T. K., Cha, J. Y., Yong, H. I., Jang, H. W., Jung, S., & Choi, Y. S. (2022). Application of edible insects as novel protein sources and strategies for improving their processing. *Food Science of Animal Resources*, 42(3), 372-388.

Kim, T. K., Yong, H. I., Chun, H. H., Lee, M. A., Kim, Y. B., & Choi, Y. S. (2020). Changes of amino acid composition and protein technical functionality of edible insects by extracting steps. *Journal of Asia-Pacific Entomology*, 23(2), 298-305.

Purschke, B., Meinlschmidt, P., Horn, C., Rieder, O., & Jäger, H. (2018). Improvement of techno-functional properties of edible insect protein from migratory locust by enzymatic hydrolysis. *European Food Research and Technology*, 244, 999-1013.

Tilman, D., & Clark, M. (2014). Global diets link environmental sustainability and human health. *Nature*, 515(7528), 518-522.

Truzzi, C., Girolametti, F., Giovannini, L., Olivotto, I., Zarantoniello, M., Scarponi, G., & Illuminati, S. (2022). New eco-sustainable feed in aquaculture: influence of insect-based diets on the content of potentially toxic elements in the experimental model zebrafish (*Danio rerio*). *Molecules*, 27(3), 818.

Villaseñor, V. M., Enriquez-Vara, J. N., Urias-Silva, J. E., & Mojica, L. (2022). Edible insects: Techno-functional properties food and feed applications and biological potential. *Food Reviews International*, 38(sup1), 866-892.

Article Id
AL04291

FOREST AND WATER NEXUS – INTRODUCTION

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Identify forest-water interactions in general, and with respect to different landscape scales; recognize pathways through which forests can influence water quantity, quality and timing; and explain how forest-water interactions result in environmental, economic and sociocultural benefits for people and the planet. First, I want to remind you why water and trees - within and outside forests - are among the most important natural resources for people on planet Earth. Together, they: host a large part of Earth's biodiversity provide food and energy. Trees and water are highly interdependent resources that influence each other at various spatial and temporal scales, from one tree all the way to entire continents.

Tree-water Interactions

Trees and water interact in many ways:

Evapotranspiration:- The combined process of: loss of water through **evaporation** from the soil surface and rainwater trapped on leaves; **transpiration** through the leaf surface of water transferred from the roots to the leaves. These two processes occur simultaneously and the evapotranspired moisture enables precipitation.

Infiltration and groundwater recharge:- Tree roots and enhanced levels of soil organic matter from litter inputs improve soil structure and water infiltrating capacity.

Precipitation formation:- Release of biological particles from trees (spores, pollen, etc.) attracts atmospheric moisture and facilitates cloud formation and rainfall.

Fog/cloud trapping:- Trees in high altitudes have the ability to collect additional moisture from clouds and fog, adding to infiltration and groundwater recharge.

Flood moderation:- Trees and X their impact on soil reduce speed and quantity in stream flows and reduce erosion in local catchments (i.e. water capture areas).

Even though we often speak of the water cycle, there in fact two different water cycles, which are interdependent and vary according to temporal and spatial scales. The short (closed) water cycle refers to local circulation, above continents or oceans. The long (open) water cycle refers to the circulation between continents and oceans. By storing and transporting large amounts of water, forest ecosystems play an integral role in regulating the timing of water flows of both cycles.

Influence on Water Quality, Quantity and Timing

I understand the tree- water interactions and the role of forests in the water cycle, but I don't see how they directly influence water. The water cycle is complex, and there is a lot to unpack in order to understand its mechanisms. Let's focus on the influence of trees and forests on water quality, quantity and timing.

Water quality:- Forests play a key role in purifying water. They provide natural filtration of sediment, nutrients and pollution compounds transported in the water. Forest management practices can affect drinking water quality, locally and downstream. The regulation of water quality is one of the most important ecosystem functions of forests. It is estimated that nearly 800 million people - about 10% of the world's population - lack basic drinking water services. At least 2 billion people around 2 out of 10 people use unsafe drinking water sources that can cause diarrhoea, cholera, dysentery, typhoid and polio.

Water quantity and timing:- Now regarding water quantity, the water flow is not consistent throughout the landscape. The key factors affecting water quantity and flows in the landscape are: **Climate:-** Total rainfall amount and rainfall intensity, **Topography:-** Slope gradient and length, **Land cover**:-Vegetation type and density and **Soils:-** Texture and structure.

These factors influence the formation of water courses, as well as groundwater and soil saturation. Forest cover will intercept and slow runoff, increase infiltration and evapotranspiration while cleared, hard or built-up areas have fewer capabilities to perform these functions, and are more likely to be flooded and contribute to erosion. The relationship between forests and water quantity and timing is highly contextual, with many trade-offs to account for. We will explore those in more detail later.

Scale Matters and Optimal Density

Scale matters are mainly two types:-

1. **Temporal scale:-**To better understand whether forests are water users or recyclers, we should look at the temporal and spatial scales. Starting with the temporal scale, the tree life cycle is closely related to trends in the water cycle. Trees have different water requirements, depending on the life cycle stage they are at. However, the impacts of trees on water availability will also depend on factors such as the type of forest, tree density, tree species, and tree water-use efficiency. Forest restoration may positively impact water yields, depending on when the restoration started.

2. Spatial scales:- There is a variety of definitions of spatial scales. In this course, we will use the scales outlined in this publication from the International Union of Forest Research Organizations (IUFRO). **(a). Local scale:-**We will call the basin, watershed and catchment scales, the local scale'. At that scale, trees take up large quantities of water through their roots and increase infiltration of water into the soil. They use water to grow, and will optimize water use based on its availability: In areas where water input (precipitation) is not a limiting factor, forests will have a limited impact on water quantity, but a large impact on water quality. If water is a limiting factor, trees may have a larger impact on water quantity. **(b). Regional scale:-** The regional scale is the largest scale at which we can realistically manage forest-water interactions.

Evapotranspiration from forested areas is greater than from other vegetation types, and contributes to precipitation downwind, but sometimes reduces local water, since the precipitation generated is deposited outside the catchment. Changes in forest cover in a river basin could significantly impact evapotranspiration, influencing water flows at the regional scale. Managing forests or watersheds, understanding that evapotranspiration processes go beyond the watershed or even the basin, is very important. **(c). Global scale:-** The global scale- or continental scale - is where the long-term and large-scale effects that influence forest evapotranspiration, precipitation and cross-continental transport of atmospheric moisture take place. Forests produce massive amounts of atmospheric moisture- - more than most land cover types - so their cumulative global importance cannot be underestimated.

Optimal density:- It shows how different tree-water interaction vary, depending on forest cover density in this specific landscape. **(a). Open (degraded):-** without trees, surface runoff

and soil evaporation are high, leading to low soil moisture and groundwater recharge, despite low transpiration. **(b). Intermediate:-** With an intermediate canopy cover, low surface runoff and evaporation, as well as intermediate transpiration, optimize soil moisture and groundwater recharge. (c). **Closed:-** In closed forest, despite low surface runoff and soil evaporation, total transpiration and interception are high, again leading to low soil moisture and groundwater recharge.

Forests Are both Water Users and Water Recyclers and Forest-Water Ecosystems

Water saver:-Forests require water in their metabolism, as trees are living organisms, and therefore may reduce streamflow downstream.

Water recyclers:-Forest also contributes to atmospheric moisture and precipitation, groundwater recharge and soil moisture, thereby 'recycling' the water into the water cycle.

Water ecosystem services depend on various factors, such as scale, age or type of forest.

Peatlands depend on the presence of water for peat - organic material - to accumulate. Peatlands are the largest terrestrial carbon sink in the world, making them very important to address climate change. They also provide key habitats for biodiversity, act as natural filters providing good quality water, and can contribute to flood mitigation. When peat lands are drained, for example for agriculture, the peat is exposed and decomposes very quickly. This results in the rapid loss of stored carbon, which contributes to global greenhouse gas emissions. It will also negatively impact the provision of the other services I mentioned. Other examples of forest ecosystems include dryland forests, cloud forests and mangroves.

Benefits from Forest-Water Relationships

Forest-water interactions lead to many benefits, which are also called ecosystem services. They include water purification, carbon storage, protection against environmental hazards and providing habitats for biodiversity. To give a comprehensive explanation of the benefits brought by forest water interactions, we will distinguish between environmental, economic and sociocultural aspects. **Environmental benefits:-** We mentioned earlier that trees and forests contribute to: regulating water quantity and timing, supporting groundwater recharge**,** generating clouds through evaporation from the ground and transpiration from the leaves**,** filtering and purifying water and reducing soil erosion and sedimentation of water bodies. **Economic benefits:-** Wood and non wood forest products, Water for people &

industries, Coastal protection and improved soil. **Sociocultural benefits:-** Spiritual and cultural values, recreational values and social values.

Conclusion

The ability of forests to provide crucial water-related ecosystem services cannot be underestimated. Trees and forest regulate water quality by acting as a natural filter for nutrients, and by reducing soil erosion and sedimentation. Trees and forest regulate quantity and timing by slowing runoff, and increasing infiltration and evapotranspiration. Trees and forests are also crucial for water access in watersheds. They support the provision of accessible fresh water for human consumption and agriculture, and offer many other environmental, economic and sociocultural benefits. Many communities, including indigenous peoples, urban centre and agricultural communities, rely on forest-water relationships for their livelihoods, sustenance and wellbeing. In addition, the spiritual and cultural connections of local communities, such as indigenous peoples, to these ecosystem may form part of their indentify and livelihoods.

References

Bonnesoeur, V., Locatelli, B., Guariguata, M. R., Ochoa-Tocachi, B. F., Vanacker, V., Zhun, M., Stokes, A., & Mathez-Stiefel, S.-L. (2019). *Impacts of forests and forestation on hydrological services in the Andes: A systematic review*. Forest Ecology and Management, 433, 569-584.

Creed, I. F., & van Noordwijk, M. (Eds.). (2018). **Forest and Water on a Changing Planet: Vulnerability, Adaptation, and Governance Opportunities*. A Global Assessment Report.* IUFRO World Series Volume 38. Vienna. 192 pp.

Agroforestry Network. 2020a. Agroforestry and water for resilient landscapes.

Agroforestry Network. 2020a. Agroforestry value chains and market systems.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04292

MACHINERY HIRING SERVICES EMERGING AS A BOON TO THE FARMERS

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Agriculture, with its allied sectors, is the basis of the Indian economy that serves as a primary source of livelihood for a significant proportion of its population. More than half of India's workforce receives their major source of employment in agriculture, which also makes a significant contribution to the country's GDP. But the labour-intensive nature of agriculture is one of its main issues. It frequently involves a variety of manual labour-intensive tasks like planting, weeding, harvesting, and caring for livestock. According to a report published by Federation of Indian Chambers of Commerce and Industry (FICCI) in the year 2015, the percentage of agricultural workers in India has been gradually declining from 59.1% in 1991 to 54.6% in 2011 which is expected to further decline to 25.7% by 2050 leading to severe farm labour shortage. The crucial strategy to address this labour shortage is reducing labour use and maximizing labour productivity which heavily relies on availability and prudent use of mechanized power by the farmers.

Farm mechanization is essential for boosting the income of the farmers and increasing the agricultural productivity. The adoption of mechanization by the farmers depends on various factors such as socioeconomic conditions, geographical conditions, crops grown, irrigation facilities etc. Thus farm mechanization is one of the obligatory steps for transforming Indian agriculture. But more than 80% of the farmers in India are small and marginal farmers and thus farm mechanization is beyond the reach of these farmers due to their poor economic condition which makes them unable to afford the costly farm machineries. This compels the Indian farmers to dependent heavily on traditional practices of farming.

In north-eastern states of India, the level of mechanization is extremely low. Apart from the socioeconomic conditions of the farmers, the reasons behind this are hilly topography, high transportation cost, lack of state financing and dearth of agricultural

machinery manufacturing industries. Thus there is a constant emphasis of the Government of India to promote mechanization for all section of the society with the aim of increasing the reach of farm mechanization to small and marginal farmers and to region where availability of farm power is low.

What is Custom Hiring Centre (CHC)?

Custom Hiring Centre (CHC) is a unit consisting of a set of farm machinery, implements, and equipment that is provided to the farmers at affordable prices on a hiring basis that are owned and managed by community based organizations like Farmer Producer Organizations (FPOs)/ Voluntary Organizations (VO) and Non Governmental Organizations (NGOs). The primary objective of Custom Hiring Centres is to encourage agricultural mechanization by offering access to modern machineries and equipments to the small and marginal farmers who might not be able to purchase their own equipment.

How CHCs are Beneficial to the Farmers?

In the context of agriculture, Custom Hiring Centres (CHCs) are a critical concept, especially in nations like India. CHCs are designed to give farmers, especially small and marginal farmers access to a range of rental agricultural machinery and equipment. Farmers who might not be able to purchase these items separately now have access to a large variety of modern agricultural machinery and equipment through CHCs, including tractors, ploughs, seeders, harvesters, and irrigation tools. Moreover, renting machinery from CHCs is less expensive than buying and maintaining the machinery; thereby farmers save money on both the major initial expenditure and continuing maintenance costs.

The utilization of mechanized equipment from CHCs may considerably boost the productivity of farming practices by minimizing the time and effort involved in various tasks like land preparation, planting, harvesting, etc. By increasing the time efficiency CHCs also potentially enabling them to diversify their income sources or engage in other activities. Generally, mechanized operations are more precise and crop outcomes are also improved when planting and harvesting methods are consistent, which results in higher yields and better crop quality. Some of the modern machinery that can be obtained by the farmers from CHCs may make better use of resources like fertilizer and water, thereby encouraging environmental friendly and sustainable farming methods. If the harvesting and post-harvest operations are mechanized, post-harvest losses can be reduced to larger extent which can

further ensure that a greater percentage of the harvest reaches the market in good condition. Thus the income of the small and marginal farmers can also be improved with the help of the machinery rental service provided by the CHCs.

How CHCs are Beneficial to Their Owners?

Apart from the farmers CHCs also provide economic viabilities to their owners by generating revenue through machinery rentals and services. Owners can earn income by providing equipment to farmers for various agricultural activities. CHC could be a profitable business venture, especially in rural locations where there is a need for mechanized agricultural services. For business owners, it may be a reliable stream of revenue. CHCs stimulate rural entrepreneurship by enabling individuals to establish and manage their own businesses which help to generate employment and enhance economic activity in rural communities.

Government organizations also promote the establishment and operation of CHCs in various nations, including India by offering various incentives, subsidies, or grants. These assistance schemes from the government benefit the owners in making the establishment and operation of the centre financially feasible. In India, under Sub – Mission on Agricultural Mechanization (SMAM) scheme, financial assistance of 40% to 50% of the project cost is provided to rural youth and farmer as an entrepreneur, Cooperative Societies of Farmers, Registered Farmers Societies, Farmer Producer Organizations (FPOs) and Panchayats for establishment of Custom Hiring Centres (CHCs) and hi-tech hubs of high value agricultural machineries.

CHCs also generate employment opportunities for individuals in the rural areas as it often requires qualified mechanics and operators for the maintenance and operation of the machinery. Thereby providing necessary agricultural services and opening up job opportunities, CHCs may contribute to the overall advancement of rural areas and enhance the local economy.

Conclusion

Custom Hiring Centres are a part of initiatives to modernize and increase the productivity of agriculture in addition to encouraging rural entrepreneurship. They ultimately contribute to higher agricultural productivity by enabling small-scale and resource-constrained farmers to take advantage of the benefits of technology and mechanization. For

farmers, especially those with limited resources, Custom Hiring Centres are an invaluable resource because they give them access to technology and equipment that can improve livelihoods, advance agricultural practices, and advance rural development as a whole. Apart from facilitating the adoption of mechanized agriculture and improving the livelihoods of farmers in the rural areas, CHCs also provide their owners a platform for entrepreneurship, income generation, and community development.

References

FICCI. (2015). Transforming Agriculture through Mechanisation. https://gtw3.grantthorton.in/assests/Transforming_Agriculture_Through_Mechanisation.pdf Accessed on 12 July 2023.

GoI. (2023). Ministry of Agriculture & Farmers Welfare, Government of India. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1896139 Accessed on 13 July 2023.

ICFA. (2017b). National Round Table of CEOs on Mechanization. https://www.icfa.org.in/assets/doc/reports/RTC_Farm_Mechanization.pdf Accessed on 16 July 2023

GoI. (2019). Annual report 2019-20, Ministry of Agriculture & Farmers' Welfare, Government of India. https://agricoop.nic.in/sites/default/files/ACFW%20English%20%20Annual%20Report%202019-20.pdf Accessed on 25 July 2023.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04293

INTEGRATED WEED MANAGEMENT IN CHICKPEA

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For long term management of weeds in chickpea Integrated weed management (IWM) is the most beneficial option. For achieving economic and ecological goals of sustainable chickpea production with the least efforts.

Chickpeas are an important food in India, Africa and Central and South America. Pulses are the first thing that comes to mind when we talk about the nutritional security of the country. Among the pulses grown in India, chickpea ranks first in both production and area. It belongs to the legume family. The seeds are high in protein, fiber and are a good source of iron, phosphorus and folic acid.

One of the biggest challenges for growing chickpeas is weed control. Unlike cereals and oilseeds, legumes are generally not competitive with weeds and are highly susceptible to yield loss (20 to 40%) due to weed competition.

Problems Related To Weed Control in Chickpea

- ✓ Limited recommended herbicide available for chickpea.
- ✓ Continuous development of resistance in weeds against weeds.

Solution of above problem: Integrated weed management in chickpea

Integrated Weed Management (IWM)

IWM is an approach to weed management using multiple control tactics. The purpose of IWM is to incorporate many methods into the growing season to give producers the best chance to control problem weeds.

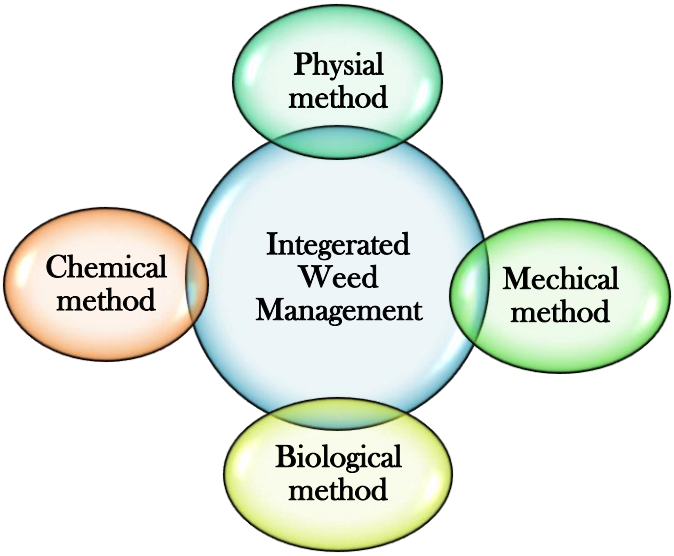

Fig. 1 Diagrammatic presentation of integrated weed management in chickpea.

Benefits of IWM in Chickpea

The advantage of IWM is that it combines different weed control methods used in agriculture and makes the best of the situation. This approach helps to find the most efficient and ecological options and avoid unnecessary use of chemicals. In addition to herbicides harming nature, crops and people, weeds tend to develop resistance to them. Even the repeated use of poisonous substances thus becomes a waste and a danger.

Conclusion

Integrated weed control is the coordinated use of different control methods, reducing reliance on herbicides alone and increasing the chances of successful control or eradication.

References

Ratnam, M., Rao, A. S., & Reddy, T. Y. (2011). Integrated weed management in chickpea (Cicer arietinum L.), *Indian journal of weed science*,43(1&2): 70-72.

Merga, B., & Alemu, N. (2019). Integrated weed management in chickpea (*Cicer arietinum* L.). *Cogent Food & Agriculture*, 5(1), 1620152.

Rathod, P. S., Patil, D. H., & Dodamani, B. M. (2017). Integrated weed management in chickpea (Cicer arietinum L.) under rainfed conditions of Karnataka, India. *Legume Research-An International Journal*, 40(3), 580-585

Article Id
AL04294

EXPLORING THE INTERSECTION OF TRADE, FOOD SECURITY, AND NUTRITION

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Trade is the connection between demand and supply through which human beings exercise their freedom to exchange goods and services. Presumably this leads to greater efficiency, and more variety and stability in consumption. Trade in day to day is shaping the global dynamics, influencing economies throughout the world, societies, and individual well-being. Of particular interest is the relationship between trade and its impact on food security and nutrition. This piece tries to dive into the interconnected dynamics of trade, food security, and nutrition, shedding light on how international trade shapes the availability, accessibility, and quality of food, consequently influencing the nutritional well-being of populations throughout the globe.

Trade, which has been an age-old practice, has been playing an pivotal role in connecting diverse civilizations and driving economic growth. The linkages between trade and food security have been subject to intense debate at the national and global levels, and have become central to many trade-related discussions and negotiations. In the contemporary era of globalization, trade dynamics have expanded beyond economic structures, affecting the social and nutritional aspects of populations. Food security, which is closely linked to trade, hovers around ensuring that all individuals have access to sufficient, safe, and nutritious food to meet their dietary requirements for leading a healthy life.

The Nexus of Trade & Food Security

1. Availability

Trade has led to a high availability of food because it enables the movement of agricultural goods & products globally. Countries have specialized in the production of certain crops, resulting into a global market where different regions contribute to the overall availability of various food items; however, some cannot access international markets

because of these or other hurdles such as trade barriers, geopolitical conflicts and undeveloped infrastructures.

2. Accessibility

The accessibility of food is a pivotal aspect of food security, and trade can either enhance or impede this accessibility. Well-structured international trade agreements can improve the flow of food across borders and thus make it more accessible. On the other hand, through imposing trade barriers and restrictive measures, some foods may not be accessed hence impacting their affordability and availability. Socio-economic disparities also affect who benefits the most from traded food's accessibility.

3. Quality

Quality is directly linked with trading practices in foodstuffs that are available. Different types of foods are exchanged through global trade which adds to dietary diversity. However, quality issues affecting traded goods can arise due to complications with regard to supply chains as well as food safety standards among others like ensuring compliance with international quality standards is crucial for safeguarding the nutritional well-being of consumers.

Trade and Nutritional Diversity

To maintain good health, it is necessary to have a varied diet which provides the body with different nutrients that facilitate growth, development and protection against illness. Nutritional diversity in trade is important because it allows for different types of foods to be traded. This becomes important in areas where certain food cannot be produced locally because of adverse weather conditions. However, concerns can arise when a few crops dominate the global trade pattern thus leading to risks like overdependence on few staple foods or relegating indigenous/traditional crops having unique nutritional qualities.

Challenges and Controversies

1. Trade Liberalization

Trade has the potential to improve food security but there are doubts about trade liberalization. Critics point out that free trade may prioritize profits before public health thereby causing a flow of unhealthy processed foods into local markets as well as making

developing economies' food systems dependent on imported goods (e.g., fish from Europe). Also, vulnerable agricultural sectors in developing countries may find it hard to compete with highly subsidized products from industrialized nations hence widening inequality gap between rich and poor nations within the world's population because there would be no economic development in poorer ones if they are not allowed to compete fairly with richer countries economically.

2. Global Value Chains

The food sector's global value chains are complex, presenting both opportunities and challenges. These chains can be efficient, low-cost channels for inputs; however they may also allow a small number of multinational enterprises to control most of them, taking advantage of farmers who produce their raw materials and disrupting local food systems. This creates a delicate balancing act between the positive aspects of global value chains and equitable, sustainable trade.

3. Climate Change and Trade

Climate change exacerbates the relationship between trade, food security, and nutrition. Changes in weather patterns can disrupt agricultural production and determine which foods are available for trade. This forces us to embrace adaptive strategies that build our resilience in responding to climate impacts on global food systems while ensuring sustainable trade policies.

Future Directions

1. Sustainable Trade Practices

Promotion of sustainable trade practices is essential towards realizing long-term food security and nutrition through trade. It entails addressing environmental concerns, fair labor practices, and supporting local economies. International agreements or partnerships could set up models that prioritize equity as well as sustainability in international trade.

2. Technological Innovations

Advancements in technology, such as precision agriculture, blockchain and data analytics can revolutionize the food trade sector. These innovations have the potential to reduce food waste, improve supply chain efficiency, enhance traceability, and ensure the

quality and safety of traded food products. This can make the global food trade system more resilient and responsive.

3. Inclusive Policies

Inclusive trade policies are shaped by governments and international organizations. This means supporting small-scale farmers, promoting gender equality in agriculture, and crafting trade policies that take into account various cultural backgrounds and dietary needs of different communities.

Conclusion

In conclusion, trade, food security and nutrition have a complex web of connections. International trade can be used for improved food security; however, this must be done by eliminating the problems about fair and sustainable results. Policies and practices in a fast changing world must therefore be designed to maximize the positive aspects of trade while reducing its impacts on food security and nutrition. Collaborative efforts, innovation adoption and sustainability commitment are critical in ensuring that trading is viewed as an influential means of achieving global food security and nutritional gains for everyone..

References

Introduction to trade, food security and nutrition. (n.d.). FAO Elearning Academy. https://elearning.fao.org/course/view.php?id=961

The State of Food Security and Nutrition in the World 2021. (2021). In FAO, IFAD, UNICEF, WFP and WHO eBooks. https://doi.org/10.4060/cb4474en

Ge, J., Polhill, J. G., Macdiarmid, J. I., Fitton, N., Smith, P., Clark, H., Dawson, T. P., & Aphale, M. S. (2021). Food and nutrition security under global trade: a relation-driven agent-based global trade model. Royal Society Open Science, 8(1), 201587. https://doi.org/10.1098/rsos.201587

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04295

MORINGA: UTILITY AND ITS FUTURE PROSPECTS

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Moringa oleifera, commonly known as Moringa, are in high demand because they are nutritious and versatile. Because of its ability to adapt to different temperatures, it is perfect for sustainable agriculture. It is used for food, medication and industrial purposes. The main purpose of this article is to provide information about the various importance of this plant including nutritional importance as a human being. *Moringa oleifera* seeds are a promising resource for food and non-food applications. The leaves of the moringa tree are particularly beneficial since they are rich in protein, calcium, iron, and vitamin C, while the bark aids in the absorption of heavy metals. The moringa plant's leaf extracts have a number of beneficial effects, including anticancer, antibacterial, and antifungal characteristics. Having various medicinal and nutritional properties, it is also known as a miracle tree. Making fermented plant juice from leaves and seeds can be used as organic fertilizer in agriculture. In view of the above, the present article attempts to highlight the fulfillment of various human needs, including human nutritional potential.

Moringa (*Moringa oleifera*), also called the horseradish tree, drumstick tree, or sajna tree, is a tree native to tropical and subtropical climates around the world. The remarkable plant known by its common name, *Moringa oleifera*, is a prime example of nature's abundant creativity and nutritional capacity. This remarkable plant is known for its variety of applications and strong nutritional makeup, and now it has gained praise in functional foods, health drinks and dietary supplements. Because of its exceptional resilience and capacity to adapt to a wide range of climates, moringa is regarded as a keystone of sustainable

agriculture and is well-positioned to strengthen global resolve in the face of the complex web of climatic fluctuations. Moringa demand, echoing the symphony of symbiotic ecological and economic dynamics, enhances the socioeconomic fabric of smallholder farmers and rural economies. However, the symphony's melodic resonance in this booming crescendo depends on the unshakable dedication to maintaining high-caliber and sustainable practices. Within the reverberating halls of scientific inquiry, the remarkable voyage of Moringa transpires, shedding light on the complex fabric of its therapeutic possibilities and revealing the mysterious array of bioactive elements. As the discussion progresses, it reveals a plethora of unexplored opportunities that are revolutionizing nutritional and medicinal uses. This thorough symposium calls upon the transcendent potential of moringa to not only meet dietary needs but also to nurture the entire landscape of sustainable practices, paving the way for a future that is harmoniously nourished.

Botany: It is an evergreen-to-deciduous shrub or tree, reaches heights of 7 to 12 m and is 20-60 cm in diameter at chest height. It has the potential to be a fast-growing perennial tree. The stem is usually straight, reaching a height of 1.5 – 2.0 m before the branches begin and can sometimes reach 3.0 m. The leaves are alternate, twice or thrice pinnate leaves crowded at the end of the branches, long petiole with 8-10 pairs of pinnate leaves each bearing two pairs of opposite, elliptic or obovate, rounded or emarginated, entire, dull green on both sides, at first shortly grey, pubescent, glabrous. This little-known species can be distinguished from the former by its larger, bipinnately complex leaves and yellow flowers with pink or red streaks. In the tropics and subtropics, the tree is extensively grown and allowed to naturally occur all over the world. The other species M. concanensis, a small tree that resembles *M. oleifera* grows wild in India (Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Goa, Andhra Pradesh and Tamil Nadu). It is utilized locally for both medicinal and edible fruit purposes.

Utility of *Moringa oleifera* for Various Purposes

Human consumption: *Moringa oleifera* tree has probably been one of the most underutilized tropical crops. This vegetable is a great way to gain nutrients for people of all ages. The tree is mostly prized for its soft, edible pods, which taste a lot like asparagus. These are consumed either cooked or pickled as a nutrient-dense vegetable. The leaves, which taste similar to watercress and are a wonderful source of vitamins and minerals, can be eaten raw or cooked with the blossoms. They are abundant in minerals, protein, riboflavin,

betacarotene, thiamin, and other vitamins, especially A and C. The Nutritional composition of moringa is presented in table 1.

Table 1: Nutritious composition of *Moringa oleifera* leaf per 1 cup

Nutrients	Quantity
Vitamin B6	19% of the RDA
Vitamin C	12% of the RDA
Iron	11% of the RDA
Riboflavin (B2)	11% of the RDA
Vitamin A (from beta carotene)	9% of the RDA
Magnesium	8% of the RDA
Protein	2 g

RDA-Recommended Dietary Allowance

Source: *Sandeep et. al., 2019*

Medicinal purpose: Several tree parts are used medicinally in traditional Indian medicine to treat a variety of conditions, such as rheumatism, ascites, poisonous bites, and heart and circulatory stimulants. The root of young trees and also the root bark are considered rubefacient, vesicant carminative, stomachic and abortifacient; among other uses, they are commonly applied externally to cure inflammatory swellings. In addition, the blossoms are utilized as a cholagogue, diuretic, and tonic. The leaves are used as an emetic and are high in vitamins A and C, which are thought to be highly helpful in treating scurvy and respiratory conditions. There are potent antibacterial and antimalarial activities in the juice that is produced from the leaves.

Economic purpose: A significant amount of proteins are present in the press cake that is produced as a byproduct of the oil extraction process; roughly 1% of these proteins are active cationic polyelectrolytes, with molecular weights ranging from 7 to 17 Daltons. Since most colloids in gloomy or filthy water have a negative electric charge, the cationic polyelectrolyte neutralizes the colloids. Thus, this protein can be utilized as a naturally occurring, non-toxic polypeptide for organics and sedimentary mineral particles in drinking water purification, as well as for cleaning vegetables, oil, and sedimentary fibers in the juice and beer industries.

Organic fertilizer (Foliar fertilizer application): Several studies have shown that applying chelated fertilizer to leaves can boost its effectiveness while utilizing less fertilizer overall. If applied as a foliar spray on late-sown wheat, moringa leaf extract gives a yield 10% higher than control (Yasmeen *et al.*, 2012). The development and yield of common bean plants may

be less inhibited by the exogenous application of moringa leaf extract (MLE), which could protect the plants from the damaging effects of salt stress (Zaki & Rady., 2015).

Livestock feed: Farmers all throughout the world utilize a variety of trees and shrubs as supplements or feed for their animals. The nutritious content of moringa makes using it as feed a wise decision. The substantial iron, potassium, calcium, and multivitamins found in moringa leaves are essential for animal growth and milk production. Moringa is a well-known source of lipophilic antioxidants, such as tocopherols and carotenoids, and polyphenols, which makes it an excellent feed option for animals and potentially beneficial to their health.

Crop disease management: Moringa is applied to numerous crops to treat a variety of illnesses. Numerous studies have demonstrated its significance for managing crop diseases. Moringa contains bactericidal and antifungal properties against a variety of infections.

Plant growth hormone: Crop yields and growth can be increased by applying moringa leaf extract as a growth hormone (Mvumi *et al.,* 2013). The extract may have advantages for root growth and plant height in common beans and maize. The extract may have advantages for root growth and plant height in common beans and maize. Using a water extract of moringa leaves has greater potential to promote growth than using a water extract of moringa roots (Iqbal *et al.,* 2020). Zeitin is a growth hormone that is present in moringa leaf extract (MLE) and has been demonstrated to increase crop productivity by up to 45% (Maishanu *et al.,* 2017). For practically every group of plants, including melons, bell peppers, tomatoes, soy, onions, sorghum, tea, and coffee, fresh moringa leaf juice can be utilized to create potent growth hormones that raise output by 25–30% (Bashir *et al.,* 2016).

Green manure: Green manure (GM) is primarily used to enhance soil quality and supply nutrients for upcoming crops. Green manures produced on-site do not bear the handling and transportation costs associated with other organic inputs. The gradual release of nitrogen from GM residues that are breaking down may be more in line with plant absorption than nitrogen from inorganic sources, increasing crop productivity and N-uptake efficiency while reducing N-leaching losses**.**

Pioneering advancements and future prospects: The continuous increase in demand has spurred creativity and investigation into the therapeutic qualities, bioactive ingredients, and industrial uses of moringa. Given the growing global focus on sustainable practices and

holistic well-being, it is impossible to overestimate the influence of moringa on current trends and potential futures. This adaptable crop's appeal is expected to rise across industries as research reveals its full potential.

Conclusion

The narrative of Moringa's rise from obscurity to fame is one of tenacity, flexibility, and lasting influence. It symbolizes the peaceful fusion of human creativity with the wonders of nature. Moringa's diverse rise is evidence of its revolutionary potential, ranging from correcting nutritional inadequacies to supporting sustainable practices, economic empowerment, and groundbreaking research. Its influence may be seen in the commercial and nutritional spheres as well as in the larger story of sustainable development and a better future for everybody. Because moringa seeds are lipid sources, removing them produces high-protein moringa seed flour that may be used in food technology and human nutrition. Moringa is an essential component of the agroforestry system because of its excellent green manure and fence ability. Moringa is a multipurpose tree as a result of its advantages for human health, the environment, and agriculture. Additionally, it's utilized in creative culinary projects and organic skincare goods. New applications for moringa have been made possible by ongoing studies on its therapeutic qualities and bioactive components. Ultimately, moringa has the ability to meet dietary requirements, encourage environmentally friendly behaviours, and help create a healthier future.

References

Yasmeen, A., Basra, S.M.A., Ahmad, R. and Wahid, A., 2012. Rendimiento de Trigo Sembrado Tarde en Respuesta a la Aplicación Foliar de Extracto de Hojas de Moringa oleifera Lam. *Chilean journal of agricultural research*, *72*(1), pp.92-97.

Zaky Safi-naz, S. and Rady, M.M., 2015. Moringa oleifera leaf extract improves growth, physio-chemical attributes, antioxidant defence system and yields of salt-stressed Phaseolus vulgaris L. plants. *International Journal of ChemTech Research*, *8*(11), pp.120-134.

Bashir, K.A., Waziri, A.F. and Musa, D.D., 2016. Moringa oleifera, a potential miracle tree; a review. *IOSR J. Pharm. Biol. Sci*, *11*, pp.25-30.

Iqbal, J., Irshad, J., Bashir, S., Khan, S., Yousaf, M. and Shah, A.N., 2020. Comparative study of water extracts of Moringa leaves and roots to improve the growth and yield of sunflower. *South African Journal of Botany*, *129*, pp.221-224.

Maishanu, H.M., Mainasara, M.M., Yahaya, S. and Yunusa, A., 2017. The use of moringa leaves extract as a plant growth hormone on cowpea (Vigna Anguiculata). *Traektoriâ Nauki= Path of Science*, *3*(12), pp.3001-3006.

Mvumi, C., Tagwira, F. and Chiteka, A.Z., 2013. Effect of moringa extract on growth and yield of maize and common beans.

Sandeep, G., Anitha, T., Vijayalatha, K.R. and Sadasakthi, A., 2019. Moringa for nutritional security (Moringa oleifera Lam.). *Int J Bot Stud*, *4*(1), pp.21-4.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04296

AN OVERVIEW OF SHEEP POX AND GOAT POX

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Small ruminants are considered as an important aspect for livelihood sustenance and employment generation opportunity for rural unemployed youths around the world. Farming communities now greatly relies upon the animal husbandry sector in view of prevailing uncertainty to agricultural income owing to frequent natural calamities and climate change. Central Govt. puts due emphasis on small ruminant sector for mitigating malnutrition as well as food security, for which disease management is now given priority which directly influences the body weight gain and economic profit to farmers. Awareness on some economical important disease of small ruminant like Sheep Pox and Goat Pox pertaining to their aetiology, clinical signs, disease pathology and prevention will be helpful to farming communities on disease management, preventing from un-necessary economic loss.

Sheep pox virus (SPV) and goat pox virus (GPV) were once believed to be same virus, but their genetic sequencing made them separate from each other now. It is a serious often fatal disease characterized by skin eruption and generalized pock lesions. It is caused by Capri pox virus under which bovine lumpy skin disease virus (LSDV) also come.

Synonyms

Sheep Pox is otherwise known as-

- Ovine Pox, Laclavelee, *Variola Ovina*
- Goat Pox is otherwise known as- *Variola Capra*

Clinical Signs

- Skin papule having diameter 0.5-1cm may appear on hairless part of body following temperature reaction. Papules are preceded by red colored macules.

- After development of papules, there is conjunctivitis rhinitis, swollen lymph nodes.
- Mucopurulent eye and nasal discharges.
- Necrotic mucus membrane of eye, nose, lips, vulva, prepuce.
- Bronchopneumonia (laboured breathing leads to death).
- Scab found on recovered animal.
- Keratitis.

Macule

↓

Papule

(1-3 days)

↓

Vesicle

(2-5 days)-contain cream color fluid

↓

Pustule

(9-12 days)-contain thick grey color material

↓

Crust

(On 12th days onwards)-size regresses forming reddish brown crust, usually fall off leaving granulation tissue

↓

Scab

Post Mortem Lesions

- Lymph nodes become 8 times more size than normal
- Pox lesions found in the membrane of eyes, mouth, nose, pharynx, epiglottis, trachea, nares, muzzle, udder, vulva, prepuce, etc.
- Congestion & focal lesions of lungs
- Enlargement and hemorrhage in mediastinal lymph nodes
- Vasculitis and necrosis of epidermis, dermis.

Prevention & Control

- Antiseptic or antibiotic ointments or lotions may be applied to control secondary bacterial infection and heal the pox wounds.
- Disinfect the fomites, premises
- If culling not possible, isolation of infected herds and sick animals from normal fleck for at least 45days.
- Caprination and ovination are oldest method of immunization
- Caprination (against goat pox)- In which the affected lymph node from the vesicle inoculated beneath the tail or inner surface of ear of a young goat. This will produce a mild form of infection and protect goat from future attack.
- Ovination (against sheep pox)- Lymph of affected sheep inoculated by intradermal injection on ventral surface of tail (oldest method of immunization).

Conclusion

Doubling the farmer's income by 2030 will only be achieved by proper disease management of livestock that to small ruminant for which awareness on different diseases with their etiology, important clinical signs, Pathomorphological changes and preventive measures among all the stakeholders is the need of the hour.

Reference

Bhanuprakash, V., Venkatesan, G., Balamurugan, V., Hosamani, M., Yogisharadhya, R., Chauhan, R.S., Pande, A., Mondal, B. and Singh, R.K. (2010). Pox outbreaks in sheep and goats at Makhdoom (Uttar Pradesh), India: evidence of sheeppox virus infection in goats. *Transbound Emerg Dis*, 57(5): 375-382.

Ramakrishnan, M.A., Santhamani, R. and Pandey, A.B. (2017). Capripox outbreak in a mixed flock of sheep and goats in India, *Transbound Emerg Dis*, 64(1): 27-30.

Babiuk, S., Bowden, T.R., Boyle, D.B., Wallace, D.B. and Kitching, R.P. (2008). Capripoxviruses: an emerging worldwide threat to sheep, goats and cattle, *Transbound Emerg Dis*, 55(7): 263-272.

Verma, S., Verma, L.K., Gupta, V.K., Katoch, V.C., Dogra, V., Pal, B. and Sharma, M. (2011). Emerging Capripoxvirus disease outbreaks in Himachal Pradesh, a northern state of India, *Transbound Emerg Dis*, 58(1): 79-85.

Article Id
AL04297

REAL WATER SAVINGS IN AGRICULTURAL SYSTEMS (REWAS)

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In agriculture, water is acrucial input that nurturescrops from seed to harvest. The issue of water shortage is becoming worse due to climate change, as well as the expanding global population and economy. It is becoming a crisis affecting millions of people around the world. Agriculture must use water-saving techniques to ensure access to accessible water as it is the most impacted sector. The REWAS project, which stands for Real Water Savings in Agricultural Systems, is an initiative that aims to address this issue.

REWAS

Real Water Saving in Agricultural Systems (REWAS) is a project of the Food and Agriculture Organization of the United Nations (FAO) and Future Water that aims to introduce tools and approaches to enhance water accounting, allocation, and productivity while offering farmers helpful guidance on how to conserve water in agriculture.Through the integration of technological, organizational, and social solutions, the project advances comprehensive environmental policy grounded in empirical facts.

In addition to addressing water scarcity, the project will improve water management, dispel common misconceptions about water conservation in agriculture, and promote sustainable agriculture. It also helps to educate those involved in water management, such as stakeholders, field program officers, and technical advisors in the water, food, irrigation, and agriculture sectors.

Water Scarcity: Types and Causes

Water scarcity occurs when demand exceeds supply due to poor planning, insufficient infrastructure, or physical scarcity. It is categorized into four categories primarily based on these factors. They are:

1. Physical water scarcity results from low natural rainfall and runoff, which limits the amount of water available to meet demand, including environmental flows.
2. Economic water scarcity is brought on by inadequate infrastructure planning.
3. Drought incidence and highly fluctuating water supply are related to seasonal water scarcity.
4. Constructed water scarcity is created when the water supply is less than water use.

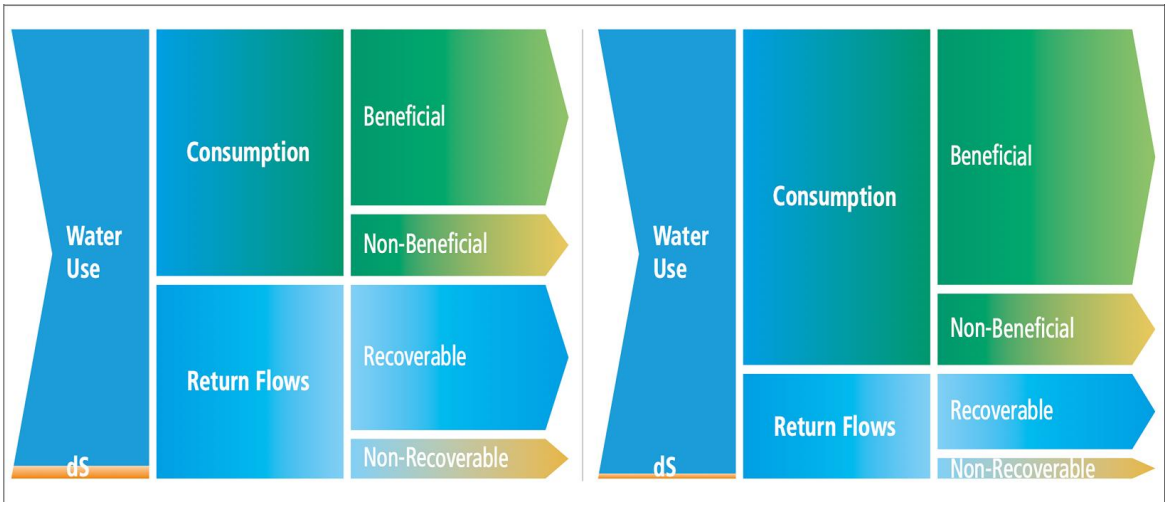
Economic and population expansion are the primary causes of water scarcity.As a result of fast urbanization, which severely strains nearby water resources and increases water consumption when combined with industrialization, population growth raises the requirement for food consumption and also modifies the dynamics of population distribution. The need for water is also increased by expanding and rival economic sectors.Water shortage is made worse by climate change, which alters temperature and precipitation patterns. This is demonstrated by the rise in the frequency and intensity of droughts during the dry season and the rise in the frequency of dry spells during the rainy season. The scarcity of water can also be caused by pollution of the water.

Water Management Through REWAS

Water accounting, the water approach, and water productivity are some of the methods that REWAS uses to improve water management. The e-learning course also helps.

Water accounting is the process of determining, measuring, reporting, and confirming the movement and storage of water in a system. It offers a comprehensive view of where and how water is lost, making it easier to spot possible areas for water conservation.

An efficient method of managing and conserving water is called "Follow the Water," which centers on tracking and comprehending the water's journey from its source to all of its destinations, including back into the environment. The method begins with water use, which is the volume of water used for a specific use, such as agricultural irrigation. There are two categories of water use: return and consumption. Consumption can have positive effects, like crop transpiration, or negative effects, such as soil evaporation. In a similar vein, return flow may be non-recoverable—that is, returned to saltwater sources—or recoverable—that is, returned to the river.



Source: www.fao.org

Reducing water consumption and non-recoverable return flows leads to an "actual water saving," whereas reducing water source consumption leads to an "apparent water saving." Thus, by using the Follow the Water strategy, sustainable measures might result in actual water savings.

One REWAS tool for calculating production or benefit from water use is water productivity. It's typically expressed in terms of yield, income, or some other metric related to a crop. Increasing water production entails using less water to accomplish more.

The FAO launched the REWAS project's eLearning course, which covers the principles and practices of actual water savings and the possible effects and remedies of water-saving actions. Field program officers and advisers in the irrigation, agriculture, and water sectors are the primary audiences for this e-learning course.

Common Misconceptions in Real Water-Saving

Some popular myths regarding water conservation in agriculture are debunked by the REWAS project, including

- It is untrue to say that conserving water at the field level will conserve water at the catchment level because the water may be utilized again as runoff or be available for use by the environment or other people.
- It is a myth that water-saving techniques make water more readily available because they can harm the ecosystem, downstream consumers, and water quality.

- Water conservation cannot be achieved by merely cutting back on withdrawals or installing water-efficient technologies; rather, it requires a thorough evaluation of water resources, their productivity, and how they are allocated among various users for various uses.

Benefits of REWAS

By encouraging actual water savings, the REWAS project advances the sustainability of agricultural methods. Some of the benefits of REWAS are:

- increases the productivity and efficiency of water
- increases the availability and security of water
- lessens water stress and scarcity and promotes livelihoods and food security
- keeps ecosystems and the environment safe

Conclusion

As water becomes less available, conserving water supplies becomes ever more crucial. As the industry most impacted by water scarcity, agriculture can use tools, approaches, and preventive measures like productivity, efficiency, and water assessment and accounting. It can also adhere to water terminologies and concepts and implement sustainable interventions along with sustainable interventions to deal with water scarcity and dispel myths about water conservation through REWAS. Policies and implementations of REWAS are grounded in reality and supported by data. Water conservation with REWAS is very effective since the water conservation and accounting guide describes the procedures and logs the flow and usage of water.

References

Food and Agriculture Organization of the United Nations. (n.d.). *Real Water Savings in Agricultural Systems* [Slide show]. FAO Elearning Academy. https://elearning.fao.org/course/view.php?id=947

FutureWater & Food and Agriculture Organization of the United Nations. (2021). Guidance on realizing real water savings with crop water productivity interventions. *FAO*. http://www.fao.org/3/cb3844en/cb3844en.pdf

AECOM India Private Limited. (2009). *Development of Rewas Port*.

Www.fao.org. (n.d.). https://www.fao.org/in-action/water-efficiency-nena/resources/webinars/wawebinars/en/

Real water savings in agriculture. (n.d.). RTP-RNE-WS.

Food and Agriculture Organization of the United Nations. (2023). Real water savings in agriculture Next Generation Water Management Policy Briefs. *FAO*. https://www.fao.org/3/cc1771en/cc1771en.pdf

Article Id
AL04298

DATA MANAGEMENT IN NATIONAL FOREST INVENTORY

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Forests are commonly known as the lungs of the earth because they have a vital role in maintaining ecological balance and sustaining life on our planet. It is no small task understanding the dynamics of these vast ecosystems, and that is where National Forest Inventory (NFI) programs become important. In the digital era, effective data management forms the bedrock of successful NFIs, enabling informed decision-making, sustainable forest management and environmental conservation. This article examines the complex world of data management in National Forest Inventory with a focus on data models, collection tools, methodologies, and the use of data dashboards and portals.

Information and Communication Technology (ICT)

Information and communication technology (ICT) is an umbrella term that includes the design, development, implementation, support and management of computer-based information systems. In essence, ICT deals with the use of computers and software to convert, store, protect, process, transmit and retrieve information.

Data Integrity

The term data integrity refers to the accuracy and consistency of data. When creating databases, attention needs to be given to data integrity and how to maintain it. A good database will enforce data integrity whenever possible.

For example, a user could accidentally try to enter a vegetation type code into a date field. If the system enforces data integrity, it will prevent the user from making these mistakes, through a warning or error message when wrong data is entered into a specific field. This is one of the advantages of using online field forms in the field data collection. Of course, not all erroneous input can be identified by this formal check.

Database and Database Management System (DBMS)

A database is a collection of data held in a computer system in an organized form for easier access and management. Databases are basically containers for data. In NFIs, databases are used to manage and archive field inventory data, field photographs, maps and remote sensing data, and related documents (such as field manuals, guidelines, inventory reports).

Database Management Systems, commonly referred to as DBMS, are software that allows us to perform various operations on databases. DBMS enable users to access databases, as well as manipulate, report, and represent data. They also help control access to the database. Some examples of popular database software or DBMSs include MySQL, Microsoft Access, Microsoft SQL Server, PostgreSQL, FileMaker Pro, Oracle Database, and InterBase.

Requirements for Forest Information Systems

Forest information systems provide a platform to offer decision-makers with high-quality and comprehensive information that has undergone quality control processes. NFIs and other forest inventory data can be seen as essential elements within this concept.

A modern system for managing forest resource information requires the following:

- Adaptability to different hardware and software environments, different conditions, and different geographical scales of inventory.
- Ability to use existing data in all the phases of inventory.
- Scalability of being transferrable to a larger operating system where it can take full advantage of the larger operating system in terms of performance.
- Flexibility to accommodate diverse data models.
- Adaptability to host data from repeated NFIs with possibly changing variable lists and other adaptations.

In addition, the system should be secure, user-friendly, accessible online and offer flexible reporting tools. The documentation of systems and their procedures needs to be transparent and allow accommodating future improvements.

Choosing ICT Tools for Forest Inventory Data Management

Forest inventory field teams perform most of their tasks outdoors, exposing their equipment to variable weather conditions and rough handling. Because of this, rugged computers are an advantage to work with. However, rugged devices are usually more expensive than standard devices.

Using touchscreen technologies

There are two varieties of touchscreen technologies that are currently in demand—resistive touch, that uses the pressure of the human body as an input, and capacitive touch, that uses the electrical properties of the human body as inputs. While choosing between these two technologies, consider the environment your device will be in.

If your device will be used in more rugged and rainy conditions, that may require wiping the screen repeatedly, a resistive touch panel may work better, as you can use it with both gloved hands and a stylus.

If on the other hand, you are using the device for more sophisticated applications, go for a capacitive touch panel. With capacitive touch panels, multi-touch is not a problem, you can scroll with ease and have excellent sensitivity.

Data Collection for NFIs

Field data can be collected and recorded using electronic devices or printed field forms. Mobile data loggers have been used in NFIs since the late 1980s, and nowadays, rugged tablets or smartphones are commonly used in collecting field data. Data input—into a computer after the field assessment—may be done manually (with a keyboard), via a cable or wirelessly from an electronic device. It is advantageous to perform data entry as soon as possible (in terms of time and space) to where the data is generated.

Data flow from the field into a clean database ready for analysis.

- **Field form data**

  While processing field form data, it is recommended to keep photocopies of the field forms at a local office, if possible. The field forms are transferred to the main office, and data is entered manually into the database.

- **Data in PDA/Smartphone**

  There are two options in which data can be transported to the main database.

  Option 1: After a working day, data is exported from the tablet and copied onto a computer. A 'safety copy' of the data is stored. The data file is then sent to the main office via email, cloud storage or carried by USB memory.

  Option 2: Data can also be sent to the server directly from the tablet.

- **Main data**

  The main data comprises:

  Entry data: This is validated, the 'error list' is removed, and all wrong entries are checked.

  Validation data: All mistakes are fixed, and the data is cleansed. It is then ready to move to the next stage.

  Analysis data: Clean data is ready for analysis.

Data Transfer and Input

Data transfer from tablets or smartphones can be organized in many ways.

- In cloud applications, data is automatically stored in the cloud server.
- Suppose the offline data is collected first and the device has Internet data connection. In that case, the data can be stored into the cloud server (Google Drive, OneDrive, DropBox etc.) or transferred by email to the office.
- In some systems, collected data can also be exported first into the tablet's storage and then copied or sent wirelessly (e.g., using Bluetooth) to a laptop and transferred later to the central database.
- In some systems, the data can also be sent directly to a network server via a mobile phone network.
- The conventional use of paper field forms requires that the field officer delivers the forms to the office, where they are inputted manually into the main database.

Data Management for NFIs

Specific requirements of ICT systems for forest inventory and monitoring

Here are some typical considerations for a workable information system for NFI:

- The requirements for data, analysis, and reporting are determined by the varying information needs that exist for different situations. Forests are complex, so the DBMS can contain data about trees, other vegetation, fauna, soil characteristics, water flows, etc. Also, spatial information needs to be collected (such as coordinates of attributes).
- The results of a data requirements analysis can usually include topics such as objects, data, relationships, processes, access paths, data integrity, information design, data sharing and data security.
- Governmental regulations, standards, and reporting commitments need to be considered while building these systems.
- These systems usually contain data on changes in the environment and multi-temporal datasets.

Data Dashboards and Portals

Dashboards and portals have the same functionality but different uses. Portals provide a centralized repository for key information for an organization or the public, and they typically contain rich text, shortcuts, interactive images and maps. Some portals can provide real time analysis of the underlying data.

Dashboards, on the other hand, provide quick visibility in order to facilitate understanding, with easy access to the most frequently needed charts, graphs and reports. Furthermore, as a rule, portals produce static representations of results in pre-defined tables and maps, while all dashboards provide more dynamic content by using data models and real time data analysis.

Conclusion

In the scope of National Forest Inventory, effective data management is not only a technical necessity but also an enabler of informed decisions and sustainable forest management practices. Data models, collection tools, and methods constitute the heart of NFIs as they provide strong foundation for understanding the intricacies of forest ecosystems.

Integration of data dashboards and portals ensures that gathered information is not restricted to scientific research but made available for all actors in order to foster collective responsibility over our most valuable natural resources. Yet even as we grapple with environmental conservation, it is the role played by data within National Forest Inventory that point us towards a future inwhich we can maintain for generations to come, the fine balance between mankind and nature.

Reference

Freiberg, M., Winter, M., Gentile, A. et al. (2020) *LCVP*, The Leipzig catalogue of vascular plants, a new taxonomic reference list for all known vascular plants. *Sci Data* 7, 416.

Fridman J., Holm S., Nilsson M., Nilsson P., Ringvall A.H., Ståhl G. (2014) Adapting National Forest Inventories to changing requirements – the case of the Swedish National Forest Inventory at the turn of the 20th century. *Silva Fennica* vol. 48 no. 3 article id 1095. 29 p.

Tokola, T., Turkia, A., Sarkeala, J. and Soimasuo, J. (1997) An entity-relationship model for forest Inventory. *Canadian Journal of Forest Research* 27: 1586-1594.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04299

ROOTING OUT CHILD LABOUR: STRATEGIES FOR A SAFER AND MORE SUSTAINABLE AGRICULTURE SECTOR

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For many years, child labour has been one of the biggest obstacles to social development. It is a challenge and long-term goal in many countries to abolish all forms of child labour. Especially in developing countries, it is considered as a serious issue these days. Child labour refers to children who miss their childhood and who do not have the basic comforts that a child should have. They are often mistreated and work long hours in very poor conditions. This can affect their physical, mental and emotional health. These children lack basic rights such as access to school or healthcare.

Estimates suggest that 160 million children worldwide, or one in ten children in total, are involved in some form of child labour. These numbers are increasing due to the effects of the COVID-19 pandemic, war and climate change. In fact, the number of children involved will reach almost 9 million by the end of 2023. This is the first increase in 20 years (End Violence, 2023).

In fact, agriculture is the sector where child labor occurs the most worldwide. According to the Food and Agriculture Organization of the United Nations (FAO), more than 112 million children work in agriculture, including agriculture, fishing, aquaculture, forestry and livestock. This is the case for 70% of child labor worldwide (FAO, 2023). Child labor in agriculture is largely invisible because most children work as unpaid family workers on small farms or scattered rural enterprises, which are hidden or hidden by employers. In rural areas, the scope of labor inspectors is limited (FAO, 2020).

By far the largest share of child labor is in the agricultural sector, 71 percent or 108 million children. Most child laborers are in Africa, where 20 percent of all children suffer and where child labor dominates agriculture. In agriculture, child labor is usually used in subsistence and commercial agriculture and animal husbandry. However, the agricultural

sector also extends to fisheries, forestry and aquaculture. Most of the children's agricultural work is unpaid and takes place within the boundaries of family members.

Not all agriculture should be considered child labor. It is important to distinguish between light work, which is not harmful to the child, and child labor, because of the time required and working conditions, which interfere with the goal of learning and disrupt the health and personal development of the child. Children's participation in non-hazardous activities can be beneficial as it contributes to intergenerational skill transfer and food security.

Age-appropriate activities that are low-risk and do not interfere with children's schooling and free time are a normal part of growing up in rural areas. In fact, these activities increase confidence, self-esteem and work performance. Children working in agriculture from a young age (ages 5 to 11) is a risky occupation, as it is a field that is very vulnerable to dangerous environments. Hazardous work can result in death, serious illness or injury due to poor health and safety standards.

The Causes of Child Labour in Agriculture

Progress in eliminating child labor in agriculture has been slow for several reasons. In general, domestic labor laws have limited coverage of agriculture and family businesses, union cohesion is low, workers are fragmented and labor inspectors are weak, everything is hidden.

Poverty and inequality are the main causes of child labor in agriculture, as in other sectors. However, other reasons include limited access to quality education, poor infrastructure, lack of social protection, low crop yields, inadequate agricultural technologies or practices, lack of resources for paid adult work, climate and other vulnerabilities, women's empowerment and traditional attitudes. etc. Our goal is to encourage children to participate in agriculture.

Recommendations for Eradicating Child Agricultural Work

While many of these challenges can be traced back to root causes like poverty, lack of knowledge and awareness and sociocultural factors, these root causes are complex and require all available resources from governments, civil society and the private sector to be tackled (Gaffar, Kämpfer, 2023). To do so, it is important to establish and reinforce

partnerships and initiatives between governments and corporate actors, aligned with international conventions, standards, guidelines and national policies (INTPA, 2023).

The government is at the forefront of efforts to eliminate child labor in agriculture, starting with strengthening social protection. By protecting households from extreme poverty, parents can prevent their children from sending them to work for economic reasons, thereby increasing their children's chances of continuing their careers (OHCHR, 2022).

As a practical solution, voucher transfers in the education sector are a good option to consider. It is a widely used social policy tool aimed at promoting inclusion and educational continuity. Families are paid for their children's school attendance (Gaffar, Kämpfer, 2023).

On the other hand, it is crucial to implement social behaviour change communications on child labour elimination and raise awareness of the harmful effects of child labour (ILO, 2023). As mentioned above, the situation of child labor in the agricultural sector is also a consequence of socio-cultural factors, so it is important to increase the visibility of children's rights and promote them at all levels of society. In this sense, it is important to encourage opportunities for discussion and debate at the local level to understand and promote local knowledge, attitudes and practices in relation to child labor in agriculture (FAO, 2022).

Conclusion

Eliminating child labor in agriculture is a long-term effort that requires the commitment of governments, communities, businesses and civil society. It is important to prioritize the lives and rights of children, work to break the vicious cycle of abuse and poverty, and create opportunities for children to grow and develop. It is important to address the economic, social and cultural factors that contribute to child labor and ensure that children have the opportunity to grow and develop. Finally, the elimination of child labor is a moral obligation and a prerequisite for justice and sustainability. This requires hard work, persistence and a holistic approach that focuses on the root causes and respects the rights and dignity of each child. By working together locally and internationally, we can create a world where every child is free to learn, grow and develop without the burden of discrimination.

References

Addressing child labour in agricultural programmes. (n.d.). Socialprotection.org. Retrieved November 4, 2023, from https://socialprotection.org/addressing-child-labour-agricultural-programmes

Braga, A. (2023, September 5). *Child labour in agriculture: a hazardous but common practice worldwide*. Humanium. https://www.humanium.org/en/child-labour-in-agriculture-a-hazardous-but-common-practice-worldwide/

Child labour in agriculture (IPEC). (n.d.). Retrieved November 4, 2023, from https://www.ilo.org/ipec/areas/Agriculture/lang--en/index.htm

Reducing child labour in agriculture through agricultural projects. (2015, March 31). Rural21.com. https://www.rural21.com/english/a-closer-look-at/detail/article/reducing-child-labour-in-agriculture-through-agricultural-projects.html

To eradicate child labour we must focus our attention on agriculture. (n.d.). International Partnerships. Retrieved November 4, 2023, from https://international-partnerships.ec.europa.eu/news-and-events/stories/eradicate-child-labour-we-must-focus-our-attention-agriculture_en

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04300

SILVOPASTORAL SYSTEMS: A SUSTAINABLE LAND USE IN DRYLANDS

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The foundation of all primary production systems is land, a non-renewable resource. Growing populations put great pressures on available land. The fact that more than 69% of our land area is classified as a dry zone by Thornthwaite adds to the demands already placed on the soil. The cattle industry is responsible for 9% of the world's anthropogenic carbon dioxide (CO2) emissions, which are mostly caused by changes in land use, particularly the expansion of pastures and arable land for feed crops and deforestation. Enteric fermentation accounts for around 40% of the greenhouse gas emissions from cattle in tropical climates, primarily from CH_4. Systems for raising cattle must strike a balance between resource use and greenhouse gas emissions. The amount of land accessible for agricultural production will decrease as climate change takes hold, which will put a lot of strain on food production systems (Dagar and Tiwari, 2016). Future reductions in the amount of arable land available may make the impoverished who reside nearby more vulnerable, which is a serious worry and sure to be a hot topic of conversation. The regrowth of woody species has been inhibited, and the overall richness of species has been restricted to a small number of important economically significant species. This makes it possible to direct nutrition and energy flows into a specific subset of plant and animal products. The farming system is expected to gain a great deal from increasing the biodiversity of grassland ecosystems through the introduction of SPS, including soil stabilisation, animal shelter and shade, revenue diversification through tree products, improved soil fertility, and increased soil water and carbon retention. They must get the utmost importance and immediate attention in order to optimise the use of drylands through tested silvopastoral systems (SPS).

Silvopastoral System (SPS)

It is a silvopastoral production unit, which is an agricultural unit that integrates woody vegetation (trees and/or shrubs) with grazing animal production.

Selection of Tree Species for SPS

- Deep-rooted to avoid competition with forage for moisture and nutrients
- Tree species must be adapted to the site to assure strong health and vigour management
- Must be compatible with planned livestock and forage species
- It should have higher rates of carbon sequestration potential
- Rows should be oriented in an east-west orientation where feasible and practical to allow maximum sunlight onto grass strips
- Resistant to pests and diseases
- Have high-value product potential
- Open-crowned to allow good forage production
- Trees should be planted at an appropriate density to allow acceptable forage production and wood products
- The invasive potential of the species must be known when selecting plant Species

Selection of Forage Species for SPS

- Suitable for the targeted livestock
- Compatible with site (soil, climate)
- Productive under partial shade and moisture stresses,
- Responsive to intensive management
- Tolerant of heavy grazing

Selection of Livestock for SPS

The choice of livestock appropriate for a given silvopastoral system will rely on the objectives and markets, in addition to the established species of trees and feed. In a silvopastoral context, some cow breeds could do better than others. Possible livestock alternatives to cattle are goats and sheep. Grazing should not begin until trees have grown to a height where the main stem terminal buds are out of reach for animals, regardless of the species chosen. Haying is advised in between young trees until they are mature enough to

handle the stresses of grazing and the presence of cattle. Large ruminants, like cattle, are more prone to crush young trees, whereas browsing animals, like goats and sheep, are more likely to consume. Because there is a greater chance of tree damage during mating seasons, bulls should not be maintained in silvopasture. In general, younger animals are more prone than older, more seasoned ones to do harm to trees. If climatic change occurs, local breeds should be given precedence over hybrid breeds (Tewari *et al*., 2014).

Benefits of SPS

1. Soil Improvement

In a system of silvopastoral forests, trees shield the soil from the direct effects of wind, water, and sun. Their increased infiltration rates let them hold onto more water, lessen runoff, and help control the water cycle. In places where trees do not provide cover, soil erosion is more likely. In order to manage grasses with trees and/or shrubs, nutrients that are taken out of the soil are recycled through the addition and breakdown of fine roots and litter fall, animal dung from grazing, and tree pruning residues. Furthermore, by interacting with microorganisms found in root nodules, the preference for legume trees utilised in the silvopastoral system fixes nitrogen from the atmosphere. The higher content of organic matter in soil and the improvement of the microclimate (moisture and temperature) due to the presence of trees in silvopastoral system promote the biological activity of the macro and micro fauna, resulting in a greater mineralization and availability of soil nutrients.

2. Soil Moisture Conservation

Trees operate as barriers to minimise runoff, covers decrease the effect of raindrops, and soil improvers improve soil permeability and water retention. Increased water infiltration, interception, decreased evapotranspiration, and decreased erosion are some of the ways that silvopastoral systems help preserve water resources. In pasture-shaded systems, evaporation rates are lower than under pure pastures, particularly in windy conditions. In contrast to the open field, this results in increased soil moisture beneath the tree tops. The benefit on soil moisture may expand as trees get older (or get larger).

3. Livestock improvement

The availability of fodder, animal productivity, and animal performance are all very susceptible to the effects of climate change. Global scale modelling suggests that grazing-

only farming systems, particularly those in Africa, Australia, Central America, and South Asia, would be more severely impacted. Studies indicate that the amount of edible biomass that is accessible to cattle in these areas might decrease by up to 50%. Planting trees and bushes in pastures is a suggested way to reduce the impact of sun radiation and its effect on animal thermoregulation. Trees help to regulate the surrounding temperature, which helps to disperse solar energy. Benefits include decreased metabolic rate and increased intake of dry matter since animals use less energy dispersing heat.

4. Improving socio economic status of farmer

In reaction to financial expenses, resource managers frequently decide to implement a land-use strategy that exclusively optimises financial gains. Due to asymmetric decision information and a lack of awareness of all benefits, the resource management, society, and the environment may lose out on the advantages in such circumstances. The chosen land-use strategy might not be the ideal one as a consequence. Financial indicators show advantages that the resource management values, even though they might not capture all benefits that could result from adopting a silvopasture strategy.

Conclusion

Dryland farmers have been providing their animals with the necessary feed by using traditional SPS. There is a massive disparity between the availability and demand of fodder in drylands because of the degradation caused by increased grazing pressure and energy demand on these traditional pasture lands. Improved SPS with appropriate tree species and their management techniques offers a great deal of potential to increase output, according to overwhelming data. SPS has a lot of potential to be used in drylands to address issues including biodiversity preservation, global warming mitigation, and land restoration. Farmers in arid areas might greatly benefit from the value-added goods produced by SPS.

References

Dagar, J.C., & Tewari, J.C.(Eds.). (2016). *Agroforestry research developments* (pp. 1–599). Nova Science Publishers.

Tewari, J.C., Ram, M., Roy, M.M., & Dagar, J.C. (2014). Livelihood improvements and climate change adaptations through agroforestry in hot arid

environments. *Agroforestry systems in India* (pp.155–183). https://doi.org/10.1007/978-81-322-1662-9_6

Article Id
AL04301

BRINGING A SUSTAINABLE FUTURE: EXPLORING THE CONCEPT AND FRAMEWORK OF FOOD SYSTEMS SUSTAINABILITY

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The term "food systems" refers to the whole spectrum of participants and their interconnected value-adding activities in the production, gathering, processing, distribution, consumption, and disposal of food products derived from forestry, fisheries, and other parts of the wider natural, social, and economic environments in which they are embedded.

Interconnected: The relationships between actors along different functions of the food value chains in a food system, such as between farmers, aggregators, processors, or retailers, can be horizontal (such as farmer cooperatives) or vertical (ranging from spot market transactions to partnerships and contract farming mechanisms).

Value added: Value added can be gained or lost throughout any food system activity.

Five components of value added are

A) Salaries and wages for employees and workers, respectively
B) Profits for enterprise owners
C) Tax revenues for government
D) Consumer surplus – is the difference between what the consumer is willing to pay for the product and the actual market price paid for it.
E) Externalities- are unintended (positive or negative) effects of an activity on the environment and society around it that are not compensated for.

Sustainable Food Systems (SFS)

A sustainable food system (SFS) is one that provides nutrition and food security for all while maintaining the economic, social and environmental foundations necessary to

provide nutrition and food security for future generations. This means that It has three main sustainabilities economic, social, and environmental. It is profitable overall, has wide-ranging benefits for society, and has a neutral or positive effect on the environment.

From an economic perspective, a food system is regarded as sustainable if every actor in the food system or provider of support services can sustain their operations in a profitable or financially feasible manner. All groups of stakeholders should profit from the activities, or create economic value-added, including workers' wages, governments' taxes, businesses' profits, and consumers' access to better food.

From a social perspective, a food system is regarded as sustainable if the economic value added is distributed fairly, accounting for marginalized groups based on factors such as age, gender, race, and so forth. Activities related to the food system must, at their core, support the advancement of significant socio-cultural outcomes, including health and nutrition, customs, working conditions, and animal welfare.

In terms of the environment, sustainability is defined as making sure that the activities of the food system have neutral or positive effects on the surrounding natural environment, while also taking into account the carbon footprint, water footprint, biodiversity, soil, water, animal, and plant health, food loss and waste, and toxicity.

A comprehensive assessment of sustainability in food systems must take into account potential trade-offs between sustainability dimensions, including resilience. This further suggests that resilient and shock-tolerant external food systems are necessary to bear external shocks like financial crises or extreme weather brought on by climate change. Resilience is the ability of a food system to keep producing and providing value despite sudden or gradual changes in supply or demand by recovering from unforeseen shocks, avoiding tipping points, and adapting to continuous change.

The three sustainability dimensions and resilience ought to be valued equally, according to theory. If win-win solutions can be found, in reality, trade-offs between the dimensions must be taken into account, which can result in win-lose solutions. When some components of sustainability are benefited while others have drawbacks, this is referred to as a trade-off. A win-win solution, on the other hand, is a circumstance in which sustainability is enhanced in every way. Another aspect of sustainability that requires consideration are the potential trade-offs associated with resilience.

An Analytical Framework: Food System Wheel

The Food System Wheel is an analytical framework that can be used to analyze food systems and their wider sustainability impacts. It arranges the components of a food system.FAO's primary objectives, which are to reduce poverty and increase food security and nutrition, are at the core of the food system wheel framework. The three facets of sustainability-economic, social, and environmental-are incorporated into the system's overall performance. The actions of various players or stakeholders in the food system (people-centric) influence this kind of performance. This behavior is reflected in the system's structure, which is made up of societal components, natural components, and a core system. The production, aggregation, processing, distribution, and consumption of food products-as well as the disposal of waste-are all included in the core system, as is a layer of services that facilitate this flow. These activities take place in both a natural and social setting.

Layers of Food System Wheel

It suggests a four-layer (04) structure. The core system consists of the first two layers, which comprise:

1) **Core actors:** Food products flow through this innermost layer, which carries out a variety of functions (production, aggregation, processing, distribution and consumption, including waste disposal)
2) **Support providers:** They make the activities and the flow of the product easier.
3) **Societal elements:** Infrastructure, institutions, organizations, and sociocultural components are all included.
4) **Natural environment and its various elements:** It is made up of ecosystems, climate, water, air, and soils. This layer takes into account how the environment affects the food chain.

Structure-Conduct-Performance (S-C-P) Paradigm

The theories that support the Food System Wheel, which aids in understanding the dynamics and feedback loops in food systems, are known as the Structure-Conduct-Performance (S-C-P) paradigm.

Structure: The food system's structure is dynamic and influenced by a wide range of complicated and varied trends, including population growth, urbanization, and climate

change, as well as forces like innovation and technological advancement, policy changes, and more.

Conduct: Actors are motivated by the structure, which also shapes their abilities, which in turn dictates how they behave. Additionally, players in the food system are dependent on one another and have the power to influence one another's motivations and levels of action.

Performance: The interconnected behaviour of all system actors determines the overall performance of the food system when expressed in terms of sustainability. Businesses, farms, and consumers, for example, can all have an impact on the functioning of the food system and bring about change. The actors' behaviour and the system's structure will be influenced by this kind of performance, which will then produce either positive or negative feedback (behaviour change within dynamic food systems).

There are two objectives here for a development agency like FAO. In order to orient actors toward behavior that results in observed system performance, it is first necessary to understand how the structure influences and creates incentives for their capacities. Secondly, to assist in the development of positive feedback loops (conduct to conduct, or performance to conduct) that produce a self-sustaining process of sustainable performance improvement.

SFS Development Paradigm

As engines of growth, sustainable food systems (SFS) produce value-added that consists of five elements.

1. salaries to workers;
2. a return on assets (profits) to entrepreneurs and asset owners;
3. tax revenues to the government;
4. benefits to consumers; and
5. impacts on the socio-cultural and natural environment.

Four feedback loops that are directly related to poverty, hunger, and nutrition and have an impact on economic, social, and environmental sustainability are started by this value addition. These are the four feedback loops:

(1) an **investment** loop, driven by savings and profits that are reinvested;
(2) a **multiplier** loop, motivated by the expenditure of higher worker income;

(3) a **progress** loop, motivated by public spending on the natural and sociocultural environments; and

(4) an **externalities** loop, motivated by effects on the environment, the economy, and society both inside and outside of the larger food system.

The food system will be more sustainable (and vice versa) if there are more positive feedback loops than negative ones.

Poverty reduction will be realized when livelihoods are enhanced as a result of higher earnings, salaries, or social support. Food security is increased when this is combined with an enhanced food supply. Better foods, increased food security, and an environment that is more conducive to promoting healthy eating all work together to produce better nutritional results. Providing catalytic support is the aim of development practitioners and policy makers. A transformative change of food systems can be promoted to assist nations in achieving the Sustainable Development goals by adopting a facilitation approach to foster positive feedback loops for both behaviour change and value creation.

Conclusion

- Sustainable food systems represent a multifaceted and evolving framework that aims to address the environmental, social and economic challenges associated with food production and consumption.
- By prioritizing sustainability, equity and resilience, Sustainable Food Systems offer a pathway to a healthier, more just and environmentally friendly food future.
- It is a concept that requires ongoing commitment and action from individuals, communities, governments and industries to achieve its goals and create a more sustainable and equitable food system.

References

eLearning FAO. (2020). Food and Agriculture Organization of the United Nations. https://elearning.fao.org/ . Accessed 3rd November 2023.

Ingram, J. (2011). A food systems approach to researching food security and its interactions with global environmental change. *Food Security*, 3(4): 417-431.

International Panel of Experts on Sustainable Food Systems (IPES). (2015) The new science of sustainable food systems: Overcoming barriers to food system reform.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04302

WEED-CROP ALLELOPATHY: IMPLICATIONS FOR SUSTAINABLE FARMING

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Allelopathy, a field of scientific study, focuses on the interactions between plants and various organisms, such as microorganisms, insects, pests and herbivores mediated by the release of allelochemicals – secondary metabolites produced by plants during different growth stages. It encompasses direct and indirect effects resulting from the transfer of these biochemical substances between plants. Initially primarily associated with inhibitory effects, it has since broadened to include beneficial impacts. These allelochemicals influence the growth, physiology and metabolic activities of receiving plants and play a vital role in agriculture. They have been harnessed for weed management, with extensive research on the inhibitory potential of allelopathic crops and trees. Despite allelopathy's historical use in agriculture, its modern recognition and application have been limited. However, in the context of organic farming and environmental preservation, allelopathy is gaining prominence, with ongoing research shedding light on its physiological, ecological, and molecular mechanisms. Further exploration and research are needed for wider integration of allelopathy into global agricultural practices.

Weeds, often characterized as non-intentionally propagated, out-of-place plants, possess innate competitive strength, allowing them to dominate ecosystems. With approximately 250,000 plant species worldwide, about 3% or 8,000 species exhibit weedy behavior. These plants, often termed invasive species, are prolific seed producers, facilitating their widespread distribution and thriving in disturbed environments. Weeds can infiltrate diverse habitats, from urban areas to oceans, deserts, and alpine regions. The relationship between crops and weeds dates back to the dawn of agriculture around 10,000 B.C., making it likely that allelopathic interactions have existed for millennia. Early observations of allelopathic effects can be traced to historical figures such as Democritus, Theophrastus, and Pliny the Elder, who noted how certain plants, like walnut, adversely affected neighboring flora. Molisch's coinage of the term "allelopathy" in 1937 marked a pivotal moment in the

field, and subsequent researchers refined its definition. While early allelopathy studies faced challenges due to limited scientific resources, research gained momentum in the 1960s, especially in temperate climates. However, these studies have often overlooked the potential of allelopathy in weed management, hindered by difficulties in exudate collection, limited knowledge of release conditions, and the replication of environmental factors driving allelopathic interactions in controlled settings. Thus, while allelopathy's potential is increasingly recognized, realizing its practical applications for weed management remains a complex challenge, requiring further exploration and understanding.

Allelopathy

Allelopathy arises from the release of allelochemicals by a donor plant species, affecting recipient species, which can be plants or microorganisms. Akobundu (1987) defines allelochemicals as substances secreted by plants that impact the germination or growth of other plant species, excluding substances introduced through non-biological means. These allelochemicals, according to Whittaker and Feeny (1971), are typically secondary metabolites or byproducts of primary plant metabolic processes, including phenylpropanes and alkaloids. Rice (1984) notes that many secondary metabolites, primarily derived from acetic acid and shikimic acid, can cause allelopathy. While all allelochemicals are secondary metabolites, the reverse isn't true. These chemicals, present in plants at varying concentrations, exert either stimulatory or inhibitory effects on the growth and development of neighboring plants or their own species, contributing to the complex dynamics of allelopathic interactions.

Mechanisms of Allelopathy

Allelopathy's inhibitory effects involve various chemical classes, like flavonoids, phenolic compounds, and more, either individually or in mixtures, with combinations often exhibiting enhanced allelopathic potency. Environmental and physiological factors, such as stress, pests, herbicides, and suboptimal conditions, further influence allelopathic weed effects. Allelopathic activity isn't limited to specific plant parts but includes leaves, stems, bark, roots, soil, and their leachates. These chemicals are released through four mechanisms: volatilization, leaching, root exudation, and decomposition. Volatilization releases chemicals into the air, which may be absorbed by nearby plants, while leaching washes compounds onto the soil or other plants through dew, rainfall, or irrigation. Root exudation involves compounds released from plant roots, and decomposition sees toxic substances released as

plant residues break down. These intricate mechanisms emphasize allelopathy's complex role in plant interactions.

Factors Affecting Allelopathic Effect

Various factors influence the allelopathic effects in a given context. Crop varieties can differ significantly in the strength of their allelopathic effects. Specificity plays a key role, as the impact of allelopathy can vary depending on the target species; a crop may inhibit one weed but not another. Autotoxicity is another facet, where allelopathic chemicals can suppress the germination and growth of seeds and plants of the same species. Crop residues can affect subsequent crops and weed growth, with larger-seeded crops being less affected. Environmental factors, including soil fertility, pests, and disease, also play a role, with low fertility increasing the production of allelochemicals. The timing of planting following allelopathic crops is crucial, with warmer and wetter conditions promoting faster decomposition of allelopathic compounds.

Types of Allelopathy

Allelopathy exhibits various forms of chemical interactions between plants, classified as alloallelopathy, autoallelopathy, true allelopathy, functional allelopathy, concurrent (direct) allelopathy, and residual allelopathy. Alloallelopathy involves inter-specific chemical co-action, where one plant's chemicals affect another species, such as maize influencing *Chenopodium album*. Autoallelopathy, on the other hand, represents intra-specific chemical co-action, with allelochemicals inhibiting the same species from which they originate, as seen in wheat and cowpea. True allelopathy refers to chemicals released directly into the environment in their active form. Functional allelopathy relies on compound modification by microorganisms for toxicity. Concurrent (direct) allelopathy entails instantaneous toxin release from living plants to nearby growth, often termed the "live plant effect." Residual allelopathy occurs as a result of decaying plant residues, affecting subsequent plant growth, as exemplified by sorghum and wheat. These diverse allelopathic interactions underscore the complexity of chemical signaling in plant communities.

Allelopathic Compounds

Allelopathic compounds encompass a diverse array of secondary products, and while it's impractical to list them all, they can be classified into various major chemical groups, including water-soluble organic acids, unsaturated lactones, fatty acids, phenols, quinones,

flavonoids, amino acids, tannins, steroids, coumarins, and more. This chemical diversity underscores the complexity and versatility of allelopathic compounds, highlighting their role in mediating plant interactions and ecological processes.

Allelopathy and Weed Management

Weeds pose a formidable challenge to crop cultivation, competing for essential resources such as light, air, water, nutrients, and space, ultimately causing substantial yield losses. Allelopathic water extracts have emerged as effective tools in organic weed management. These allelochemicals are remarkably diverse in their nature and structure, lacking a common mode of action. When applied at high concentrations, they disrupt vital physiological processes in weeds, including cell division, hormone biosynthesis, membrane permeability, and photosynthesis, respiration, and water relations, resulting in significant growth suppression. Sorghum water extract, known as sorgaab, has proven to be a potent natural herbicide, substantially reducing weed density and biomass in various crops. When applied in combination with water extracts from crops like sunflower, eucalyptus, sesame, *brassica*, and rice, it offers even more effective weed management. Moreover, allelopathy can be harnessed through soil incorporation of allelopathic crop residues, mulching, intercropping, and the inclusion of cover crops with allelopathic potential. These multifaceted allelopathic approaches, when integrated thoughtfully, hold great promise for organic weed control. Site-specific decision-making, coupled with genetic improvements and biotechnological advancements to enhance crop allelopathic potential, will further strengthen the role of allelopathy in sustainable weed management.

Application of Allelopathy in Weed Management

The application of allelopathy in weed management offers several promising strategies. Firstly, the development of novel biopesticides like herbicides, insecticides, or fungicides derived from allelochemicals is of paramount importance. Examples include the use of glufosinate-AM, a synthetic analogue of the microbial toxin bialaphos, for weed control, and cinmethylin, a synthetic herbicide similar in structure to the allelopathic agent 1,8-cineole found in sage. Additionally, AAL-toxin, a natural herbicide produced by the pathogenic fungus *Alternaria alternata f. sp. Lycopersici*, has potential applications in weed management. Furthermore, certain crops exhibit allelopathic effects, and efforts have been made to identify crop cultivars with competitive allelopathic properties, reducing the need for weed control. Sorghum residues have been successfully applied to control weeds in

subsequent rotational crops. The use of allelopathic crop residues as mulch and the incorporation of allelopathic crops into rotational sequences can also effectively suppress weed populations without negatively impacting the main crop. Lastly, the utilization of companion crops selectively allelopathic to weeds and not detrimental to the main crop shows promise in weed control, particularly in intercropping systems like sorghum + cowpea or maize + cowpea/soybean, although further research is needed for validation and quantification of these effects.

Problems in Allelopathic Research

Challenges in allelopathy research include the difficulty of translating lab findings to field applications, the complexity of allelopathic chemical mixtures and their concentration assessment, and the potential oversight of biologically active chemicals within intricate mixtures. Understanding these challenges can guide the development of genetically modified plants to resist phytoxins and reduce environmental risks while enhancing agricultural productivity.

Future Prospects

The prospects for allelopathy research are vast and promising, particularly in the context of sustainable agriculture. Future research should focus on innovative weed control strategies, such as biological weed control through allelopathic crops, reducing weed seed banks, and exploring the potential use of allelochemicals as herbicides. Biotechnology offers exciting avenues for developing allelopathic crop cultivars and varieties resistant to pests. Investigating the interactions between crops, allelopathic effects, and biological nitrogen fixation is crucial for optimizing crop combinations. Moreover, in-depth studies on allelopathic mechanisms, identification of allelochemicals, their activation, and factors affecting their concentration in soil are essential for harnessing allelopathy's full potential in agriculture

Conclusion

In response to the growing demand for sustainable agriculture, allelopathy has gained prominence in agricultural research. It offers the potential to maintain productivity while reducing the reliance on synthetic herbicides. Although numerous questions remain, allelochemicals hold promise for weed suppression, whether as natural herbicides or through allelopathic cover crops. Advancements in analytical techniques and biotechnology are

accelerating research in this field, making allelopathy a key component in the development of integrated weed management strategies for a sustainable agricultural future.

References

Akobundu, I.O.(1987).Weed Science in the Tropics: Principles and Practices. *John Wiley and Sons*, New York, pp 522.

Rice, E.L. (1984). Allelopathy, 2nd edition. Academic Press, New York, USA.

Whittaker, R.H. & Feeny, P.P. (1971).Allelochemicals: Chemical interactions between species, *Science*,171, 757-770.

Molisch, H.(1937). Der Einflusseiner Pflanze auf die Andere-Allelopathic. Fischer, Jena, Germany, 31, 12–16.

Article Id
AL04303

VALUE ADDITION OF FLOWERS - A PERFECT PLATFORM FOR WOMEN ENTREPRENEURS

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Our first Prime Minister of India, Pandit Jawaharlal Nehru said, "You can tell the condition of a nation by looking at the status of its women". So, empowering and educating women is the need of the hour. Gender equality, financial dependency and women safety plays key role in women empowerment. A confident, innovative and creative woman capable of achieving self-economic independence individually or in collaboration generating employment opportunities for others through initiating, establishing and running the enterprise by keeping pace with her personal, family and social life is known as 'women entrepreneur'. According to Budget 2020, women entrepreneurs constitute 14 % of total entrepreneurs among which 79 % of women enterprises were small and self-financed. The contribution of women entrepreneurs to Indian GDP is 17 %, while the average global contribution is 37 %. Government of India has taken measures such as skill development through training programmes, provision of financial assistance, rendering safety and security for women in the working as well as living environment.

Value Addition of Flowers as a Venture

Value addition of flowers is the process of adding value to the flower or ornamental crops either through form, space or time utility. This may be a perfect choice for women entrepreneurship. Because unlike other agricultural or horticultural commodities, flowers are ultimately expounded for beautifying and enhancing the aesthetic sense of environment. Women are naturally connected more with flowers by using them for worship, hair adornment, etc. So, this natural bond could be manipulated to craft admirable and innovative products out of flowers. Moreover, it does not need wider scientific and research knowledge and is entirely oriented on skill and creativity. In addition, it is a low input and high output

task which could add monetary value by even 20-200 %. Only a meagre technical knowledge and skill with constant financial support is required to boost the venture. Hence, value addition could significantly aid in empowering women by tapping their hidden potential.

Value Added Products

Fresh flowers, dry flowers and even the floral waste can be utilized for value addition in an enterprise level. Nowadays, there is an increasing demand of floral arrangements in hotels, restaurants, IT companies and multi-national companies to increase employees' work efficiency by improving the working environment. Thus, women self help groups (WSHG) and women co-operatives can themselves indulge in such floral designing and arrangement activities. Loose flower crafts too have great requirement especially during festivals and weddings. Some of the well known loose flower crafts in south India are *thodutha maalai*, *kortha maalai*, *veni*, *ghajra*, bridal crowns and *jadai*. Further, women can be trained to extract essential oils as Government of India is encouraging women with several schemes and subsidies for setting up their own enterprises.

The demand for dry flowers is increasing at an impressive rate of 8-10 % and therefore there is a great scope for women entrepreneurs. Dry flower articles like dry flower bouquets, floral cards, wall hangings, sceneries, photo frames, wreathes, pomander, night lamps, backdrops, potpourris, dried flower candles, herbal soaps are also popularising in the market. Also, making floral ornaments such as ear rings, pendants and key chains made of dried, special flowers like autumn leaves, roses, dandelions, bougainvillea, jasmine, *Lantana camara* and orchids using heated resin or natural edible wax could pick up rapidly as the consumers always desire for novel products.

Edible flower products like pickles from dried magnolia & liliums, sugared candies from pressed flowers of pansy, jams and jellies from hibiscus, rose & lotus, sweets, chocolates, cookies and cakes from dried petals of marigold, rose & carnation and rose gulkhand could be the great platform for women entrepreneurship as these are simple to execute and the women has in-built talent to plan amazing food products.

Further, women folks could use the floral wastes from temples to make incense sticks and handmade paper. This method not only reduces the generally discarded waste produced by temples, but also recycles and reuses them as environment-friendly products. Handmade

paper made from flower waste has many advantages as they are 100 % free from wood, chemicals and harmful by-products.

Steps to Develop Small Scale Entrepreneurship

- Identification of suitable value added product of the region based on the availability of raw materials, consumer preferences and working environment.
- Acquiring information on production procedure by visiting KVKs or State Agricultural Universities and also undergoing training programmes
- Project planning by considering raw material availability, market access, budget, profit and risks associated with the project
- Validation of proposed project with any resource person from KVKs or SAUs
- Approaching funding agency for consistent and stable financial support
- Project implementation according to the plan

Successful Initiatives by Women in Value Addition of Flowers

Start-up	Entrepreneur	Product
Green wave	Nikhik Gampe and Preetham Gampe (Mumbai & Kanpur)	Incense stick (Nirmalya)
Help us Green	Ankit Agarwal and Karan Rastogi	Charcoal free incense stick (Phool), Biodegradable thermocol (Florafoam), Bio-leather (Fleather), Vermicompost and soaps
Holy Waste	Maya Vivek and Minal Dalmia (Gundlapochampally)	Paraben-free soaps with flower oils (Petals), Hand-rolled incense sticks (Vimoksh) and Enriched compost (Bhoomija)
Kashmir Aromatics	Rubeena Tabassum (Chaddora)	Essential oil extraction
Vaagai (TN), Pelli Poola Jada (AP)	Kalpana Rajesh and Kalaivani (Hyderabad & Chennai)	Flower arrangement and floral jewellery
'Bihan' scheme of Chattisgarh	Women self help group (Raipur)	Gulal

Conclusion

Crafting in floriculture through dry flower making, floral decor, bouquet making, dry flower frames & articles and potpourris by using ornamental plants is considered as an ideal venture in the recent past for livelihood and women empowerment. Women groups can work together with small-scale processing enterprises to create new markets for higher value

floriculture products. Besides, utilization of floral wastes for making value added products creates awareness among people as wells as control environmental pollution. Thus, it will be a better option for women to start their own enterprise as it needs little investment with some basic knowledge. In addition, this approach could build confidence, risk taking and decision making ability of women as well as improve the nation's economy.

References

Alka, S. (2017). Floral crafts for improved livelihood and women empowerment. *International Journal of Information Research and Review*, 4(5): 4160-4163.

Baskaran, V., Abirami, K. and Jerard, B. A. (2020). Drying of ornamental flowers: An income earning venture. *Biotica Research Today*, 2(5): 283-286.

Mayilvaganan, S. and Santhini, M. (2015). Women entrepreneurs in India – An overview. *International Journal of Economic and Business Review*, 3(1): 113-116.

Priyanka, Raheja and Aarti, Garg (2018). Women entrepreneurship in rural sector. *International Journal of Academic Research and Development*, 3(1): 529-533.