Open Access Multidisciplinary Online Magazine

Agri-India TODAY

Monthly e-Newsletter

ISSN : 2583-0910

Volume 03 | Issue 06 | June 2023

www.agriindiatoday.in

Editorial Board

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ISSN : 2583-0910
Agri-India TODAY
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Peer reviewed
monthly newsletter

Article ID : 03/VI/01/0623

ZERO BUDGET NATURAL FARMING: AN ALTERNATIVE WAY TO THE GREEN REVOLUTION

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Introduction

Chemical-free farming known as "Zero Budget Natural Farming" (ZBNF) consists the overall cost of cultivating and harvesting plants is zero. The investment done from farmer's side is recovered through intercropping in this. Finance Minister Nirmala Sitharaman brought up the subject of "Zero Budget Natural Farming" in her address introducing the 2019 budget describing as a way to double farmers' income. The process of growing crops without utilizing any external inputs, such as pesticides and fertilizers, is known as zero budget natural farming (ZNBF). Any crops having zero production costs are referred to as "Zero Budget" crops. The ZBNF's advice on sustainable farming practices can help to maintain soil fertility, provide chemical-free agriculture, and ensure a low cost of production increases the farmers' income (zero cost). ZBNF is, to put it simply, a farming method that emphasizes growing crops in harmony with the environment. Several studies have shown that fertilizers and pesticides affect soil health by killing millions of microorganisms that are important for plant growth present in the soil (Zafar *et al*., 2001; Jayashree and Vasudevan, 2007). Decreasing trend in crop yield due to indiscreet /abuse of inputs such as fertilizers and pesticides (Lal, 2009; Pingali, 2012).

Natural farming is based on low-input, climate-resilient and low-cost farming system, as all inputs (insect repellents, fungicides and pesticides) made up of natural herbs, which integrates crops, trees and livestock allowing functional biodiversity (Rosset and Martinez-Torres, 2012). Thus natural farming drastically cut down production costs by replacing the use of industrial fertilizers and pesticides with home based product and adopting intercropping and mulching (Palekar, 2005; 2006). The government has promoted organic farming under the specialized scheme known as Paramparagat Krishi Vikas Yojana (PKVY). This programme encourages the use of various kinds of chemical-free farming techniques, including Zero Budget Natural Farming.

Initially, Japanese farmer Masanobu suggested natural farming, based on the idea of working with the cycle and process of the natural world (Fukuoka, 1987). In India, the movement of endorsing ZBNF has been championed by an Indian agriculturist and Padma Shri recipient Subash Palekar. As an alternative to the Green Revolution techniques, he created it in the middle of the 1990s. Several points were depicted by Subash Palekar in support of Zero Budget Natural Farming. Thousands of farmers employ the Zero Budget Natural Farming method in a variety of agroclimatic zones and soil types. Everything a plant needs to grow is available in nature. Plant growth does not require the use of chemicals. As an illustration, soil contains seven times as much nitrogen as earthworm excrement. Many small farmers choose this method because they believe

that Zero Budget Natural Farming is a tool that can help them to become free from debt and default. It increases the profitability and sustainability of farming. Many states widely adopted at varying levels, especially, Maharashtra, Andhra Pradesh, Karnataka, Himachal Pradesh (Khadse *et al*., 2017; Mishra, 2018; Niyogi, 2018).

Benefits of Zero Budget Natural Farming (ZBNF)

"Zero Budget Natural Farming" has various advantages in the current situation. When compared to non-ZBNF approaches, ZBNF methods utilize between 50% and 60% less water and electricity for all crops. Through frequent aerations, the ZBNF greatly decreases methane emissions. Mulching also makes it feasible to stop residue from burning. The price of cultivation is cheaper in ZBNF. The rising cost of external inputs is the main cause of debt and suicide among farmers (seeds, fertilizers, pesticides and herbicides). According to data from the National Sample Survey Office, about 70% of households in the agricultural industry spend more than they bring in, and more than half of all farmers are in debt (NSSO). Since ZBNF does not need payment of money or taking out loans for external supplies, the cost of production might be reduced and agriculture could become a "zero budgets" endeavor. This will free up a lot of small farmers from a vicious cycle of debt and open the door for farmers' incomes to double. ZBNF creates organic yields that bring in more revenues for farmers than traditional agricultural yields because it is a completely chemical-free technology. Organic foods help to prevent diseases that were formerly brought on by non-organic foods, which over time will not only improve overall human health but also lessen the strain on the healthcare system. All crops can be grown in all agro climatic zones with it.

Components of Zero Budget Natural Farming

It is well known that, there are four components of ZBNF methods. Those are i) Bijamrita ii) Jiwamrita/Jeevamrutha iii) Acchadana/Mulching iv) Waaphasa/Moisture (Soil Aeration).

i) **Bijamrita:** The seeds are treated with formulations derived from cow dung and urine of native species as they can be better adapted to the climatic conditions of India and easier for small and marginal farmers to manage. Bijamrita is used to treat seeds, whilst neem leaves and pulp, tobacco, as well as green chilli extracts, are utilised to manage insects and pests. The "Bijamrita" seed treatment also protects the seeds from the fungus and other soil borne diseases which affect immediately after the seed sowing.

ii) **Jiwamrita/Jeevamrutha:** Cow dung is a natural resource that is used to improve the soil's fertility and nutritional value. There could be 300-500 billions of beneficial bacteria in one gram of cow manure. These microorganisms aid in the breakdown of soil biomass and its conversion into readily available nutrients for plants. Jiwamrita is produced from cow dung and urine. It is a part of the diet of the plants. Jiwamrita is an uncontaminated soil, jaggery, cow dung, urine and pulse flour-based fermented microbial culture. This fermented microbial culture, when added to soil, improves the soil's nutrient content and serves as a catalyst to promote the activity of earthworms and microorganisms. 500 litres of jeevamrutha should be applied twice a month to each acre of land; after three years, the system may become self-sustaining. One indigenous cow is sufficient for cultivating crops in 30 acres area (Palekar, 2005). Unlike in organic farming, only a small quantity of cow dung and urine are required in natural farming, to prepare the concoction of Jeevamrutha. This culture promotes the availability of nutrients to plants, protects crops from soil

illnesses, and increases the carbon content of the soil by encouraging soil microbial activity.

iii) **Acchadana/Mulching:** Mulching entails covering the topsoil with cover crops, organic waste or agricultural residue. Humus is produced by decomposing the mulching materials, and it not only enhances soil nutrition but also conserves topsoil, increases soil water retention, lowers soil evaporation loss and fosters soil fauna. Moreover, it stops weed growth.

iv) **Waaphasa/Moisture (Soil Aeration):** The soil needs to be adequately aerated in order for plants to develop and thrive. Mulching and applying Jiwamrita encourage soil aeration, humus content, water availability, water retention ability, and soil structure. All of which are crucial for crop growth, especially during dry spells.

The Principles of Zero Budget Natural Farming:

There are several different principles which is followed under Zero Budget Natural Farming.

i) The external inputs for this type of farming is actually zero.
ii) It is very important to keep the remaining living roots throughout the year for the purpose of enhancing or preserving the health of the soil by providing the food and shelter to the soil beneficial bacteria and fungi.
iii) The soil should not be disturbed or minimum during cultivation.
iv) Natural bio stimulants to be incorporated to obtain better plant growth, adoption in the stress condition and yield benefits.
v) The seeds of indigenous genotypes are one of the other pillars to broaden the diversity of natural gene pool and that to use under mixed farming.

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ISSN : 2583-0910
Agri-India TODAY
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Peer reviewed
monthly newsletter

Article ID : 03/VI/02/0623

NANOTECHNOLOGY: A BOON FOR AGRICULTURE

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Abstract
Agriculture is considered as the backbone of most developing countries, with more than 60% of the population dependent on it for their livelihood. In the same times there are many challenges facing agriculture sector, like climate change, non-reasonable use of resources and usage of too much chemical fertilizer Nanotechnology is emerging out as the greatest imperative tools in recent agriculture and predictable to become a driving economic force in the near future. At the same time Nanotechnology employs different chemical agents and novel delivery systems to implement crop productivity and potentials to decrease use of bulk agrochemicals, Nanotechnology may afford keener solutions for the current problems in the field of agriculture. Direct applications of nanotechnology in agriculture include delivery of agrochemicals and nutrition, pesticides, nano-scale carriers, smart packing, Nano sensors, veterinary care, fisheries and aquaculture, detection of nutrient deficiencies.

Keyword: Agriculture, population, climate change, Nano technology

What is Nanotechnology?
Nanotechnology is a new scientific approach that includes the use of materials and equipment capable of using physical and chemical properties of a substance at molecular levels to explore the biological and material worlds in nanometer-scale and use it in various carriers from medicine to agriculture. Nanotechnology is the science and technology of tiny things, the materials that are less than 100 nm in size. One nanometer is 10^{-9} meters, Nanotechnology combines solid state physics, chemistry, chemical engineering, biochemistry, biophysics, and materials science.

Properties of the nanoparticles
Two principal factors cause the properties of nanomaterials to differ significantly from other materials, increased relative surface area and quantum effects. Morphology-aspect ratio/size, hydrophobicity, solubility-release of toxic species, surface area/roughness, Surface species contaminations/adsorption, during synthesis/history, Reactive Oxygen Species (ROS) O2 / H2O, capacity to produce ROS, structure/composition, competitive binding sites with receptor and dispersion/ aggregation are the important properties of nanoparticles.

Applications of Nanotechnology in Agriculture
Over the time agriculture gets constant benefits from different technological innovations like hybrid varieties and synthetic fertilizers and pesticides. Now agricultural scientists are realizing that smart innovation like nanotechnology is strongly required for agricultural growth, to face

global challenges of food security and climate change. The importance of nanotechnology applications in agricultural sector came only in recent years, but the research was started about half a century back. The uses of nanomaterials are required for increasing fertilization (or fertilizer) use efficiency, yields, and reducing pesticide need, rapid and early pathogens and toxic chemical detection in food items, smart pesticides and fertilizer delivery systems, smart systems used for food packaging and processing, and regulating agricultural food security. Agricultural productivity can be improved through nanomaterial-induced genetically improved animals and plants, site-specific drug and gene delivery of molecules at cellular/molecular levels in animals and plants.

Nano fertilizer

Nano fertilizers are made from conventional fertilizers, bulk materials for fertilizers, or extracted from different plant or plant parts by encapsulating/coating them with nanomaterials for controlled and slow release of nutrients for the development of soil fertility, productivity, and quality of agricultural products. Considering the unique physicochemical properties and advantages of nanomaterials, the encapsulated nutrients can be released in Nano sized form in a controlled manner to improve the efficiency of crop plants along with minimum impact on the environment. Owing to the high reactivity of nanomaterials, they interact with fertilizers, which results in an improved and effective absorption of nutrients for plants. Nano fertilizer comprises Nano formulations of nutrients deliverable to plants, enabling sustained and homogeneous absorption A Nano fertilizer refers to a product that delivers nutrients to crops in one of three ways. The nutrient can be encapsulated inside nanomaterials such as nanotubes or nonporous materials, coated with a thin protective polymer film, or delivered as particles or emulsions of nanoscale dimensions. Owing to a high surface area to volume ratio, the effectiveness of Nano fertilizers may surpass the most innovative polymer-coated conventional fertilizers, which have seen little improvement in the past ten years.

Pest and disease detection

Pollutants, pests and plant diseases cause severe damage to crops. For instance, insect pests cause 25% loss in rice yields and 50% for cotton, Bio-sensors consisting of an organic-based detection mechanism, such as enzymes, are able to detect these specific threats Due to their size-related properties, nano-biosensors show an increase in accuracy, detection limits, sensitivity, selectivity, temporal response and reproducibility, compared to conventional biosensors. They are able to detect single viruses and contaminants at the molecular level. These particles are smaller than is approved by EU standards Therefore, Nano-biosensors provide a very precise tool that can be used to prevent pest outbreaks and monitor soil quality, which enhances quality and quantity of yields.

Nano-pesticide

Persistence of pesticides in the initial stage of crop growth helps in bringing down the pest population below the economic threshold level and to have an effective control for a longer period. Hence, the use of active ingredients in the applied surface remains one of the most cost-effective and versatile means of controlling insect pests. In order to protect the active ingredient from the adverse environmental conditions and to promote persistence, a nanotechnology approach, namely “nano-encapsulation” can be used to improve the insecticidal value. Nano encapsulation comprises nano-sized particles of the active ingredients being sealed by a thin-

walled sac or shell (protective coating). Nano-encapsulation of insecticides, fungicides or nematicides will help in producing a formulation which offers effective control of pests while preventing accumulation of residues in soil. In order to protect the active ingredient from degradation and to increase persistence, a nanotechnology approach of "controlled release of the active ingredient" may be used to improve effectiveness of the formulation that may greatly decrease amount of pesticide input and associated environmental hazards. Nano-pesticides will reduce the rate of application because the quantity of product actually being effective is at least 10-15 times smaller than that applied with classical formulations, hence a much smaller than the normal amount could be required to have much better and prolonged management.

Nano-herbicide

Weeds are menace in agriculture. Since two-third of Indian agriculture is rainfed farming where usage of herbicide is very limited, weeds have the potential to jeopardize the total harvest in the delicate agro-ecosystems. Herbicides available in the market are designed to control or kill the above ground part of the weed plants. None of the herbicides inhibits activity of viable belowground plant parts like rhizomes or tubers, which act as a source for new weeds in the ensuing season. Soils infested with weeds and weed seeds are likely to produce lower yields than soils where weeds are controlled. Improvements in the efficacy of herbicides through the use of nanotechnology could result in greater production of crops. The encapsulated Nano-herbicides are relevant, keeping in view the need to design and produce a nano-herbicide that is protected under natural environment and acts only when there is a spell of rainfall, which truly mimics the rained system.

Application of Nanotechnology in Seed Science

Seed is most important input determining productivity of any crop. Conventionally, seeds are tested for germination and distributed to farmers for sowing. In spite of the fact that seed testing is done in well-equipped laboratories, it is hardly reproduced in the field due to the inadequate moisture under rainfed conditions. In India, more than 60% of the net area sown is rainfed, hence, it is quite appropriate to develop technologies for rainfed agriculture. A group of research workers is currently working on metal oxide nano-particles and carbon nanotube to improve the germination of rainfed crops. The use of carbon nanotube for improving the germination of tomato seeds through better permeation of moisture is helpful. Their data show that carbon nanotubes (CNTs) serve as new pores for water permeation by penetration of seed coat and act as a passage to channelize the water from the substrate into the seeds. These processes facilitate germination which can be exploited in rainfed agricultural system.

Enhanced delivery of nutrients and plant protection products (ppp)

Up to 70% of conventional fertilizers and ppp's do not reach their target because they are unstable in the environment and difficult to be taken up. Nano-based smart delivery systems have the ability to provide more efficient and targeted delivery to specific plant cells due to their size-related properties. Also, they show enhanced stability in the environment, which improves the availability of nutrients and ppp's to crops. Smart delivery systems further enhance the delivery of nutrients and ppp's through their ability of slow or controlled release. In addition, the effect of pesticides was found to be twice as strong with half the dose applied. Enhanced delivery of nutrients and ppp's improves the resistance of crops towards threats like droughts, pests and pollution. Therefore it improves the quality and quantity of yields. Nano-biosensors can enhance

this process even further by enabling smart delivery systems to precisely release nutrients and ppp's in response to environmental triggers and biological demands.

Nanotechnology in Water Management

Nanotechnology offers the potential of novel nanomaterials for the treatment of surface water, groundwater and wastewater contaminated by toxic metal ions, organic and inorganic solutes and microorganisms. Due to their unique activity towards recalcitrant contaminants many nanomaterials are under research and development for use for water purification. To maintain public health, pathogens in water need to be identified rapidly and reliably. Unfortunately, traditional laboratory tests are time consuming. Faster methods involving enzymes, immunological or genetic tests are under development. Water filtration may be improved with the use of nanofiber membranes and the use of Nano biocides, which appear promisingly effective. Biofilms contaminating potable water are mats of bacteria wrapped in natural polymers which are difficult to treat with antimicrobials or other chemicals. They can be cleaned up only mechanically, which cost substantial down-time and labour. Work is in progress to develop enzyme treatments that may be able to break down such biofilms.

Application of Nanotechnology in Animal Sciences

Nanotechnology has the ability to provide appropriate solutions for addressing the issues of food items, veterinary care and prescription medicines as well as vaccines for domesticated animals. Taking certain medications such as antibiotics, vaccines, and probiotics, would be effective in treating the infections, nutrition and metabolic disorders, when used at the nano level. Medicines used at the Nano level have multilateral properties to remove biological barriers for increased efficiency of the applied medicine. Appropriate timing for the release of drug and self-regulatory capabilities are the main advantages of the use of nanotechnology in the application of drugs. The Nano-magnets can be used as drug delivery system specially to treat the cancerous growth without any harm to the surrounding tissues. Different types of proteins like albumin, gelatin, gliadin and legumin can be used to prepare nanoparticle-based drug delivery system. Inert Nano beads were used to neutralize the antigen causing osteoarthritis in racing horses. Use of Nano based antibiotics in treatment of animal diseases requires less amounts of antibiotics leaving less antibiotic residues. Nanoparticle based chromium supplementation has beneficial effects on growth performance and body composition and it increases tissue chromium concentration in the muscles. Iron deficiency is a common problem in animals, especially during the early stage of life, gestation and parasitic infestation due to less bioavailability. The bioavailability can be increased with the supplementation of ferric phospholicnano-particles.

Nano biotechnology

Nano biotechnology has the potential to increase the efficiency and quality of agricultural production and food storage, to enhance the safety of food supplies for the protection of consumers and producers and to introduce new functionality (value-added products) for food, fiber and agricultural commodities. Nano biotechnology will pave the ways for new researchable areas and applications such as DNA chip, protein identification and manipulation, novel nucleic acid engineering based films, smart delivery of DNA using gold nanoparticles. Biological tests measuring the presence or activity of selected substances become quicker, more sensitive and more flexible when Nano-particles are put to work as tags or labels. Magnetic nanoparticles, bound to suitable antibody, are used to label specific molecules, structures or microorganisms.

Crop Improvement Nanotechnology

Nanotechnologyhas lured scientists to think differently. It has been able to modify the genetic makeup of the crops, which has otherwise been possible through mutation breeding. A nanotech research endeavor in Thailand aimed to modify the characteristics of indigenous rice cultivars, including the famous jasmine rice, at atomic level. It is an endeavor to rule out the controversy over genetically modified organisms (GMOs) as the Nano biotech helps agriculture to avoid the argument of GMOs and to reach to the next level, atomically modified organisms (AMOs). According to BIOTHAI, scientists of nuclear physics lab at Chiang Mai University have stepped forward and have been successful to modify the color of an indigenous rice cultivar, "Khao Kam," using nanotechnology. The meaning of the word "Kam" is deep purple, and the cultivar is known for the purple stem, leaves, and grains. The purple color of the stems and leaves of the cultivar has been changed from purple to green by the scientists using nanotechnology. Scientists of the research group told that their next target is to deal with jasmine rice. They are targeting to breed a modified jasmine cultivar which will be photo-insensitive and can be cultivated throughout the year, having dwarf stems and better color of grain. The researchers at Chiang Mai are using a type of mutation breeding. They are trying to find out an ideal passage through the cell wall and membrane of plant so that the nanoparticle can penetrate the cell to induce targeted alteration in the genetic makeup without hampering other essential functions of the cell wall and membrane. Crop improvement through mutation breeding and nuclear physics are well-known method, and the United Nations Food and Agriculture Organization/International Atomic Energy Agency program in Vienna have significant contribution in this line since inception of the technology.

Conclusion

Nanotechnology is becoming increasingly important for the agricultural sector. Promising results and applications are already being developed in the areas of delivery of pesticides, bio pesticides, fertilizers and genetic material for plant transformation. The use of nanomaterials for delivery of pesticides and fertilizers is expected to reduce the dosage and ensure controlled slow delivery. A main contribution anticipated, is the application of nanoparticles to stabilize biocontrol preparations that will go a long way in reducing the environmental hazard. Nanotechnology, by exploiting the unique properties of nanomaterials, has developed Nano sensors capable of detecting pathogens at levels as low as parts per billion. Apart from detection, nanotechnology also has solutions for degrading persistent chemicals into harmless and sometimes useful components. Nanomaterials would be beneficial in the development and formulation of next generation pesticides, insecticides and insect repellents. Thus, nanotechnology is considered as one of the best possible solution of the problems present in food and agriculture sector.

ISSN : 2583-0910
Agri-India TODAY
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monthly newsletter

Article ID : 03/VI/03/0623

STATISTICS : A TOOL FOR DECISION MAKING IN AGRICULTURE RESEARCH

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Today India is a $3.5 trillion economy. If the current growth trend continues, the country is likely to be a $5.4 trillion economy by 2027 (IMF forecast,2022). The country averaged a GDP growth of 6.7 per cent per annum in this period and its agri GDP growth stood at 3.8 per cent per annum. The current data showed that agriculture has great potential of increasing the country's overall GPD. Agriculture is the centre of Indian economy and any major change in the sector leads to a multiplier effect on the entire economy. We need to improve the performance of agriculture sector that engages the largest workforce – 46.5 per cent. Here our focus is on how statistics helps in decision making and analysing the data related to sustainable growth of agriculture sector.

Agricultural Statistics is the science of collecting, presenting, analysing and interpreting the data related to agriculture. Results obtained after analysing the data helps to reach a particular decision that also on the basis of accurate facts and figures. For example, decision on optimum fertilizer doze in agronomy experiments, prediction cost of total inputs, minimization of cost, maximization of profit, prediction and estimation of area and production under various crops, etc. Statistical tools are imperative to make a decision about various agricultural problems like which crop would make the maximum profit in coming years, pattern of demand and supply of various agricultural commodities, etc. In addition to this, knowledge of statistics plays a pivotal role for recommendation of specific farming system to be adopted, choice of tree crop/species, crop spacing and other components of a farming system. Thus, statistical tools of utmost importance and their applications are our key focus area here, which are discussed one by one.

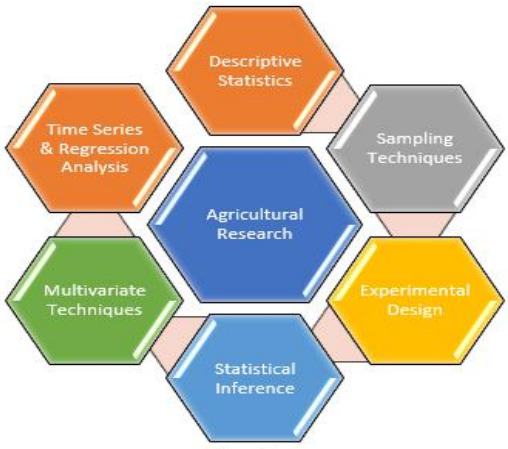

Figure 1

i. **Descriptive Statistics:** Descriptive statistics are tabular, graphical and numerical summaries of data. The purpose of descriptive statistics is to facilitate the presentation and interpretation of data. The informatics in table 1 is presented using descriptive statistics i.e. averages. Table 1 shows the socio-demographic profile for Mid Hills Sub Humid Zone of Himachal Pradesh.

Table 1. Socio-demographic profile of sampled households

Particulars	Farm Size			
	Marginal	**Small**	**Medium**	**Overall**
Number of sampled households	81	124	115	320
Average size of family member (number)	5.09	5.23	4.99	5.10
Males (%)	52.30	51.23	51.91	51.81
Females (%)	47.69	48.77	48.08	48.18
Sex ratio	912.04	951.80	926.17	930
Structure of family				
Joint Families (number)	35 (43.20)	51 (41.13)	50 (43.47)	136 (42.50)
Nuclear Families (number)	46 (56.79)	73 (58.87)	65 (56.53)	184 (57.50)

*Figures in parentheses indicate percentage of the overall

ii. **Sampling Techniques:** Sample survey methods are used to collect data from observational studies. There are two types of sampling methods i.e. probability and non- probability sampling. Probability sampling ensures that each unit in the study population has an equal chance of being selected. For example: Simple random sampling, Stratified sampling etc. Non- Probability sampling uses non- random sample based on specific criteria and the sample is chosen arbitrarily by the researcher. For example: Convenience sampling, Quota sampling, Snowball sampling etc.

iii. **Experimental Design:** Scientific researches and investigations are carried through experiments and surveys. Designing of experiments means planning an experiment for assigning treatments under investigation to individuals or experimental units in such a way that the extraneous conditions are controlled as much as possible. Designing of experiments is imperative for research and development programmes in agriculture sector. For example, in finding the most yielding variety of crops among all the varieties, in finding the best breed of animals among all the breeds on basis of yield etc., in making a decision on optimum dose of fertilizer required, etc. Shrestha *et al* (2020) conducted research to evaluate the performance of seven cucumber varieties on the basis of their quality traits using **Randomized Block Design** with 3 replications and concluded that among all the 7 varieties Shalini performed the best.

iv. **Statistical Inference:** Statistical inference is the process of drawing conclusions about populations or scientific truths from data. Inferential statistics are used by scientists and researchers to produce accurate estimates at a relatively affordable cost. For example, to check whether a particular fertilizer has any impact on the crop, we set up a hypothesis and draw an inference on the basis of data and test statistic used for its

analysis. Statistical inference consists of two parts i.e. parameter estimation and testing of hypothesis.

v. **Multivariate Techniques:** Agricultural research generally involves measurement and collection of multiple response variables in an effort to understand the more complex nature of system being studied. Multivariate statistical methods encompass the simultaneous analysis of all variables measured on each experimental or sampling unit. The common applications of multivariate methods and techniques for agricultural sciences are principal component analysis (PCA), discriminant analysis, cluster analysis, multiple regression, path coefficient analysis, etc. Raheem *et al* (2023) conducted field trials during 2019, 2020 and 2021 using split-split plot design with 3 replications to study the underlying interrelationships among the rice variables experimented, select the best linear combination of traits and determine the cluster of planting techniques with corresponding optimum seed rates for optimal yield. Using Principal Component Analysis (PCA), they identified 5 principal components that together accounted for 84 per cent of the total variation in the data matrix of 18 traits.

vi. **Time Series and Regression Analysis:** Time Series Analysis is a way of studying the characteristics of the response variable with respect to time as independent variable. Time series data associated with agricultural prices can be used for forecasting short term and long-term price estimates. It helps to identify patterns, trends and seasonal variations in prices especially with respect to production during rabi, zaid and kharif seasons which ultimately helps farmers to make a proper decision regarding which crop to grow and how much area is to be assigned to a particular area. Most frequently used time series models are ARMA, ARIMA, etc. Kurumatani (2020) proposed Recurrent Neural Network, a time series forecasting method for the future prices of agricultural products. Regression analysis is a statistical method used to determine the strength and character of relationship between a dependent variable and one or more independent variables. The most common use of regression analysis is forecasting, determining the relationship between yield and factors responsible for yield, yield prediction etc. Yield prediction benefits the farmers in reducing their losses and to get best prices for their crops. Sellam and Poovammal (2016) used linear regression analysis to establish relationship between explanatory variables (Area Under Cultivation, Annual Rainfall and Food Price Inflation) and the crop yield as response variable.

vii. **Statistical Genetics:** Statistical genetics is the scientific discipline that focuses on the development and application of statistical methods to derive inferences from genetic data. Statistics has important and interesting interfaces with agriculture including genetics and breeding of crop plants and animals. Statistical genetics is an area at the convergence of genetics and quantitative analysis. Statistical genetics deals with linkage analysis, allelic association tests, gene statement array data analysis, sequence analysis, comparative genomics, phylogenetic tree construction, etc.

Conclusion

Since the beginning of the twentieth century statistics has reshaped the experimental cultures of agricultural research taking part in the subtle dialectic between the epistemic and the material

that is proper to experimental systems (Parolini, 2015). The role of statistics in agriculture science is obvious, where the collection, analysis and interpretation of data is required. Sound and timely statistics are key to inform decisions, policies and investments. In agriculture, statistics is the basis of any scientific study. From performing an experiment in the field to collection of observational data using sampling techniques, statistics is inevitable.

Abbreviations

IMF: International Monetary Fund
GDP: Gross Domestic Product
ha: Hectare
et al: et alia
ARMA: Auto Regressive Moving Average
ARIMA: Auto Regressive Integrated Moving Average

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ISSN : 2583-0910
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Article ID : 03/VI/04/0623

APPLICATION OF LIGHT IN INSECT PEST MANAGEMENT

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Compound eyes and ocelli are the two main types of photoreceptive organs found in insects. Compound eyes are made up of numerous ommatidia, which are photosensitive units. An ommatidium is made up of a lengthy cluster of photoreceptor cells, each of which has distinct spectrum sensitivity. The ommatidia are arranged in a hexagonal pattern to cover a wide visual area with a particular level of spatial precision and detect object motion. The visible light wavelength for insects is determined by the spectral sensitivities of their photoreceptors, and it frequently extends into the ultraviolet (UV) area, which is invisible to humans. As demonstrated by honeybees, an insect compound eye normally consists of three different types of photoreceptor cells, with spectral sensitivity peaking in the UV, blue and green wavelength areas, respectively.

Effects of lights on insect ethology and development

Light affects insect behavior and development in a variety of ways and one of the most typical responses to light is phototaxis. Insects display the following phototactic behaviors (Shimoda and Honda, 2013).

i) **Attraction**: Also known as positive phototaxis, this reaction can be employed to capture insect pests. The wavelengths and intensities of light that work best in attracting insects depend on the species.
ii) **Repulsion**: By exposing light at wavelengths and intensities that repel insect pests, it is possible to prevent them from entering a cultivated area. Repulsion is nothing more than negative phototaxis, or moving away from light.
iii) **Light adaptation**: When nocturnal insect species exhibit typical daytime behaviors like ceasing to move and settling down after a few minutes of exposure to light, they are said to have undergone light adaptation. Night time exposure to intense light inhibits nocturnal insects' ability to fly and reproduce.
iv) **Circadian rhythms** are daily behavioral patterns like waking up, moving around, eating, and mating etc. Artificial night time lighting, can change the timing of an insect's nocturnal or diurnal actions *i.e.,* "phase shift" in chronobiology.
v) **Photoperiodicity :** The physiological reaction of insects to the light cycle is called photoperiodicity. Insects can be regularly exposed to light over the course of many days to delay the onset of diapause. Insects that don't go into hibernation can't survive the winter.
vi) When retina of insect's compound eyes are subjected to abnormally high doses of UV-radiation and blue light radiation, light toxicity occurs, causing its structural degeneration and retinal damage (Meyer-Rochow *et al*. 2002). Additionally, certain insects are unable to develop normally or survive.

vii) Insects won't purposefully fly in the direction of something they can't see. In other words, plants inside a greenhouse can be made invisible to insects by covering it with UV-blocking film. As a result, pests won't be able to enter that greenhouse.

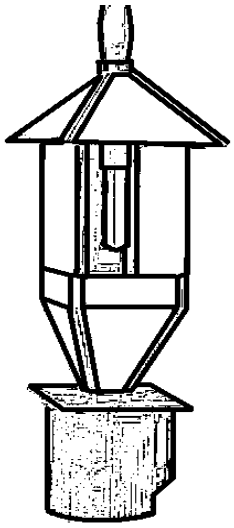
viii) Finally, some insects that are free to fly exhibit a dorsal light reaction, which allows them to maintain their horizontal orientation by interpreting light that strikes their dorsal side as sunlight does while they are flying. Light reflected from below disrupts the typical orientation of flight when the ground is covered with a highly reflecting mulching layer. These latter two lighting effects are helpful in keeping insects out of a farming area.

Use of light as a tool of physical method of pest management

Management of insect pests attacking crops in the field involve multiple approaches in which attempts have been diversified to minimize crop loss without disrupting the surrounding ecology. One such approach widely advocated in IPM programme is use of light traps because of its ease of handling and effectiveness in the region monitoring and management of insect pests. In Integrated Pest Management (IPM) programme, the use of light traps are recommended as it is an effective and user-friendly tool for keeping a watch on the pest population particularly moths and other night flying insects which are attracted to source of light (Halder and Rai, 2021). The collected insect sample provides information on the diversity of insect active in the agro ecosystem and how their population functions (Halder *et al*.,2018).

The light traps work on the principle of luring the phototrophic insects towards light. The insects after getting attracted to the light are caught in the trap or are tactfully encouraged to enter inside the trap from which they cannot escape any more. There are primarily two types of insect light traps *viz*., box type and funnel type. In case of box type traps, an outer wall containing a light source consists of two panes of glass sloping to a narrow horizontal aperture, as the insect enters into chamber; there is little opportunity to escape. In case of funnel shaped trap, a light source is suspended over a funnel which tappers into a chamber beneath it. As the insect enters into the chamber through funnel, it cannot escape.

This device consists of a source of light of different wave length depending upon the insects. However, before installing and using the lights precautionary measures should be read carefully and should be followed strictly for users' safety.



Pic: Light Trap

As different species of insects are having unique response to specific range of the visible and non-visible spectrum, various types of light traps have been explored from time to time.

The mercury light was found to more efficient for attracting insect orders like Lepidoptera, Hemiptera, Hymenoptera, Odonata, and Diptera whereas the black light was reported to be efficient for attracting the insects of the order Coleoptera, Orthoptera, Isoptera, and Dictyoptera and order Coleoptera have exhibited similar attractiveness to the mercury and black light sources (Ramamaurthy *et al*., 2010). Light traps become more effective if these are placed in front of a white painted wall or any other white cloth or sheet as its background. The power supply can be obtained from electricity but under field condition, if electric supply is not available, solar light traps or gas lamps or paraffin vapor lamps can be good alternatives.

Light trap collection provide useful information about timing, relative abundance or species composition of different insects among insect population. The obtained data gives clue to the understanding and prediction of the period of maximum insect diversity and activity. Further, correlating this data with weather parameters will help to explore population dynamics of different insect species which in long run will help in formulating population prediction models (Halder *et al*., 2022).

Table 1.The pests that are attracted to light traps include:

Paddy	Yellow stem borers, Leaf folders, Leaf hoppers, Plant hoppers, Gundhi bugs
Maize	Stem borers
Pulses	Semi loopers, Pod borers
Sugarcane	Borers and Sugarcane leaf hoppers
Vegetables	Diamond Back Moths, Semi loopers, Leaf miners, Shoot and fruit Borers
Fruits	Moths
Polyphagous pests	Cut worms, Grasshoppers, Armyworms, White grubs

Light traps for stored grain insect pests : Besides fields, light traps can also be used in grain storage or godowns around different corners to monitor the presence of stored grain pests as well as to check their future population build up by mass trapping the insects. In godowns, light traps can attract stored product insects like Lesser grain borer (*Rhyzopertha dominica*), Red flour beetle (*Tribolium* spp.) and Saw toothed beetle (*Oryzaephilus surinamensis*) etc when erected at corners of godowns at 1.5 – 5 m above ground level in large numbers. Psocids are also attracted to light which are also a great nuisance in godowns. These traps can be more useful in grain storages at the time of arrival of a new stock as well as during post fumigation periods to control the leftover resistant strains, if any.

Inhibition of flight by reflective mulching films

Spreading reflective mulching sheet over the open crop field ground reflect the insects and thereby reduce the invasion of thrips, alate aphids and whiteflies. The mechanism by which reflecting light controls the invasion of these pests is not yet fully understood.

Advantages: The light trap gives encouraging results on insect pest monitoring for several crops irrespective of the agrochemical conditions. Acceptance level for this device has increased by

leaps and bounds among the field researches. There are many advantages of using light traps for pest management such as:

- Light traps are economical and helpful to reduce use of chemicals ultimately reducing pest management costs.
- This is an eco-friendly device.
- Reduce adult population of insects and check the development of subsequent progeny in the field.
- Farmers can decide about type of pest management to be followed once the insect population in light trap crosses a certain limit.

Limitations

- This method of pest control is not applicable for all types of insects.
- Electric source is essential for light traps, so may not be accessible for all habitats.
- Some light sources *viz*., UV light etc. are harmful for human being so proper care/precautions should be taken before their application.
- Through knowledge of insect behavior and its biology is pre-requisite before trapping the insects thorough light traps.

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ISSN : 2583-0910
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Article ID : 03/VI/05/0623

GROWING AND CULTIVATING BER FRUIT : A COMPREHENSIVE GUIDE

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Introduction

Ber (*Zizyphus mauritiana Lamk)*, which may also be termed as Indian jujube or Chinese date, is a fruit that is native to Southeast Asia and grows on the tree Ziziphus mauritiana. It has a sweet and tangy flavor, with a texture similar to that of an apple. The fruit is small, round or oval in shape, and has a thin, edible skin that ranges in color from yellow-green to red-brown when ripe. Ber is a popular fruit in many parts of Asia, Africa, and the Middle East, where it is often eaten fresh, dried, or used to make jams and juices. In addition to its culinary uses, Ber is renowned for its medicinal properties and has been utilized in traditional medicine to alleviate a variety of ailments. In recent years, ber has gained popularity in the Western world due to its unique flavor and potential health benefits.

Importance

Compared to other fruit trees, Ber cultivation demands little care and input. This crop can yield well even in the absence of irrigation and can thrive as a rainfed crop in arid and semi-arid areas. As a result, Ber trees can serve as a dependable source of income, even in challenging growing conditions, and can provide affordable and nutritious food. Dried Ber fruit is a popular dessert and can also be preserved as candied fruit.

Climate

Ber is a robust fruit that thrives in diverse climatic conditions across the country, including elevations of up to 1000 meters above sea level. They grow best in areas with a tropical or subtropical climate. They prefer hot and dry conditions and can tolerate high temperatures of up to 45°C (113°F) during the growing season. Ber trees are also able to tolerate drought conditions, but they require regular watering during the fruiting season to produce high-quality fruit.

Soil

The Ber plant is capable of growing in a diverse range of soils, including shallow, deep, gravelly, sandy, and clayey soils. Within a short period of growth, the plant develops a deep tap root system that enables it to withstand adverse soil conditions. The Ber plant is also capable of withstanding alkalinity and slightly waterlogged conditions. It is known to thrive in poor soil conditions, outperforming many other types of fruits.

Varieties

Several horticultural varieties of Ber are cultivated throughout India, with popular ones including Umran, Karaka, Gola, Seb, Chhuhara, Sanaur-2, Ilaichi, and Mehrun. In Haryana, the Umran variety is commonly grown on a commercial scale.

Propagation

In the past, propagation of the Ber fruit tree was commonly done through seeds. However, this method had a significant disadvantage due to the heterogeneity and variability in the progeny of seedlings. As a result, it is now recommended to propagate superior varieties using the patch budding technique. To establish a budded plant, sow seeds in the field at appropriate intervals and use the seedlings *in-situ*. To facilitate early germination of seeds, breaking them is recommended as it results in faster germination.

Planting season

To establish a Ber plantation in Northern India, planting should take place either in February-March or July-September, with a recommended spacing of 7-8 meters. Once the layout of the plantation is determined, pits measuring 60x60x60 cm should be dug. To prevent termite infestation, 100 g of 10% carbaryl or Aldrex dust should be applied to the bottom of each pit. The pits are then filled with a mixture of topsoil, 20 kg of farmyard manure, and 1 kg of superphosphates. At the onset of the monsoon season, treated seeds or bud grafts should be planted in these pits to establish the Ber plantation. Providing protective irrigation during the summer months is essential for ensuring plant survival and optimal growth. Beheading the seedlings to ground level in May results in new shoots emerging by July, which can then be patch budded to convert them into the desired variety.

Interculture

Regular weeding and hoeing are important to maintain weed-free soil around young Ber plants for optimal growth. In irrigated conditions, low-growing vegetables can be planted between the Ber trees as intercrops until the trees reach commercial production, which typically takes 4-5 years. In rainfed conditions, intercropping with legume crops such as Moong, Moth (horse gram), and cowpea is recommended. Stirring the soil beneath the tree canopy after rainfall is also beneficial, as it enhances aeration around the roots, helps conserve soil moisture, and assists with weed control.

Care of young orchards

Training

Ber trees tend to grow into large, bushy forms, making them difficult to manage, and resulting in low productivity per unit area. To prevent this, trees need to be properly trained during the initial 2 to 3 years to develop a strong canopy framework. One way to encourage vertical growth is to provide support with sticks to the new plantlets that emerge from either in-situ or transplanted seedlings. When the Ber tree's growth reaches 1-1.5 meters, it's recommended to pinch the terminal growth. This allows the lower buds on the main stem to sprout and develop into primary branches. As these primary branches grow, they should be pinched to promote the growth of secondary branches. This process of pruning helps keep the plants in a manageable shape and size, with a well-developed framework.

Pruning

In Ber production, it is a crucial activity as the fruits grow in the axil of leaves on young shoots of the current season. Pruning is done annually to promote the growth of a maximum number of healthy new shoots that can produce high-quality fruits. Based on the climatic conditions in

Haryana, it has been observed that the optimal time for pruning is between May 15th and June 15th**.**

Special Horticultural practices

The application of growth regulators such as GA, NAA, CCC, and Ethephon has proven to be effective in enhancing fruit set, size, and early or delayed maturity. Specifically, GA at a concentration of 10 ppm and NAA at 10 ppm were found to be effective during the development of fruit, while Ethephon was applied one month before harvesting. The use of NAA was shown to increase fruit yield.

Irrigation

It is primarily cultivated as a rainfed crop, and irrigation is generally not practised. However, if irrigation is available, it can increase the crop yield. It is important to note that an increase in yield may come at the cost of fruit quality.

Nutrition

Similar to other fruit trees, Ber requires the regular application of manure and fertilizers to achieve good yields. To improve the quality and quantity of fruits, it is recommended to apply 30-50 kg of FYM, 250 g of N (split in 2 doses), 250 g of P2O5, and 50 g of K2O per fully grown tree (at 5 years of age and beyond) per year.

Plant protection:

1. Ber fruitfly: *Carpomyia vesuviana* (Tephritidae: Diptera)

Damage symptoms

The maggots of fruit flies tend to consume the pulp of the fruit, leading to decay and eventual dropping of the fruit.

Management

- Choose fruit fly-resistant varieties such as Safeda Ilaichi, Chinese, Sanaur-1, Mirchia, Tikadi, and Umran for cultivation.
- Collect and dispose of any fallen or infested fruits by burying them in a pit and covering them with soil.
- Plough the inter-spaces to expose pupae
- Preserve natural parasitoids : *Opius compensates* and *Spalangia philippinensis*
- To manage fruit flies, one option is to use methyl eugenol lure traps, with 25 traps needed per hectare, to both monitor and kill adult flies. Another approach involves preparing a mixture of methyl eugenol and malathion 50 EC in a 1:1 ratio, using 10 ml of the mixture per trap. Another technique is to apply a bait spray composed of molasses or jaggery at a concentration of 10 g/L, along with one of four insecticides (fenthion 100 EC at 1ml/L, malathion 50 EC at 2 ml/L, dimethoate 30 EC at 1ml/L, or carbaryl 50 WP at 4g/L), twice at two-week intervals before fruit ripening. Additionally, spraying malathion 50 EC (1.0 L), dimethoate 30 EC (1.0 L), or dichlorvos (700 ml) during flower formation and fruit set can be effective.

2. Ber fruit borer: *Meridarches scyrodes* (Carposinidae: Lepidoptera)

Damage symptoms

Yellow larvae in the 1st and 2nd instars feed on the fruit superficially, while red larvae in the 3rd–5th instars bore deeply into the fruit, consuming the pulp and depositing faecal frass**.**

Management

- Remove any damaged fruits and dispose of them.
- Regularly rake the soil around the plants.
- Apply 40 kg of chlorpyrifos 1.5 D per hectare around the trees before the fruits reach the marble stage.
- Apply either 1.0 ltr of malathion or 750 ml of dimethoate per litre water during the fruit set, and repeat the application every 15 days.

3. Fruit/ Stone weevil: *Aubeushimalayanus* Voss (Curculionidae: Coleoptera)

Damage symptoms

The stylar end of Ber fruits may exhibit a marking of black-coloured eggs laid by pests. When eggs are laid after half of the fruit's maturity, the development of grubs may not be successful. Infestation rates of up to 43% have been observed in a single branch. Varieties with a higher stone ratio are more susceptible to weevil attacks.

Management

- One strategy for controlling weevils is to remove infested fruits from the vicinity of trees and manually collect and dispose of adult weevils in the morning and evening, particularly during September and October when their population is at its peak.
- Another effective approach is to apply Carbaryl 50 WDP at a concentration of 0.1% shortly before fruit formation and reapply the spray every three weeks.

Harvesting and yield

Ber fruit harvesting in Northern India peaks from February to April, and since the fruits on the tree mature at different times, they are gathered in four or five rounds. The harvesting process is manual, using a ladder, and it's crucial to pick the fruits at the appropriate stage of maturity, based on their characteristic color and softness. This stage is reached after the fruit has achieved its full size, which takes about 120 days. In dryland (rainfall) conditions, an average of 60-80 kg of fruits can be harvested per tree each year. However, under irrigated conditions, the yield can be significantly increased, up to three or four times higher.

Post-harvest handling and marketing

After sorting out the underripe, overripe, and damaged fruits, the remaining sound fruits are separated into two grades - large and small - based on their size. These graded fruits can then be packed into a variety of containers, including gunny bags, wooden boxes, cardboard boxes, or nylon knot bags.

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Article ID : 03/VI/06/0623

ROLE OF FORESTS IN CLIMATE CHANGE MITIGATION IN MEGHALAYA

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Abstract

Global temperatures are expected to rise as a result of climate change phenomenon like temperature is likely to rise by 1.4 to 5.8^{o} Celsius by the end of the 21st century. Forest cover in Meghalaya is 76% of its geographical area. However, deforestation and forest degradation have been identified as significant threats to the state's forests, and their carbon storage potential. In order to mitigate the effects of climate change, it is essential to conserve forests and their carbon storage potential. Therefore, forest of Meghalaya plays a vital role is mitigating climate change and biodiversity conservation.

Introduction

Climate change refers to variation in the climate through time, whether it is brought on by natural variability or human action (IPCC 2007). Climate change affects forest ecosystems through changes in average temperature and rainfall, as well as in the frequency and severity of extreme weather and climate events, such as forest fires, storms, cyclones, and droughts (Garcia *et al*., 2014; Barry, 2014). It is expected to cause notable changes in the distribution, flowering and fruiting of many forest tree species (Grimm *et al*., 2013). Changes in tree phenology are regarded as one of the earliest indicators of species response to climate change (Barry, 2014).Scientists have now estimated that the average global temperature is likely to rise by 1.4 to 5.8^{o}Celsius by the end of the 21st century (IPCC, 2007).The forests in Meghalaya are evergreen and semi-evergreen trees, which have a high carbon storage capacity due to their long life spans and dense canopy cover (ISFR, 2019). Meghalaya, a state in north-eastern India, is known for its lush green forests, which cover about 76% of its geographical area (ISFR, 2019).

Forests are a critical component of the global ecosystem, providing a range of important ecosystem services including carbon sequestration, biodiversity conservation, and recreation opportunities (FAO, 2015; Puydarrieux *et al.,* 2021). The IPCC estimates that the level of CO_2 in today's atmosphere is 31% higher than it was at the start of the industrial revolution about 250 years ago. Atmospheric level of CO_2 have risen from 280 ppm at the pre-industrial to the present level of 390 ppm and it is projected to be in the range of 540 to 970 ppm in the year 2100 (IPCC, 2007). Evidence suggests that a rise in atmospheric CO_2 concentration is due to expanding use of fossil fuel for energy and most of the increase has occurred in the second half of the 20th century. Carbon storage in forests occurs through the process of photosynthesis, where trees absorb carbon dioxide (CO_2) from the atmosphere and store it in their biomass and in the soil (Selin *et al*., 2023). The present forests are not only important for the biodiversity conservation but they also support the role in carbon storage, which is crucial in mitigating climate change. Forests are one

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of the largest terrestrial carbon sinks, and they play a vital role in regulating the Earth's climate. Several studies have been conducted to estimate the carbon storage potential of forests in Meghalaya. These studies highlight the significant carbon storage potential of forests in Meghalaya. In this article, we will explore the carbon storage capacity of forests in Meghalaya and their importance in combating climate change.

Carbon storage potential in Meghalaya Forest

Forests play a critical role in mitigating climate change by sequestering carbon from the atmosphere. The carbon stored in forests helps to reduce the concentration of CO_2 in the atmosphere, which is a major greenhouse gas responsible for global warming. Forests also help to regulate the Earth's climate by absorbing and storing heat from the sun and releasing water vapor into the atmosphere, which helps to cool the Earth's surface. Assessing the biomass and carbon stocks of trees in forests is an important tool for understanding their role in mitigating climate change and evaluating the sustainability of forest management practices (Chave *et al.,* 2014).Meghalaya has an above-ground biomass pool of carbon stock that is, on average, 55 Mg C ha^{-1}(Chaturvedi *et al.,* 2017). The Forest carbon stock densities show a large variability in Meghalaya (Fig. 1).

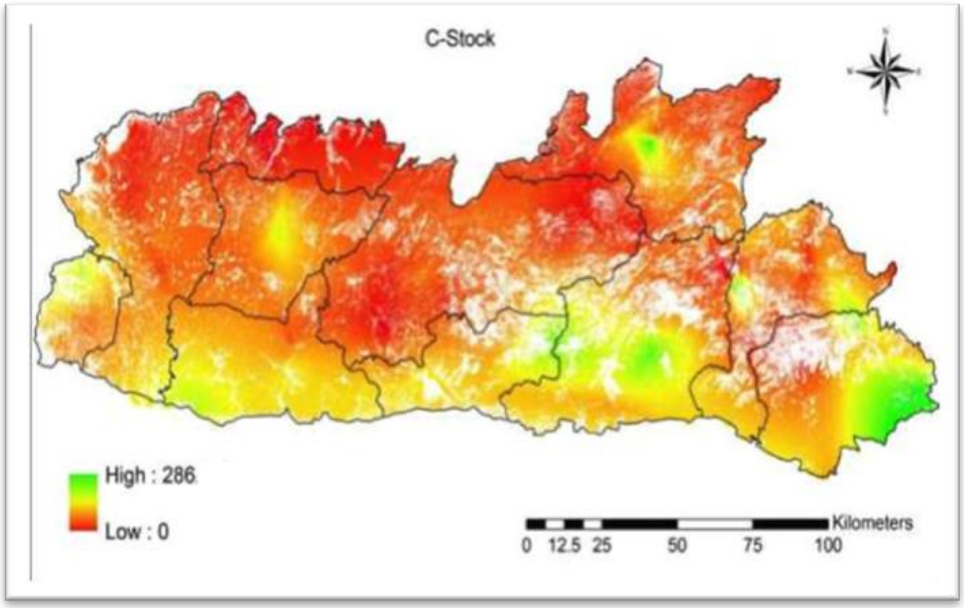

Fig. 1.Carbon stock distribution in forests of Meghalaya Chaturvedi *et al.,*(2017)

Table 1.Forest carbon in Meghalaya in different pools (in '000 tonnes) by ISFR, 2019& 2021

AGB (Above ground Biomass)	BGB (Below ground biomass)	Deadwood	Litter	SOC (Soil organic Carbon)	Total
		2019			
52,302	14,963	731	4,328	1,08,642	1,80,966
		2021			
55241	15820	1238	3075	1,08,014	1,83,388

According to Indian State Forest Report (2019 & 2021) showed the increasing trend in carbon pool in Meghalaya (Table 1). Sahoo *et al.,* (2013) estimated that the aboveground carbon storage in the forests of Meghalaya ranges from 90 to 210 Mg C ha^{-1}, while the soil organic carbon storage ranges from 50 to 150 Mg C ha^{-1}. Another study by Barik *et al.,* (2018) estimated that the carbon storage in the forests of Meghalaya ranges from 32.98 to 68.08 Mg C ha^{-1}.

Conservation Measures for Forest Carbon Storage

According to the Global Forest Resources Assessment (2015), deforestation and forest degradation are responsible for about 10% of global greenhouse gas emissions. In Meghalaya, deforestation and forest degradation have been identified as significant threats to the state's forests, and their carbon storage potential. Several conservation measures have been implemented to protect the state's forests. In order to mitigate the effects of climate change, it is essential to conserve forests and their carbon storage potential. One such measure is the Community Forest Management (CFM) program, which empowers local communities to manage and conserve their forests. The CFM program has been successful in promoting sustainable forest management and protecting the state's forests. Moreover, The Kyoto Protocol, an international agreement under the United Nations Framework Convention on Climate Change, was formally adopted in 1997 and legally enforced in 2005, binding its 128 Parties. Its objective is to address the stabilization of greenhouse gas (GHG) concentrations in the atmosphere, specifically carbon dioxide (CO_2). To achieve this, the Parties have committed to taking action to reduce emissions from various sources and enhance sinks, including forests, by implementing methods like carbon capture and storage (CCS) (UNFCC 1998).

Another conservation measure is the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, which provides financial incentives to developing countries to reduce their greenhouse gas emissions from deforestation and forest degradation. Meghalaya has been identified as a potential site for REDD + implementation due to the state's high forest cover and the threats of deforestation and forest degradation (Chaturvedi *et al.,* 2017).

Conclusion

Forests are critical for carbon storage and play an essential role in mitigating climate change. The forests of Meghalaya, with their high carbon storage potential, are essential for the state's biodiversity and its role in regulating the Earth's climate. However, deforestation and forest degradation pose significant threats to the state's forests and their carbon storage potential. Therefore, it is essential to implement conservation measures such as the CFM and REDD+ programs to protect the state.

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ISSN : 2583-0910
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Article ID : 03/VI/07/0623

GENE IMPRINTING A FASCINATING PHENOMENON

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Introduction

Genomic imprinting is a mechanism that regulates gene expression based on the parent of origin. In other words, each gene only has a single copy that can be expressed, and whether that copy is active depends on whether the gene was inherited from the mother or the father. The process of genomic imprinting is intricate and poorly understood. But it is believed to be crucial for healthy growth and to be involved in a number of illnesses, such as Prader-Willi syndrome, Angelman syndrome, and Beckwith-Wiedemann syndrome. Gene imprinting is a phenomenon that occurs in plants and animals alike, in which certain genes are expressed differently depending on which parent they are inherited from. In plants, gene imprinting plays a critical role in controlling the growth and development of seeds, flowers, and fruits. In this article, we will explore the basics of gene imprinting in plants, its underlying mechanisms, and its implications for plant breeding and agriculture.

To understand gene imprinting in plants, it is important to first understand the basic principles of genetics. Each cell in an organism contains a complete set of genetic information, which is stored in the form of DNA molecules. These DNA molecules are composed of genes, which are the basic units of heredity. Each gene codes for a specific protein, which in turn determines the physical and biochemical traits of the organism.

In most cases, genes are expressed equally from both parents. However, in some cases, certain genes are "imprinted" or silenced, depending on which parent they were inherited from. This means that only the copy of the gene inherited from one parent is expressed, while the other copy remains inactive. This leads to the expression of only one allele of the gene, rather than both alleles. The mechanism behind gene imprinting in plants is complex and not yet fully understood. However, it is known to involve the addition or removal of chemical marks called methyl groups, which are added to specific regions of the DNA molecule. These methyl marks serve as "flags" that signal the gene to be either activated or silenced, depending on which parent the gene was inherited from. One well-known example of gene imprinting in plants is the control of seed size in maize. In maize, the gene responsible for seed size is imprinted, so that only the copy inherited from the mother is expressed. This results in larger seeds when the mother plant is crossed with a larger father, and smaller seeds when the mother is crossed with a smaller father.

Another of the best-studied examples of gene imprinting in plants is the regulation of seed development in Arabidopsis thaliana, a small flowering plant that is widely used as a model organism in plant biology research. In Arabidopsis, the imprinted gene MEDEA (MEA) is expressed

only when inherited from the mother, while the gene PHERES1 (PHE1) is expressed only when inherited from the father. MEA and PHE1 are involved in the regulation of endosperm development, which is the tissue that surrounds and nourishes the developing embryo inside the seed. In Arabidopsis, the endosperm is triploid, meaning it has three sets of chromosomes instead of the usual two. This is because it is formed by the fusion of two sperm cells with the central cell of the female gametophyte, which is also triploid.

The imprinted expression of MEA and PHE1 in Arabidopsis is controlled by a process called DNA methylation. DNA methylation is a chemical modification of the DNA molecule in which a methyl group is added to a cytosine base. In plants, DNA methylation is involved in the regulation of gene expression, as well as in the defense against transposable elements and viral infections. In Arabidopsis, the maternal copy of the MEA gene is heavily methylated, which silences its expression. The paternal copy of the PHE1 gene, on the other hand, is not methylated, which allows its expression. This results in the activation of genes that promote endosperm development from the paternal genome, while genes that promote embryo development are activated from the maternal genome.

It is believed that genomic imprinting is crucial for plants to develop normally. It has been connected to several significant plant characteristics, such as seed size, germination, and flowering. Uncertainty exists regarding the precise mechanism of genomic imprinting in plants. However, epigenetic changes to DNA are thought to be involved. DNA can undergo epigenetic modifications, which are chemical changes that do not affect the DNA's sequence. These alterations may be passed down from parents and may have an impact on gene expression.

A new field of study in plant biology has been made possible by the identification of genomic imprinting in plants. The process is intricate and fascinating, and it is still being researched. However, it is obvious that it is crucial for plants to develop normally.

Some of the ways that genomic imprinting is thought to function in plants are as follows:

- **Methylation of DNA:** Methylation is the process of adding a methyl group (CH3) to a DNA molecule. Methylation can alter how proteins bind to DNA, which in turn can alter how genes are expressed.
- **Histone modification:** Histone proteins encase DNA and control the expression of genes. Gene expression may be impacted by histone modification because it can change how tightly DNA is wrapped around histone proteins.
- **RNA interference (RNAi):** Using the method of destroying messenger RNA (mRNA), RNAi is able to silence genes. A gene copy used to make proteins is called messenger RNA, or mRNA. The presence of specific DNA sequences can cause RNAi to occur.
  The process of genomic imprinting is complicated and still under investigation. However, it is obvious that it is crucial for plants to develop normally. Additionally, it may play a role in a number of plant diseases.

Regulation & Implications

The regulation of gene imprinting in plants is a complex process that involves a number of epigenetic mechanisms, including DNA methylation, histone modification, and non-coding RNA. It

is still not fully understood how these mechanisms interact to control gene expression in a parent-of-origin-specific manner.

The study of gene imprinting in plants has important implications for plant breeding and agriculture. By understanding the mechanisms behind gene imprinting, plant breeders can manipulate the expression of certain genes to produce plants with desired traits. This could lead to the development of new crop varieties that are more productive, disease-resistant, and visually appealing. Gene imprinting also plays a crucial role in controlling the development of fruits and flowers in plants. For example, the gene responsible for determining the color of flowers in the snapdragon plant is imprinted, so that only the copy inherited from the mother is expressed. This results in a predictable pattern of flower color inheritance in snapdragons, depending on which parent the gene was inherited from.

Future Prospects

Gene imprinting and its impact on human health have become better understood in recent years. This has prompted the creation of fresh diagnostic procedures and imprinting disorder therapies. We will probably continue to gain knowledge about gene imprinting in the future. This will result in the creation of even more potent diagnostic tools and imprinting disorder therapies. Additionally, it might provide fresh perspectives on the origins of conditions like diabetes and cancer.

Here are some of the potential future prospects of gene imprinting research:

- **Improved diagnosis and treatment of imprinting disorders**: It will be possible to create more precise diagnostic tests for imprinting disorders as our knowledge of gene imprinting advances. Early detection and treatment of these disorders will be possible as a result, which can enhance the quality of life for those who have them.
- **New insights into the causes of disease**: Cancer, diabetes, and obesity are just a few of the diseases that are impacted by gene imprinting. Researchers may be able to create new treatments for these diseases by comprehending how gene imprinting functions.
- **New ways to prevent disease**: Additionally, gene imprinting might contribute to the emergence of certain conditions, like cancer. Researchers may be able to create novel methods to stop these diseases by comprehending how gene imprinting functions.

The study of gene imprinting has a promising future. We'll probably learn more about gene imprinting's operation and potential applications to better human health as research advances. Gene imprinting research may result in new understandings of human behaviour and development in addition to the advantages previously mentioned. For instance, some studies have suggested that the development of autism and other neurodevelopmental disorders may be influenced by gene imprinting. Researchers may be able to create new treatments for these diseases by comprehending how gene imprinting functions. Gene imprinting research has a very bright future overall. We are likely to learn more about gene imprinting's functioning as well as its potential applications for enhancing human health and understanding behavior with further study.

In conclusion, gene imprinting is a fascinating and complex phenomenon that plays a critical role in controlling the growth and development of plants. While much remains to be learned about the underlying mechanisms of gene imprinting, its potential applications in plant breeding and

agriculture are vast and exciting. As researchers continue to uncover the secrets of gene imprinting in plants, we can look forward to a future of more bountiful and beautiful crops. As gene imprinting plays a critical role in the regulation of development, growth, and reproduction in plants. It is involved in the regulation of seed development in Arabidopsis, as well as in the determination of flower morphology and fruit size in other plant species. The regulation of gene imprinting in plants involves a complex interplay between epigenetic mechanisms, including DNA methylation, histone modification, and non-coding RNA. Further research is needed to fully understand the mechanisms underlying gene imprinting in plants and their significance in plant biology.

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ISSN : 2583-0910
Agri-India TODAY
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Peer reviewed
monthly newsletter

Article ID : 03/VI/08/0623

SILTIMUR (*LINDERA NEESIANA* WALL EX NEES) KURZ – AN UNDERUTILIZED SPICE CROP

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Abstract

According to the Spice Board of India around 63 different spices are grown in India. Beside these spices there are many other underutilized spice which is found in India among them one of which is Siltimur (*Lindera nessiana* Wall ex Nees). It is a medium size perennial tree belongs to the lauraceae family and it is widely distributed in Nepal, India, Bhutan and Myanmar. The fruits of *Lindera nessiana* are aromatic and they are used as a spice in preparation of various food products and also as traditional medicines by the locals to treat diarrhea, tooth pain, headache, and gastric disorders. Due to its easy management and also having high medicinal value, the popularity and acceptance of this crop among the locals of Sikkim, Darjeeling and Assam is high. Though, this spice crop is still underexploited at national level. Commercial utilization, proper exploitation, further research work and awareness are necessary for popularizing this crop and also to enhance the livelihood of local province.

Keywords : *Lindera nessiana*, underexploited spice crop, medicinal profile.

Introduction

India is known as 'The Land of Spices' and the glory of Indian spices is known throughout the world. India is the largest consumer, producer and exporter of the spices in the world. According to the Spice Board of India around 63 different spices are grown in India. Beside these spices there are many other underutilized spice which is found in India among them one of which is Siltimur (*Lindera nessiana*). Siltunur, the international name – derived from the Nepalese name sila timura, It is a medium size perennial tree belongs to the lauraceae family which is grown in temperate himalayan region at an altitudes of 1000 to 2800 meters. It is widely distributed in Nepal, India, Bhutan and Myanmar. In Indian it is mainly found in Darjeeling, Sikkim and some parts of Assam. The fruits of *Lindera nessiana* are aromatic and they are used as a spice in preparation of various food products and also as traditional medicines by the locals to treat diarrhea, tooth pain, headache, and gastric disorders (Watanabe *et al* 2013).

Plant botany

The genus Lindera consists of about 100 species which is widely distributed in tropical, subtropical, and temperate zones of Midwestern America and Asia (Devkota *et al* 2016). It is a deciduous shrub or small tree which grows up to a height of 5m tall. The leaves are alternate, entire or three-lobed, ovate, membranous and strongly aromatic when crushed. *Lindera nessiana* is a dioecious in nature and the inflorescences are composed of 3-35 small flowers existing as pseudo-umbels. They are sessile or no short shoots. The flowers are actenomorphic and greenish

to white, greenish-yellow, or yellowish in colour. It is an insect pollinated plant. Economical part is fruit. Dried fruit of *Lindera nessiana* is used as spice.

Figure 1: Siltimur (*Lindera neesiana* Wall ex. Nees)

Figure 2: Dried berries of siltimur (*Lindera nessiana* Wall ex Nees)

Medicinal value

Basically the fruits of *Lindera nessiana* are used as a spice in preparation of various cuisines. Beside that this plant shows wide spectrum of therapeutic uses in indigenous and folk medicine by locals to treat diarrhea, tooth pain, headache, gastric disorder, burn cough, fever and is also used as a stimulant. Essential oils of *Lindera neesiana* fruit consisted mainly of Z-citral, E-citral, eucalyptol, citronellal, α pinene and β pinene, which have a potent antibacterial and antifungal effects (Subedi *et al* 2016). The water extract from the fruits of *Lindera nessiana* also have a potent neuroprotective and anti-neuroinflammatory activity (Comai *et al* 2010). The hydroalcolic extract of the leaves and twings of lindera nessiana also act as potent pancreatic lipase inhibitory activity (Devkota *et al* 2019).

Conclusion

Due to its easy management and also having high medicinal value, the popularity and acceptance of this crop among the locals of Sikkim, Darjeeling and Assam is high. Though, this spice crop is still underexploited at national level. Commercial utilization, proper exploitation, further research work and awareness are necessary for popularizing this crop and also to enhance the livelihood of local province.

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ISSN : 2583-0910
Agri-India TODAY
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Peer reviewed
monthly newsletter

Article ID : 03/VI/09/0623

MINCED BASED FISH PRODUCTS

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A variety of items, including fish sausage, cakes, cutlets, patties, balls, pastes, surimi, texturized goods, etc., can be made with minced fish. Most of these products may be produced using simple processes, and several of them are ideal for launching small-scale businesses.

Surimi

Fish flesh that has been mechanically deboned, rinsed in water, and combined with cryoprotectants for a long frozen shelf life is known as surimi in Japanese. In addition to removing fat and unpleasant components like blood, colours, and odoriferous components, washing increase the concentration of myofibrillar protein, which enhances the product's gel strength and flexibility. This feature can be used to create a range of manufactured goods, such as shellfish analogues.

Figure-1 : Surimi

Surimi production method

A meat-bone separator is used to separate the flesh. In order to prevent skin and scales from going through the holes, perforations in the drum should not be larger than 3–4 mm in diameter. The minced fish is repeatedly rinsed in cool water (5–10°C) to remove the majority of the water-soluble protein. Three washings are often utilized, and 5–10 times the amount of water. To facilitate the removal of water during the final washing, 0.01-0.3% sodium chloride is added, and the material is then screw-pressed to a moisture content of 78–80%. Cryoprotectants, such as sucrose, sorbitol, and polyphosphates, are blended into the dewatered fish meat at levels 4, 4, and 0.2%, respectively, using a silent cutter.

It is not allowed for the temperature to rise above 10 °C during the process because it could harm the protein's functional property. The total protein lost during the washing process is approximately 30% of the minced meat and depends on the amount of water used and number of washing cycles employed.

Surimi based products

Fiberized product

Among the surimi-based imitation shellfish items, Fiberized products are the most popular. As surimi itself has a bland flavour, it is used to create goods that imitate seafood, such asshrimp analog, lobster analog, scallopanalog, crab leg, and crab stick are fiberized products high in demand Surimi, Salt, Starch, Egg White, Shellfish Meat, Shellfish Flavour, Flavour Enhancers, and Water can all be the ingredients used to make fiberized items.

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Kneaded products

Surimi is used in the processing of a number of kneaded products, including kamaboko, chikuwa, hampen, fish ham and sausage, while also incorporating additional components. The majority of these preparations use the identical ingredients, although the classification is primarily determined by the production method used.The ingredients employed other than surimi include salt, monosodium glutamate, sugar, starch, egg white, polyphosphate and water.All of these goods are processed by mixing the various materials to form a fine paste, which is then given a heat treatment.

Kamaboko (steamed)

Fish flesh that has been mechanically deboned, rinsed in water, and combined with cryoprotectants for a long frozen shelf life is known as surimi in Japanese. In addition to removing fat and unpleasant components like blood, colours, and odoriferous components, washing increase the concentration of myofibrillar protein, which enhances the product's gel strength and flexibility. This feature can be used to create a range of manufactured goods, such as shellfish analogues.

Figure-1 : Kamaboko

One of Japan's oldest traditional fish paste items is kamaboko (steamed). Myofibrillar proteins are essentially in the form of a gel, and the resulting products are solid and white in color. 'Fish cake' is another term for it.In West Japan, steamed kamaboko is known as Sumaki or Mushiita, whereas fried kamaboko is known as Tenpura and Satsuma Age [ah-gay] in East Japan. According on regional tastes, fish species, additives, and other ingredients, it can be prepared using a variety of recipes that call for salt, monosodium glutamate, sugar, starch, sweet "sake," egg white, eggs, or polyphosphates, water, and other materials.

Chikuwa (Steamed or Broiled)

Chikuwa, which is made by broiling surimi mixed with spice and other ingredients, has a hollow and cylindrical shape.A good chikuwa has a brown surface and is white inside. It is prepared by wrapping a metal tube or a piece of bamboo with ground surimi and other ingredients, then moving the assembly inside the oven as the broiling or grilling process is carried out.

Figure-2 : Chikuwa

Hampen

Hampen is a mixture of components that includes surimi, Japanese yarn, and various other ingredients. Due to its boiling procedure, it differs from Kamaboko (steamed) and Chikuwa (broiled). Good Hampen is soft and spongy in texture because air is incorporated quickly after kneading.

Figure-3 : Hampen

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Fish ham

Fish ham is made from the surimi of Alaskan Pollock and tuna; non-fish meat can also be included. The commonly used processing procedure is as follows: the surimi is mixed with salt, sugar, chemical flavourings, spices, and a smoke flavouring, and the mixture is allowed to cure for one or two days in a cool environment. The cured bulk is blended into a fine paste together with additional grade surimi, flour, and 50% protein. The paste is enclosed in a PVC casing, boiled in water for 40–60 minutes at 85–90°C, and then frozen after cooling. If the product is meant to be sold fresh, it will be steamed at 120°C for four minutes

Figure-4 : Fish ham

Fish Sausage

An emulsion-based fish product is fish sausage. In a bowl mixer, thawed surimi is combined with salt, sugar, STPP, starch, spice mixture (coriander, chilli powder, ginger garlic paste, pepper), vegetable oil and water to create a homogenous paste for the manufacture of fish sausage. Ideally, the mixing process should be finished in 12 to 15 minutes. The paste is then placed into synthetic casings, usually PVDC, and heatedly processed in Japan. This type of surimi shellfish differs from others in that it has additional components, specifically edible fat and seasonings. The banger is mostly eaten as a snack, an appetiser, or as a component of salads and stir-fried dishes. 45 minutes at 90°C, 15 minutes of cooling in ice water, and one minute of reboiling follow. The product is originally produced in Japan, and differs from other surimisea food based on the added ingredients (i.e., edible fat and spices). The sausage is mostly eaten as a snack, an appetiser, or as a component of salads and stir-fried dishes

Figure-5 : Fish sausage

Fish finger

Slices of the mince are frozen in this particular shape. The slabs are battered and breaded after being sawn into thin fingers. They are then 20 second flash fried. Fish fingers can alternatively

Figure-7 : Fish finger

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Fish balls

Fish mince is combined with cornflour, salt, and spices to make fish balls, which are then moulded into discs with a diameter of 2-4 cm and cooked in boiling brine for 8–10 minutes. The balls can then be heated in a suitable fluid medium or further processed as a coated product by pre-dusting, battering, and breading.

Figure-8 : Fish balls

Fish burger

Burgers are created from lean white fish mince and are similar to fish cutlets. Round forms are created by mixing cooked mince with cooked potato and mild spices. Burgers are breaded and battered before being deep-fried for 20 seconds.

Figure-9 : Fish burger

Fish cutlet

To make fish cutlets, cooked fish mince is combined with cooked potato, fried onion, and other ingredients. After that, it is shaped into the required form, each weighing around 40 g. The cutlets are made, battered, breaded, then cooked for 20 seconds in a flash.

Figure-10 : Fish cutlet

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Figure 6 Fish cutlet

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Article ID : 03/VI/10/0623

NANO DAP FOR SMART AND SUSTAINABLE AGRICULTURE

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Abstract

Development and application of smart fertilizers using innovative nanotechnology are one of the potentially effective options of significantly enhancing the agricultural productions needed to meet the future demands of the growing population. The available literature indicates that some engineered nanomaterials can enhance plant-growth in certain concentration ranges and could be used as nano-fertilizers in agriculture to increase agronomic yields of crops and/or minimize environmental pollution. This article summarizes the benefits of Nano DAP very recently developed by IFFCO and included in the Fertilizer Control Order.

Introduction

The world is witnessing a transformational change in agriculture. From chemical intensive approaches, there is a clear shift towards sustainable alternatives. The chemical fertilizers are used to provide the right dose of nutrients to the crops for optimum growth and productivity of the crop. But currently used fertilizers have not been particularly successful in increasing fertilizer use efficiency and so the crop productivity. The use efficiency of fertilizers commonly used in agriculture is quite low. For example, the use efficiency of the three most basic major nutrients, viz., nitrogen, phosphorus, and potassium, are 30–40 percent, 18–20 percent, and 40–50 percent, respectively, indicating that most of the fertilizers used in crops (more than half of the amount) is lost due to various factors such as photolysis, hydrolysis, leaching and microbial immobilization of water, nutrient enrichment of water bodies (eutrophication)and can't reach the target sites. Farmers use more fertilizers to compensate for lower fertilizer efficiency. However, in the long run, this intensive use of synthetic fertilizers can lead to serious environmental risks such as air pollution, soil health degradation, hydro-eutrophication and groundwater contamination. In addition, increased use of synthetic fertilizers not only increases the cost of their production but also the cost of cultivation and thus reduces the profit margin of the farmers. Environmental risks related to low fertilizer efficiency and over-use of synthetic fertilizers have been a long-standing obstacle to sustainable agriculture. High release levels of nutrients applied through chemical fertilizers compared to crop nutrient requirements or conversion of nutrients into forms that are not available to plants is a big challenge. Increasing fertilizer use generally due to low fertilizer efficiency is making farming costlier day by day with environmental footprints. Now a days, the application of nanotechnology in agriculture is likely to transform the traditional use chemical fertilizers. This article summarizes the benefits of Nano DAP very recently developed by IFFCO and included in the Fertilizer Control Order.

Nano Fertilizers

Nanofertilizer refers to a nanomaterial, which is either a carrier of a nutrient/element (major, secondary or micronutrient) required by the plants, coated with a nanomaterial that meets the plant's requirements, regulates nutrient release and results in a significant increase in nutrient use efficiency. It is noteworthy that nano fertilizers can release nutrients for 40-50 days, while synthetic fertilizers do so for 4-10 days. As a result, after application of urea, more than 70 % nitrogen is rapidly lost through volatilization and leaching leaving only 30-40 % nitrogen available to the crop. For this reason, Urea and DAP have to be used in large quantities due to their low utilization capacity. It is known that some quantity of used fertilizers escapes into the atmosphere in the form of gas and pollutes the environment. The loss of nitrogen in the nitrate form through leaching pollutes the ground water. For this reason, the efficiency of nitrogen given by urea is 30-40 percent and the efficiency of phosphorus given by DAP is estimated at 15-20 percent. While the loss of nitrogen and phosphorus given through nano urea and nano DAP is stopped so they are more effective. In fact, nano fertilizers will help in dealing with such a problem. This will also reduce the dependence on import of fertilizers like Urea and DAP and the government will not be burdened with subsidy.

IFFCO's initiative to produce nano fertilizers

IFFCO's leadership in consonance with the call of Prime Minister Narendra Modi to halve the use of urea had already initiated research and development work to prepare Nano fertilizers ie. Nano N, Nano Zinc, and Nano Cu, a decade back. As a result of this, IFFCO successfully confirmed the benefits of these Nano fertilizers through a large number of on-station and on-farm testing all over the country by sponsoring research projects to the ICAR Research Institutes, KVKs and State Agriculture Universities. The Central Government on the recommendations of the Indian Council of Agricultural Research issued a Gazette notification and Nano Urea (Liquid) was included in "Fertilizer Control Order (FCO) 1985" on June 2021. While, on October 17, 2022, Prime Minister Narendra Modi had launched Liquid Nano Urea developed by IFFCO's National Biotechnology Centre (NBRC) at Kalol, Gujarat. IFFCO started its production on August 1, 2021, and produced 29 million bottles (500 ml) till March 31, 2022. The central government has also roped in public sector undertakings (PSUs) such as Rashtriya Chemicals and Fertilizers Ltd (RCF) to make it. During 2022-23, the total production of nano-urea was 50 million bottles of which IFFCO produced 27.5 million. According to the Union Minister for Chemicals and Fertilizers Mr. Mansukh Mandaviya, by 2024-25, India will be producing around 440 million bottles of nano urea and after 2025 India need not import urea as domestic production of conventional and nano liquid urea could be sufficient to meet domestic demand. In this context, it is important to mention that Urea imports decreased from 9.83 million tons in 2020-21 to 9.13 million tons during 2021-22 and further down to 7.48 million tons during 2022-23. As for DAP, these are early days as production has just started.

IFFCO Nano DAP : A New Invention After IFFCO Nano Urea

Mr. Mansukh Mandaviya, Union Chemicals and Fertilizers Minister, announced on March 4, 2023that the government has authorized the launch of nano liquid DAP (di-ammonium phosphate) fertilizer for the benefit of farmers and to increase the country's self-sufficiency.The fertilizer Co-operativeIFFCO has the credit for the development and its largescale production of Nano DAP fertilizer first of its in the world. Nano DAP is in the form of a nanoparticle containing

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nutrient particles of 10-70 nanometres in size. It provides nitrogen (8%) and phosphate (16%) nutrients to plants in liquid form as an complement to conventional DAP. A 500-ml bottle of nano-DAP may be equivalent to a 50-kg bag of conventional DAP. It is available to the farmers for Rs 600/ per bottle of 500 ml without any subsidy support. The conventional DAP is made available at more than double this price ie. Rs. 1,350/ per bag and that too with the government giving a subsidy of Rs 2650. If all conventional DAP is replaced by nano–DAP, DAP subsidy can be brought down to zero. Additionally, farmers will need to pay half of what they currently pay.

Picture 1. The gazette authorizing launch of nano liquid DAP by the Government

On April 26, 2023, Union Minister for Home and Cooperatives Amit Shah launched liquid nano-diammonium phosphate (nano-DAP) developed by the Nano Biotechnology Research Centre (NBRC), Kalol of Indian Farmers Fertilizer Cooperative (IFFCO). During the current fiscal, IFFCO plans to produce 50 million bottles (500 ml) of nano-DAP which will be scaled up to 180 million bottles by 2025-26. According to US Awasthi, Managing Director of IFFCO, by then imports of DAP might not be required; currently, India imports over 50 percent of its DAP requirement. It is, indeed, a historic land mark not only for IFFCO but also for the country, for its revolutionary Nanotechnology-based fertilizers IFFCO Nano Urea and IFFCO Nano DAP.

Picture 2. A view DAP Trial and remarks of Prime Minister on Nano DAP (Liquid)

As we know, to make fertilizers affordable to farmers, the Centre controls the maximum retail price (MRP) of urea at a low level unrelated to the cost of production and distribution, which is higher. The excess cost over MRP is reimbursed to the manufacturer as a subsidy, which varies from unit to unit depending on its cost. For non-urea fertilizers, it fixes 'uniform' subsidies on a per-nutrient basis for all manufacturers and importers. Subsidy on every ton of fertilizer produced and sold multiplied by the total tonnage gives the total subsidy paid from the Union Budget. In this situation, the Government bears a huge budgetary burden to pay the subsidy so as to make fertilizers affordable to farmers. Here, it will be important to add that the fertilizer subsidy went up from an already high of Rs. 162,000 crore during 2021-22 to Rs 253,000 crore during 2022-23. The budget estimate (BE) for 2023-24 is Rs. 179,000 crore (this reduced allocation is no consolation as invariably, the actual payment turns out to be higher than the BE; for instance, during 2022-23 the actual was more than double the BE of Rs 105,000 crore.

Recent studies have suggested that nano fertilizers, apart from increasing the crop yield and produce quality provide solutions to the problems of climate change, the environment and depleting natural resources by arresting the emission of greenhouse gases, ensuring balanced plant nutrition, increasing fertilizer use efficiency, developing abiotic and biotic stress and salt resistance in crop plants. Apparently, Nano fertilizers can ensure the desired increase in crop productivity and income of farmers to feed the growing population and also to ensure better livelihood of the farmers.

Nano DAP (Liquid) is now available to the farmers

With the production of Nano DAP (Liquid) it has now reached the farmers, and IFFCO is providing it to the farmers with a bottle of 500 ml whose capacity is equal to one bag of DAP, which is available for only Rs. 600/- without subsidy. This will increase the availability of DAP, thereby eliminating import dependence, and will result in huge savings in subsidy to the government. IFFCO's Managing Director Dr. Uday Shankar Awasthi's far-reaching vision to make Nano Urea and Nano DAP in the interest of the nation and farmers has resulted in outstanding success and India became the first country in the world to make Nano Urea and Nano DAP. Dr. Awasthi believes that with the introduction of Nano DAP in the market, where the country will be self-sufficient in fertilizer production, there will also be a huge saving of expensive foreign exchange.Nano Urea is available at all Instrument Cooperative Societies , IFFDC, Agri Junction, DCF, Marketing Societies, Central Consumer Storage, IFFCO Kisan Sewa Kendra , Mandi Samiti , IFFCO E-Bazar etc.

ON-FARM Trials with Nano DAP (Liquid)

Two hundred sixty five on-farm trials on wheat during 2020-21 were conducted with high yielding cultivars in different districts of Uttar Pradesh during *Rabi* season of 2021-22 with 3 treatments (T_1, T_2 and T_3)as per details given in **Table 1**. In T_1 as per farmers fertilizer practice (FFP) 100 % of N, P and K were applied. In T_2 and T_3, where only 50 and 25% of the P applied by the farmer as per FFP was used, and N, K and other nutrients were applied uniformly. The requisite quantity of the seed was treated with Nano DAP@5ml/kg seed with desired volume of water so that the entire seeds could be treated well with the solution in T_1 and T_2. The seeds were properly spread in the shade and kept for half an hour to get these dried and then utilized for sowing. After 25-30 days of germination (DAG), foliar Spray of Nano DAP in T_2 was done @ 2 ml/litre and in T_3 @ 4 ml/litre of water. Flat fan or cut nozzle sprayer was used for uniform foliar spray. The spray was done during morning or evening hours ensuring that there was no dew on the leaves. The standard cultural

practices were adopted and the field was irrigated timely and weed-free condition was maintained as far as practical under farmers' conditions. The crop was harvested at maturity and grain and straw yields were recorded on dry basis.

Table 1. Details of treatments

Treatments	Details
T_1	100 % NPK and other nutrients as per farmers practice (FFP)
T_2	FFP (50% N and P and 50% N and and100% other nutrients + Seed/seedlings treatment with Nano DAP @ 5 ml/litre water for seedlings treatment and 5 ml Nano DAP mixed in one litre water for seed treatment +One Foliar spray (FS) of Nano DAP @ 2 ml/litreat20-25 days after transplanting + one foliar spray of Nano Urea at panicle initiation @ 2 ml/litre of water.
T_3	FFP (50% N and P and 50% N and and100% other nutrients + Seed/seedlings treatment with Nano DAP @ 5 ml/litre water for seedlings treatment and 5 ml Nano DAP mixed in one litre water for seed treatment +One Foliar spray(FS) of Nano DAP @ 2 ml/litreat20-25 days after transplanting + one foliar spray of Nano Urea at panicle initiation @ 2 ml/litre of water.

The results of this investigation are presented in the following columns.

Data related to effect of IFFCO Nano DAP on yield of grain and straw and the additional return are given in **Table 2.** The increases in mean grain yield over T_1ie. recommended doses of NPK with T_2 (FFP (50% P and 100% N & K) + Seed treatment with Nano DAP +One Foliar spray (FS) of Nano DAPat20-25 DAT) and T_3 (FFP (25% P and 100% N & K) + Seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT) were 232 and 7 kg/ha respectively. It is clear that the performance of Nano DAP was substantially better than recommended doses of NPK (RDF) and also the yield obtained with 25% P **+** 100% N & K) + Seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT) was at par to T_1 (recommended doses of NPK) (RDF). The straw yields also showed substantial increase with reduced doses of P as compared to recommended dose P applied through conventional DAP. Apparently, the increases in mean straw yield recorded over recommended doses of NPK with T_2 (FFP (50% P + 100% N & K) + seed treatment with Nano DAP +One Foliar spray (FS) of Nano DAPat20-25 DAT) and T_3 (25% P **+** 100% N & K) + seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT) were 320 and 21 kg/ha, respectively. Thus, it is inferred that the straw yields also showed substantial increase with reduced doses of P (50%) as compared to recommended dose P applied through conventional DAP. Like grain yield, straw yield obtained under T_1 (recommended doses of NPK) (RDF) was also at par to T_3 (25% P **+** 100% N & K) + seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT).

Additional return obtained through grain and straw yields with T_2 (FFP (50% P + 100% N & K) + seed treatment with Nano DAP +One Foliar spray (FS) of Nano DAPat20-25 DAT) over T_1 (recommended doses of NPK) (RDF) was Rs. 5382/ha ie. Rs. 4582/ha through grain + Rs. 800/ through straw. However, additional return with T_3 (25% P **+** 100% N & K) + seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT) over and Rs. 191/ha ie. Rs. 138 through grain

+ Rs. 53/ through straw as compared to T1 (recommended doses of NPK) (RDF). Thus, the additional return with T_2 (FFP (50% P + 100% N & K) + seed treatment with Nano DAP +One Foliar spray (FS) of Nano DAPat20-25 DAT) was better than T_1 (recommended doses of NPK) (RDF) and T_3(25% P **+** 100% N & K) + seed treatment with Nano DAP +One foliar spray (FS) of Nano 20-25 DAT) was at par to T_1 (recommended doses of NPK).Some glimpses of Nano DAP (Liquid) seed treatment and field view of on-farm trials are shown in **Picture 3.**

Table 2 : Effect of IFFCO Nano DAP (Liquid) on economic yield and net return of wheat (2021-22) (Number of Trials-265)

Particulars	Grain			Straw		
	T1	T2	T3	T1	T2	T3
Lowest yield, kg/ha	2300	2850	2500	3303	3612	3412
Highest yield, kg/ha	6775	7250	5875	11675	12200	10175
Mean	3979	4211	3986	5712	6032	5733
Response over FFP, kg/ha	-	232	7	-	320	21
% Increase	-	5.83	0.18	-	5.60	0.37
Net return over FFP, Rs./ha	-	4582	138		800	53

Note:- T_1- Farmer's method of fertilizer application (FFP), T_2- 100% Nitrogen and Potassium, + 50% Phosphorus + Seed treatment with Nano DAP @ 5 ml / kg seed + foliar spray of Nano DAP@ 2 ml/litre one month after sowing or 25th day after germinationT_3- 100% Nitrogen and Potassium, + 25% Phosphorus + Seed treatment with Nano DAP @ 5 ml / kg seed + foliar spray of Nano DAP@ 4 ml/litre one month after sowing.

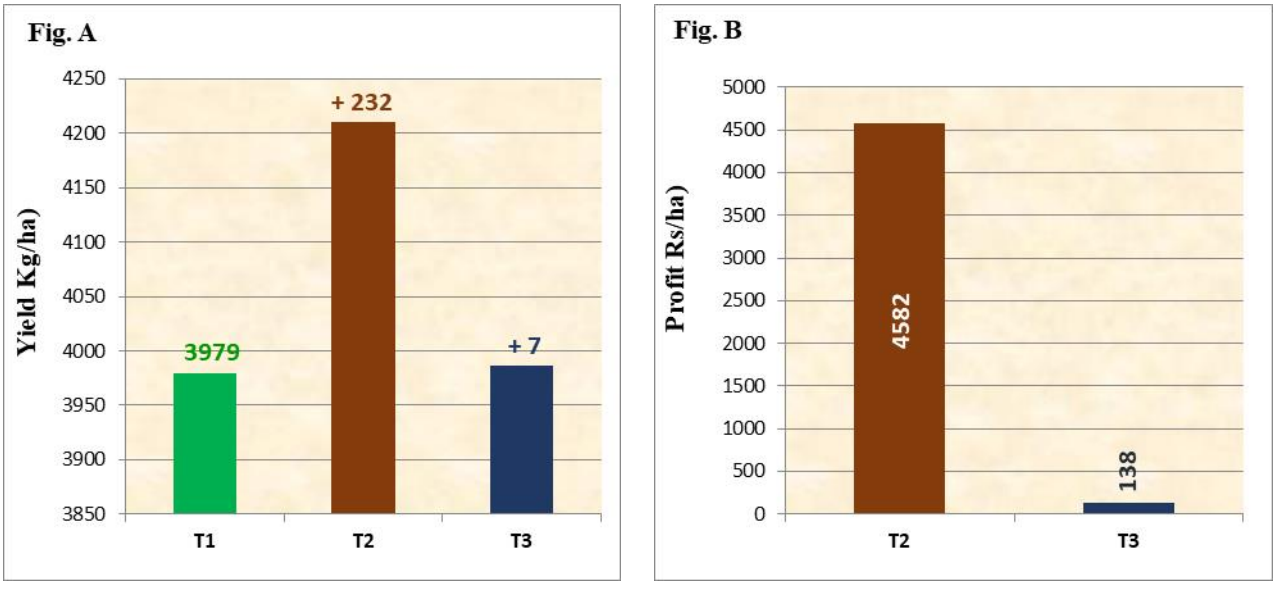

Fig.1. Effect of IFFCO Nano DAP on wheat grain yield and economic return in U.P (Number of Trials-265)

Note:- T_1- Farmer's method of fertilizer application (FFP), T_2- 100% Nitrogen and Potassium, + 50% Phosphorus + Seed treatment with Nano DAP @ 5 ml / kg seed + foliar spray of Nano DAP@ 2 ml/litre one month after sowing or 25th day after germinationT_3- 100% Nitrogen and Potassium, + 25% Phosphorus + Seed treatment with Nano DAP @ 5 ml / kg seed + foliar spray of Nano DAP@ 4 ml/litre one month after sowing.

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Picture 3. A view of seed treatment with Nano DAP (Liquid) and of on-farm trials

Conclusion

After nano urea, the government has now approved nano DAP. Which will improve the livelihoods of Indian farmers and contribute to Prime Minister Narendra Modi's vision of *Aatmanirbhar Bharat*. It is yet another step toward achieving self-sufficiency in fertilizers, and that it will greatly help farmers. IFFCO Managing Director, Dr. U. S. Awasthi stated that IFFCO intends to introduce nano-potash, nano-zinc, and nano-copper fertilizers. Nano Fertilizers can provide reliable, high quality fertilizer inputs in an eco-friendly manner and ensure increase in crop yield, reduce the cost of production for the farmer and save government money on subsidy bills and cut imports of urea and DAP. These nano fertilizers (Nano Urea and Nano DAP) will not only prove to be important for obtaining the maximum economic yield of the crops due to better fertilizer efficiency, but their judicious use will also protect the environment.Due to the continuous development of nanotechnology, there will be immense employment opportunities for the youth as business man in this field.

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Article ID : 03/VI/11/0623

NANOTECHNOLOGY : A DIMENSION OF MODERN AGRICULTURE

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Abstract

Agriculture is the backbone of our country. To feed the growing population, increasing production & productivity play important role in modern agriculture. Nanotechnology play vital role by utilizing different techniques like nanoparticle, nanozeolite, nanosensor, nanofertilizer, nanopesticide which act as component in crop growth. Among different fields of application of nanotechnology, agriculture is now a growing sector and its judicious use increase the crop yield.It also helpful for increasing shelf life of food materials.

Keyword: nanotechnology, crop growth, nanosensor, shelf life.

Introduction

Agriculture has always been the backbone of the developing countries. Nanotechnology as defined by size is naturally broad; including fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, energy storage, engineering, micro fabrication, and molecular engineering. The associated research and applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nano scale to direct control of matter on the atomic scale. Nanotechnology has been used to create many new materials and devices with a vast range of applications, such as in nanomedicine, nanoelectronics. In agriculture, nanotechnology has been utilized for development for novel nutrient sources and biomaterials. Nanopesticides and nanofertilizers are already in commercial use. Nanozeolites and hydrogels has been used to improve soil quality (Afzal, S., & Singh, N. K.,2022). Apart from its direct use in nanofertilizers and nano-pesticides, devices based on nanotechnology like nanosensors find its use in monitoring of crop growth and nutrition status. Nanotechnology helps in increasing plant production.

Nanotechnology applications in agriculture

- Nanoparticles are smaller size, more surface area. So the reacting area is more and accordingly they react and form the product. Nanoparticles for slow and controlled nutrient release, minimizing fertilizer wastage. Silver nanoparticles reduced the growth of *Magnaporthe grisea*, a fungal pathogen that causes rice blast disease.
- Nanostructured fertilizers for improved nutrient uptake and utilization by plants.
- Nanofertilizers of different types like silver, iron, zinc, titanium, carbon nanotubes, molybdenum and silica and applied on various crop systems.
- Nanoparticles as antifungal and antibacterial agents for disease control.
- Silver has been known to be an antibacterial agent for many years and is widely used to control pathogenic bacteria. Copper is another metal, reported as an antimicrobial agent.

Copper nanoparticles have been reported in the effective control of rice blast and leaf spot disease.

- The use of polymers in the development of nano-formulations of active ingredients has produced new generation nano-insecticides which showed controlled release and target specific activity.

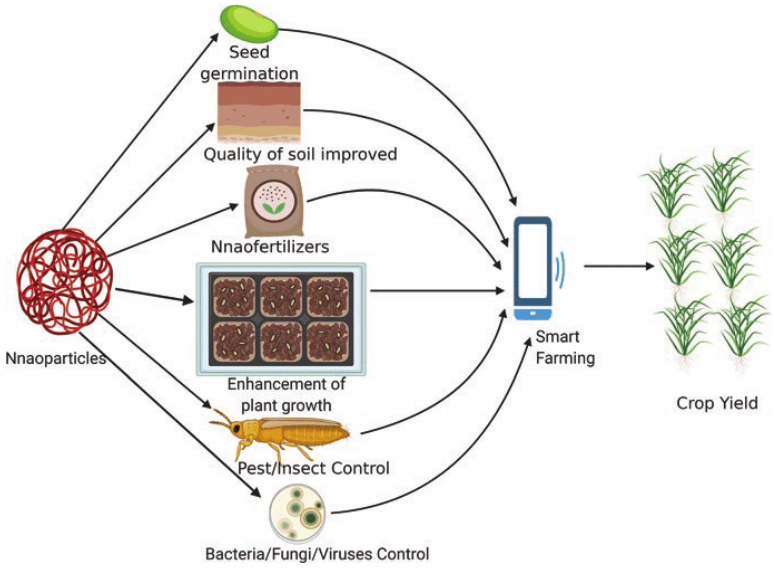

Fig. 1 Different nanoparticles and their use (Indira *et al*., 2021)

Nanozeolites has high porosity and high cationic capacity and ion exchange characteristics. So it helps in increasing yield &nutrient use efficiency of crop. Now a days its wide use in agriculture i.e. crop growth, development, increase production & productivity, increase vigour & vitality of plant. Nano materials usage increase soil pH and soil structure. Nanotechnology can be used to harness the full potential of seed. Water purification using nanotechnology exploits nanoscopic materials such as carbon nanotubes and alumina filters for nano filtration. Nano encapsulation of insecticides, fungicides or nematicides will help in producing a formulation which offers effective control of pests while preventing accumulation of residues in soil.

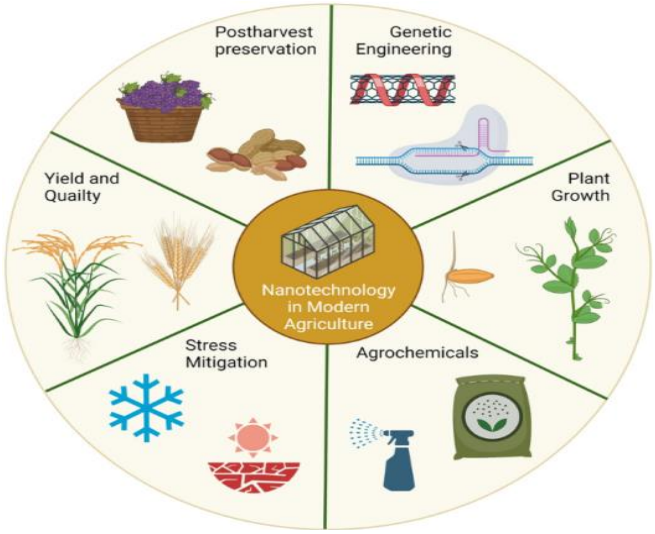

Fig. 2 Mitigation of stress by nanotechnology technique

- Nano coatings for seed protection, controlled release of nutrients, and efficient water uptake. Nano encapsulation of agrochemicals to improve their efficacy and reduce environmental impact.
- Nanobiosensors for detecting seed quality, disease presence, and environmental stressors. Nanobiosensors for early detection and diagnosis of plant diseases.
- Nanotechnology Applications in Post-Harvest Management.
- Nanoemulsion increased the retention capacity of active ingredient in the plants due to nanosize and increased uptake (Anjali et al., 2010).
- Nanomaterials have been used as food packaging materials to preserve and enhance shelf life of packaged food materials. Nanocomposites have been found suitable in food packing as antimicrobial agents.

Nanotechnology can increase agricultural production, and its applications include:
(1) Nanoformulations of agrochemicals for applying pesticides and fertilizers for crop improvement.
(2) The application of nanosensors in crop protection for the identification of diseases and residues of agrochemicals.
(3) Nano-devices for the genetic engineering of plants.
(4) Plant disease diagnostics.
(5) Animal health, animal breeding, poultry production and
(6) Postharvest management.

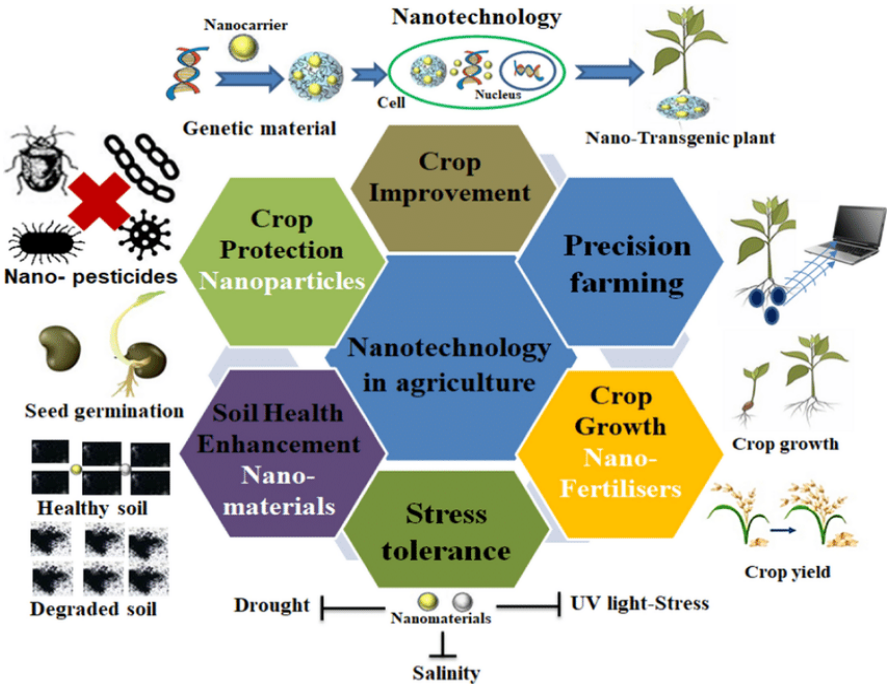

Fig.3 Role of nanotechnology in agriculture

Conclusion

Nanotechnology in agriculture as nanofertilizer, nanopesticide and nanosensor significantly proved their applications in plant growth and crop production in a sustainable manner. Nutrient

loss from soil is a major issue and estimation of its extent is necessary to develop amelioration strategies. Nano-coated fertilizers possess easy uptake ability and can thus reduce losses in terms of leaching. The nanotechnology based sensors can provide accurate information about fertilizer requirements, which can be helpful in reducing costs to farmers and save unutilized fertilizers. Nanomaterial based sensors also showed potential in detection of residual pesticides or pathogens and ensured food safety to consumers. Nanoencapsulation and application of nanomaterials in food packaging improved the shelf life of food products and provided sustainable solutions for food degradation and deterioration during transport. Nanotechnology helps in crop production, crop improvement and crop protection.

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Article ID : 03/VI/12/0623

POLICY AND TECHNOLOGICAL PREFERENCES FOR DEALING WITH CLIMATE LED DISASTERS IN INDIA

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Abstract

This article examines strategies and tools for preventing climate-related catastrophes in India, such as floods, cyclones, heat waves, and droughts. To improve early warning systems, strengthen agricultural resilience, and create disaster response and recovery initiatives, the Indian government and other stakeholders are employing a variety of strategies. The paper also calls for an integrated approach and points out the shortcomings of Japan's extension system. The article's overall message emphasises the critical need for efficient technologies and policies to lessen the devastating effects of climate-related disasters on India's ecosystems, infrastructure, and way of life.

Introduction

Natural catastrophes have become more frequent and intense in India as a result of climate change, which presents substantial challenges for stakeholders and policymakers. India must implement effective policies and embrace the right technical preferences if it wants to lessen the effects of calamities caused by the climate. Given India's national priorities, the socioeconomic circumstances of the nation, and the particular difficulties brought on by climate change, these policies and technical preferences must be in line with those. The framework for India's climate change policies stresses a variety of actions, such as capacity building, mitigation, and adaptation. In order to solve calamities brought on by climate change, technologies like remote sensing, artificial intelligence, and machine learning can be quite useful. These technologies could be combined with sensible policies to provide India a more robust and sustainable future.

Policy and Technological Programmes for Dealing with Climate-led Disaster in India

National Policy on Disaster Management (NPDM)

India's disaster management framework document was developed by the Ministry of Home Affairs in 2009. It aims to create a proactive and comprehensive approach to disaster management involving all stakeholders, recognizing the significant impact disasters can have on the country's social, economic, and environmental development.

National Innovations on Climate Resilient Agriculture (NICRA)

Indian government launched a program for smallholder farmers to promote climate-smart agriculture practices and technologies to enhance the agricultural system's resilience to climate change. It offers support for research, capacity building, and adoption of climate-resilient technologies.

National Institute of Disaster Management (NIDM)

The NIDM aims to build capacity in disaster management through collaboration and training with other institutes, working under the NDMA regulations, to become a "Centre of Excellence".

National Disaster Management Plan (NDMP)
The NDMP provides a detailed roadmap for disaster management in India. It identifies the types of disasters that the country is vulnerable to and outlines the measures that need to be taken to prevent, mitigate, and respond to disasters.

National Disaster Response Force (NDRF):
NDRF, consisting of personnel from Indian Army, Navy, and Air Force, is a specialized force formed to respond to disasters.

Disaster Mitigation and Management Fund (DMMF)
The DMMF provides funds to states for disaster management, and is managed by the NDMA.

National Cyclone Risk Mitigation Project (NCRMP)
NCRMP launched to reduce cyclone risk in India via improved early warnings, infrastructure, and community resilience.

2.8. National Flood Control Program (NFCP)
NFCP aims to enhance the capacity of states in India to respond to and prevent/mitigate flood damage through a flood management program.

National Program for Capacity Building of Engineers in Earthquake Risk Management (NPCBEERM)
NPCBEERM program educates and trains engineers to design earthquake-resistant structures, building their capacity in earthquake risk management.

National Program for School Safety (NPSS)
The NPSS program in India aims to enhance school safety by improving disaster preparedness and response capabilities while implementing measures to prevent and reduce disaster damage.

Disaster Management Act, 2005
The Catastrophe Management Act governs India's disaster management, with responsibilities outlined for various stakeholders including NDMA, SDMAs, and DDMAs.

Other schemes like PMJDY, PMFBY, and PMAY were aimed at providing financial inclusion, crop insurance, and affordable housing to all households in India, including those affected by disasters.

Policy Preferences
Climate change adaptation plans
To address climate change-induced disasters in India, developing adaptation strategies is crucial to mitigate risks and vulnerabilities, prioritizing the protection of vulnerable groups such as women, children, and the elderly.

Disaster management plans
Emphasis on early warning systems, evacuation protocols, and assistance measures. Technology and innovation should be used in these strategies to improve catastrophe response and recovery.

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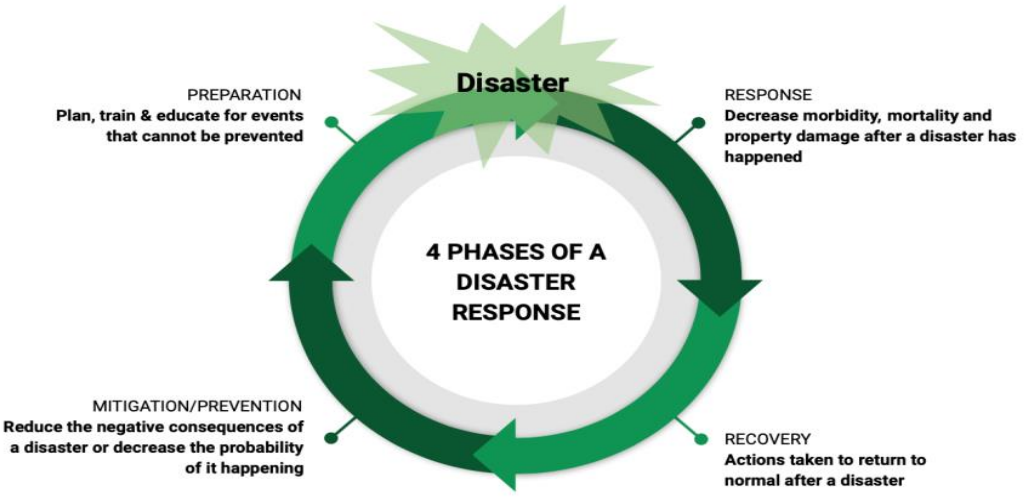

Fig. 1: Phases of a disaster management

Ecosystem restoration and conservation

Policies for restoring and protecting ecosystems like forests, wetlands, and grasslands may protect populations from landslides and floods, as well as aid to control the climate.

Infrastructure development

Infrastructure development strategies to make sure that they are robust to the effects of climate change. Buildings, roads, and other infrastructure should be planned and built to endure harsh weather conditions.

Technological Preferences

Climate data and information systems

Climate data helps policymakers plan and implement strategies to reduce the impact of climate-led disasters using remote sensing, climate models, and GIS technology.

Early warning systems

Utilizing technology like weather monitoring systems, satellite imaging, and mobile phone apps can provide real-time alerts and warnings to communities, aiding in reducing the impact of natural disasters.

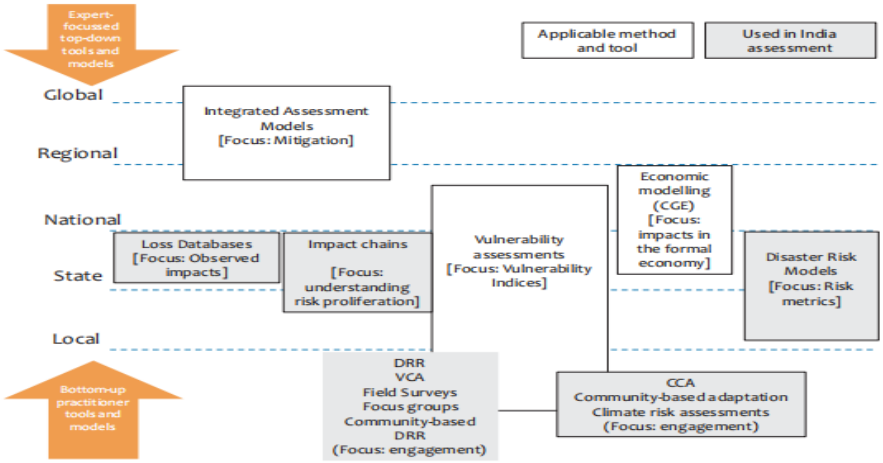

Figure 2 : Methods and tools across scales and tools used for the India application.

Disaster response and recovery tools

Drones, robotics, and sensors can enhance disaster response by assessing damage, accessing hard-to-reach areas, monitoring water levels, and detecting potential hazards.

Renewable energy

Renewable energy technologies like solar and wind power can mitigate climate change by reducing greenhouse gas emissions and providing reliable and sustainable energy to disaster-prone communities.

Challenges to Policy and Technological Preferences for Dealing with Climate-led Disaster in India

Despite the potential benefits of policies and technological preferences for dealing with climate-led disasters in India, there are several challenges that need to be addressed. These include:

Limited resources

India must invest heavily to implement climate change policies and technologies, prioritizing resources to the areas at the highest risk of climate-led disasters due to limited resources as a developing nation.

Lack of infrastructure:

In India, the lack of infrastructure, the efficiency of early warning systems, disaster response, and recovery activities may be hampered in some places by the lack of dependable energy, internet connectivity, or transportation infrastructure, for instance.

Lack of awareness and education

The risks and effects of climate change are not well understood or educated among many people in India. This may reduce the efficacy of technical advancements and policy measures intended to lessen the consequences of climate-related disasters.

Political challenges

Political barriers including bureaucratic red tape, corruption, and conflicting goals may make it difficult to implement policies and technical preferences for dealing with climate-related disasters. Political will and leadership are required to ensure that policies and technological preferences are implemented successfully.

Conclusion

In conclusion, climate-driven disasters in India have catastrophic effects on infrastructure, ecosystems, human lives, and property. India is particularly susceptible to these catastrophes because of its location, socioeconomic standing, and insufficient infrastructure. In this article, the policy and technology preferences for tackling climate-driven disasters in India were examined. These preferences included boosting early warning systems, strengthening agricultural system resilience, and creating disaster response and recovery initiatives. The article also noted the flaws of the Japanese extension system and the demand for a more comprehensive strategy to deal with climate-driven disasters. The Indian government and other stakeholders must adopt efficient policies and technology to lessen the effects of disasters caused by climate change and to safeguard both human life and the environment.

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ISSN : 2583-0910
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Article ID : 03/VI/13/0623

PREPARATION OF JAM MARMALADE AND THEIR COST ANALYSIS

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Introduction

Due to their low price, year-round availability, and appealing sensory qualities, marmalades are among the most consumed food items. These items are referred to as gels because pectin was utilized in their composition as a gelling agent (Kavaya *et al.,* 2019) Marmalade is a fruit jelly in which slices of fruits or its peel are suspended, generally made from citrus fruit like oranges and lemons in which shredded peel is used as the suspended material. The FSSAI specifications for marmalade are TSS 65% and fruit juice 45% of the prepared product. Citrus marmalades are classified into jelly marmalade and jam marmalade. Jelly Marmalade is generally used for products prepared from oranges or lemon and contains orange peels or slices of lemon. It is prepared from the classified pectin extract and the pectin and acid contents of marmalades are kept slightly higher than recommended for jellies .Jam marmalade is prepared by almost the same method as jelly marmalade. In this case, the pectin extract of fruits is not clarified and the whole pulp is used. Also, the pectin test is not essential, since it does not give any indication of the amount of sugar needed. This is because the fruit pulp will make the marmalade thicker in consistency. Sugar is added according to the weight of fruit, generally in the preparation of 1:1. The pulp sugar mixture is cooked till the TSS reaches 65-70%.

General method for preparation of jam marmalade

- Select fresh and mature fruit, free from blemishes.
- Wash the fruit with water, peel and cut it into pieces or crush. Keep peels aside for further processing.
- Cut the peels into $3/4^{th}$ long shreds and soften them by boiling in water for 45-60 minutes.
- Boil the fruit pieces with 1 ½ time of weight of water and cook till soft. Add sugar depending upon the sourness or sweetness of fruit. Generally, 750g of sugar is added to sweet fruits in contrast with 1kg sugar to sour fruits.
- Add citric acid @ 1.5-2.5kg per kg of fruit pulp.
- Cook the mixture with occasional stirring.
- Add shreds of the peels @ 62g per kg of pulp.
- Mixture is boiled till the end point is reaches which can be detected by plate or temperature test.
- When marmalade is ready, cool down and stir slowly to keep the shreds evenly distributed.
- After the cooling of marmalade in sterilized bottles or jars and seal airtight.

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Figure – 1
Take 1 kg orange

Figure -2
Peeled off and separation of juice and pulp

Figure - 3
Mixture of juice, pulp, and shreds

Figure - 4 Addition of sugar and continuously stirring

Figure - 5
Final product

Figure - 6
Filling into jam bottle

Figure - 7
End point testing with plate method

Figure - 8
End point testing by thermometer

Sensory evolution

Sensory properties have been evaluated from 8 panelists (4 men and 4 women) from the faculty of Horticulture department, School of Agriculture, Lovely Professional University, Punjab. The prepared marmalade's various qualities were rated on a 7-point hedonic scale. Based on the 7-point hedonic scale for a group of qualities, including overall acceptability, color, flavor, texture, appearance, consistency, and taste, was performed to gauge how much the sample was liked. Each panelist submitted their sensory score in a private testing booth as given in Table– 1.

Table – 1 Sensory Score of Jam marmalade

Panelists	Color	Appearance	Texture	Consistency	Taste	Flavor	Overall Acceptability
1	5.0	7.0	7.5	6.5	8.0	6.0	Good
2	8.0	7.0	8.0	7.0	8.0	7.0	V. Good
3	8.0	7.0	6.5	8.0	8.0	8.0	Good
4	8.0	7.0	9.0	6.5	8.0	8.0	Good
5	8.0	8.0	7.0	5.0	7.0	7.0	Good
6	9.0	8.0	7.0	6.0	7.0	8.	Good
7	8.0	7.0	8.5	8.0	8.0	8.0	Good
8	8.0	8.5	9.0	8.0	8.0	8.0	Good

Cost Analysis

After estimating the costs involved, which included operating costs, the benefit: cost ratio was calculated.

The following formula will be utilized to determine net profit:

Net Profit = Gross income - Total input cost

Benefit cost ratio will also be determined using the following formula because it is a useful indicator of the commercial viability of the preparation of the products.

Benefit cost ratio = Benefit / Cost= (Gross income - Total input cost) / Total cost of production

Table – 2 Cost Benefit ratio for Jam marmalade

Ingredient		Quantity/ Number	Rate (Rs.)	Amount (Rs.)
Variable Cost	Orange	1kg	120/kg	120/-
	Sugar	650g	50/kg	32/-
	Pectin	2g	144/100g	1.5/-
Total variable cost				**153.5/-**
Fixed cost	Fuel and other charges			**20/-**

Total input cost = Variable cost + Fixed cost

= 153.5 + 20 = **Rs. 173.5**

The total input cost for Jam marmalade jam preparation from 1kg oranges is Rs. 173.5.

Average market price for orange jam marmalade is Rs.174 per 500g. Therefore, 1000g or1kg of jam orange marmalade is Rs.348/kg.

Net Profit = Gross income - Total input cost

= 348 – 173.5 = **Rs. 174.5**

The total net profit of orange jam marmalade is **Rs. 174.5**.

Physicochemical Parameters

The prepared marmalade product was evaluated based on pH, Acidity and TSS. The pH was measured by using calibrator pH meter, TSS was measured by using Digital refractometer and Acidity was estimated by titrating the sample against 0.1N Sodium hydroxide.

pH : The pH of the prepared marmalade was measured by using calibrator pH meter. At the time of measurement, the pH of the final product is 3.92.

TSS : The TSS of the product was measured by using a Digital refractometer. Final product's TSS was 64.9°Brix at the time of measurement.

Acidity : The acidity of the product was measured by titrating the sample against 0.1N NaOH. 5g sample is taken from the product and made-up volume up to 100ml using distilled water. Filter it and take the 5ml aliquot from it. Added 2 drops of phenolphthalein indicator in it and then titrated against 0.1N NaOH until the pink color came. After, the pink color came, the noted reading was 0.1.

Conclusion

In conclusion, the jam marmalade preparation method resulted in a product with good sensory qualities, including color, appearance, texture, consistency, taste, and flavor. The cost analysis indicated a net profit of Rs. 174.5 for 1 kg of orange jam marmalade. The physicochemical parameters of the marmalade, such as pH, TSS, and acidity, were within acceptable ranges for a marmalade product. The jam marmalade preparation method described in the study resulted in a product that possesses appealing sensory qualities, meets the desired physicochemical parameters, and shows potential for profitability. This information can be valuable for individuals or businesses involved in the production and marketing of marmalade products, providing insights into the quality, economic feasibility, and market potential of jam marmalade made from oranges.

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ISSN : 2583-0910
Agri-India TODAY
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Article ID : 03/VI/14/0623

RISKS ASSOCIATED WITH BURNING CROP RESIDUES (PARALI) AND ALTERNATIVE METHODS OF DISPOSAL

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Abstract
Stubble (Parali) burning has been identified as a major source of air pollution, particularly in South Asia. Due to the intensive rice-wheat rotation system, which generates a large amount of stubble, the situation in India is more austere. The disastrous haze seen over India during the winter season has been linked to stubble burning because it occurs during the burning season (October-November). During this period, most Indian cities, particularly those in the National Capital Region (NCR), suffer from severe pollution, with the air quality index (AQI) frequently reaching critical levels leading to serious health effects. In addition to affecting air quality, stubble burning has an impact on soil fertility (via nutrient destruction), economic development, and climate. Crop stubbles, if managed properly, have the potential to provide enormous economic benefits to farmers while also protecting the environment from severe pollution. Alternative management practices include incorporating stubble into the soil, using stubble as fuel in power plants, using stubble as raw material for the pulp and paper industries, or using stubble as biomass for biofuel production. Most farmers in North India are unaware of the numerous alternatives for managing stubble and, as a result, believe that burning is the best option. This necessitates massive awareness campaigns to educate farmers about the availability of economically viable options and the cumulative effects of stubble burning.

Keywords: Parali burning, Soil fertility, Health risks, Alternative methods to burning parali.

Introduction

India is an agricultural powerhouse. Agriculture and various types of crops grown in India support 80% of the country's population. Rice-wheat systems are more common, and these crops are also responsible for stubble burning. Crop residue burning in Punjab, Haryana and western Uttar Pradesh has been known, but nowadays it's spreading more frequently in other parts of country. Burning of wheat stubble is a relatively new issue that began with mechanised harvesting using combine harvesters in last 4-5 years. Burning causes a thick layer of smog consisting of soot, dust and other particles in Delhi, the capital city of India, that makes it difficult for residents to breathe, especially from October to November (Yadav 2022). In 2017, burning of parali in Punjab during late October increased air pollution levels of particulate matter (PM) 2.5 to 1000 mg/m^3 and in early November 10 to above 1500 mg/m^3, which should be below 60 and 100 respectively as per the Indian standard (Sharma 2018). Farmers face financial difficulties as well as health risks because it deteriorates the quality of the soil. Farmers prefer to burn crop stubble after harvest to quickly prepare the farmland for the next sowing (of rice or wheat, as the case may be). In order

to quickly prepare the farmland for the next planting, farmers simply burn the stubble on the field, emitting a large number of hazardous pollutants (Vadrevu et al. 2011).

With rising population and food demand, the impact of stubble burning may grow in the coming years. According to a United Nations report, the world population could reach 10 billion by 2050, resulting in increased food demand. Crop production in India is expected to rise by 45% by 2050, from 619 Mt (million tonnes) in 2017 to 899 Mt in 2050 (United Nations, 2014). This article aims to comprehensively cover (1) the risks associated with stubble (parali) burning and (2) the alternative techniques for managing crop stubbles.

Risks associated with stubble (parali) burning

- **Contribution to Atmospheric Pollution:** Stubble burning is a significant contributor to atmospheric pollution, ranking third after industrial and vehicular emissions. It accounts for approximately 60% of total biomass emissions in Asian countries such as China. At the same time, it accounts for roughly one-fourth of total biomass burning (including forest fires) globally. The terrible haze that has engulfed India's national capital region (NCR) has been directly linked to stubble burning, which occurs during the months of October and November.
- **Human Health Impacts:** Prolonged exposure to high levels of pollution also increases mortality rates; according to research, the life expectancy of Delhi residents has decreased by about 6.4 years as a result of their exposure to high levels of pollution.
- **Soil's Health:** It raises soil temperature to approximately 42°C, displacing or killing important microorganisms up to a depth of about 2.5 cm. Ground-level ozone generated from stubble burning affects plant metabolism and penetrates and destroys leaves, causing severe crop damage in northern India.
- **Economic Loss:** According to reports, the number of tourists visiting Delhi has decreased by 25-30% as a result of the increase in air pollution. The economic cost of air pollution is estimated to be USD 2.9 trillion, or 3.3% of global GDP.

Alternative techniques for managing crop stubbles

- **Bio Enzyme - PUSA:** The Indian Agriculture Research Institute has developed a novel solution for stubble burning in the form of PUSA, a bio-enzyme. When sprayed, this enzyme decomposes the stubble in 20-25 days, converting it to manure and improving soil quality even further.
- **Mushroom cultivation:** It can be used for composting button mushrooms, growing oyster mushrooms, and growing summer mushrooms. After harvesting, the spent compost straw can be used as vegetable manure.
- **Bio-ethanol Production:** Bioconversion of cellulosic biomass into fermentable sugar for ethanol production using microorganisms, particularly cellulose degrading fungi, makes bioethanol production cost-effective, environmentally friendly, and renewable. Rice straw can potentially produce 205 billion liter bio-ethanol per year in the world, which is about 5% of total of consumption.
- **Packing materials:** Crop residues based packaging may be the best option, as it will not only solve the problem of managing paddy straw but will also help to reduce the use of plastic for packaging.

Conclusion

The large-scale rice-wheat crop rotation system used in India has resulted in significant amounts of crop stubble being produced, often more than the amount of grains harvested. A significant portion of these stubbles are typically burned on-field to clear the farm for the next planting, releasing toxic pollutants into the atmosphere and deteriorating air quality. Rather than being burned, the stubbles can be used to produce economically valuable and environmentally friendly substances such as compost or biochar. They can also be used as fuel in power plants, biomass for biofuel production, cement/brick blends, or raw materials for pulp and paper production.

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ISSN : 2583-0910
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monthly newsletter

Article ID : 03/VI/15/0623

ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN FISHERIES AND AGRICULTURE

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Introduction

Information and communication technology are a set of tools that help with the electronic capture, storage, processing, transfer, and display of information. Information and communication technology used responsibly can help fishing communities improve their livelihoods and reduce poverty. Information and communication technology encompasses both old and modern technology. The fishing and fisheries sector plays an important role in the country's socioeconomic development. New Information and communication technology are being employed in the fisheries sector across the board, from resource assessment to catch and culture to processing and crisis management. Specialist uses include sonar for locating large schools of fish. The use of information and communication technology (ICT) can help fishermen increase their output. General purpose applications (GPT); GPS for navigation and location finding: widespread use of mechanized boats, mobile phones for trading, information exchange, and emergencies, eco-sounder for depth measurement, wireless set for communicating with other vessels while at sea, radio programming with fishing communities, and Web-based information and networking resources are the main tools used in the fishery industry. It is widely believed that information and communication technology (ICT) as a basic resource for development, as well as a variety of information and communication technology tools such as mobile phones, television, radio, GPS, and sonar, can significantly improve the development and reduce the level of poverty of various communities, including fishermen. Information and communication technology (ICT) is becoming increasingly significant in agriculture. E-Agriculture is a new field that aims to promote agriculture and rural development by enhancing information and communication operations. E-agricultural, in particular, entails the conception, design, development, assessment, and deployment of novel ways to employ information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. Agriculture necessitates constant contact and information. People have been gathering knowledge from one another since they began farming crops, raising cattle, and catching fish. "Using electronic means for processing and transmitting information and thereby facilitating communication swiftly and effortlessly" is a wide definition of information and communication technology.

Role of Information and Communication Technology in Fisheries

Mobile phone

Mobile phones play a critical role in increasing market proficiency. Information dissemination has become faster and less expensive availability of mobile technologies. Fishermen can stay up to date on prices and quality of fish at nearby markets using their cell phones, which helps them increase their earnings. Furthermore, mobile phones have made it simple for fisherman to find

the best rates for their catches in various markets. Mobile phones have given this community new directions and techniques for acquiring market and weather information. It can be used to sell or buy things directly from the agency, as well as keep track of prices.

Radio and television

The development of fishermen and fishing communities is also aided by radio and television. A lot of fishermen have their own radio. Some of the fishermen have listened to fishing-related radio programmes. When we go fishing, the weather forecast may change unexpectedly, and there will be no means to receive the information. Furthermore, if a fishing boat stranded in the middle of the sea and fails to return to port, Save Our Souls and Save Our Ship could be broadcast to other boats via radio station.

Global positioning system and sonar system

The use of global positioning system and Sonar has also had a huge impact on fishermen's lives. The use of communication technology has had an impact on various communities and groups, and these communities have benefited much from it. For example, fishermen use global positioning system to locate themselves at sea when fishing. However, global positioning system data was required to make sense of the data, and the best zones were located at a distance from the shore that could only be reached by larger boats. Similarly, smaller boat fishers were able to benefit from this information.

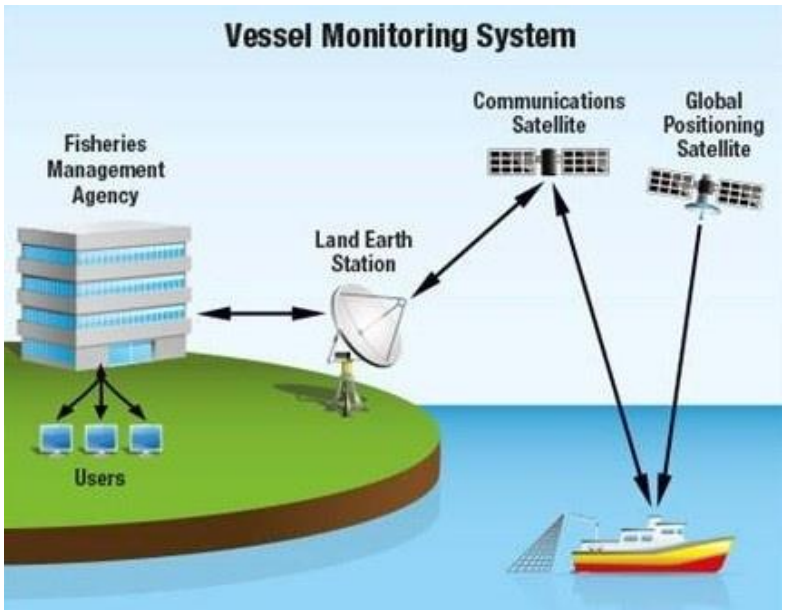

Fig- 1

Role of Information and Communication Technologies in Agriculture

Decision Support System

Farmers benefit greatly from information and communication technologies as a decision-support system. Farmers can get up-to-date information about agriculture, weather, new crop types, and novel strategies to boost productivity and quality control via information and communication technologies. In Indian agriculture, appropriate, efficient, and specialized technology relating to agro-climatic zones, farm sizes, and soil type, among other factors, are lacking, and this is a major challenge for policymakers. Farmers may use information and communication technologies to

transmit precise and accurate information at the proper time, allowing them to benefit from it. Farmers can use an information and communication technologies-based decision support system to plan the type of crops they want to grow, as well as to cultivate, harvest, post-harvest, and market their produce for better results. Agriculture necessitates a wide range of data depending on agro climatic zones, land holding sizes, crop varieties, technology used, market orientation, and weather conditions, among other factors. According to several researchers, the majority of farmers believe that a "question and answer service" is the greatest way to acquire customized solutions to their individual agricultural challenges.

Widen Market Access

Complex distribution systems for marketing agricultural produce are one of the primary problems in Indian agriculture. Farmers are unaware of current commodity pricing, the best locations for marketing their inputs, and consumer trends. For optimal benefit, information and communication technologies offers the ability to expand farmers' marketing horizons directly to customers or other appropriate users. Farmers can communicate directly with a large number of people and learn about current commodity pricing. They can access the market from the comfort of their own homes. Furthermore, it will reduce the middle profit, which will benefit the farmers. This can increase a farmer's cash stream, as well as empower farmers to make informed decisions about future crops and commodities, as well as marketing channels through which they can sell their produce and obtain inputs.

Strengthen and empower farming community

Through extensive networking and collaborations with various institutes, non-governmental organizations, and the corporate sector, information and communication technologies can aid in the strengthening of farming communities. Farmers can also improve their own capabilities by accessing up-to-date knowledge and broad exposure to the scientific, farming, and trade communities.

Conclusion

Information and communication technologies can play an important role in enhance the capacity of people specially fisheries and agriculture sector. There are many factors such as poverty illiteracy and unawareness is big problem among fishermen and agriculture farmer about information and communication technologies. In the ocean, the majority of fishermen have limited awareness of mobile phones, global positioning system, sonar and the internet. Many governments in poor nations do not provide enough facilities for fishers. If possible, the government, non-governmental organizations, and associated departments and agencies should give training and formal education to fishermen in order to improve their capacity and socioeconomic situation. In the agriculture sector, they should turn agriculture into modern digital agriculture to further boost social and economic benefits in the agriculture industry. With technology advancements and skill development, farmers' digital access can be improved. Adopting advanced information and communication technologies tools in agriculture, such as GPS, GIS, RFID, Remote sensing, and Smart devices, for precision agriculture, sustainability, the environment, and food safety, among other things.

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ISSN : 2583-0910
Agri-India TODAY
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monthly newsletter

Article ID : 03/VI/16/0623

SOIL MOISTURE SENSORS AND ITS APPLICATION

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Soil Moisture Sensors

Agriculture is one of the most essential activities that aims to feed the growing population. It is essential to provide an optimal environment for plant growth and produce production. Soil moisture is one of the primary factors that affect plant growth. Too much or too little water can hinder plant development. Here, soil moisture sensors come into play. These devices assist producers in optimizing irrigation and ensuring that plants receive adequate water.

Scope of Soil Moisture Sensors in Agriculture

Precision agriculture relies on soil moisture sensors, which help farmers and agriculturalists maintain optimal water levels in their soil. Using these sensors, they are able to precisely measure the soil's moisture, making it simpler to determine when irrigation is required and thereby reducing the waste of valuable resources.

The benefits of using a soil moisture sensor significantly outweigh any potential cost or time investment; you will be better armed to maximize your yields while maintaining high sustainability standards. In addition to being economical and user-friendly, they are an attractive option for many producers. With proper use and maintenance, soil moisture sensors can be a worthwhile investment, resulting in greater yields and healthier plants.

Technology is Used in Soil Moisture Sensor

The technology of time-domain reflectometry (TDR) is predominantly utilized in soil moisture sensors. TDR soil moisture sensors measure the dielectric constant of the soil to determine the soil's water content. Since the dielectric constant of water is greater than that of air, TDR sensors

inserted into soil reflect a signal proportional to the amount of water in the soil. TDR soil moisture sensors are utilized in a variety of agricultural applications, including irrigation system monitoring, crop yield estimation, and water resource management.

Working Principle of Soil Moisture Sensors

Plant moisture monitoring systems measure the moisture content of the soil in order to optimize irrigation and fertilization. These systems are based on the dielectric constant of water. Because water has a high dielectric constant, it can carry a large amount of electrical charges. When the soil is dry, it has a low dielectric constant and can't store much electrical charge.

Soil has a high dielectric constant when wet and may store more electrical charge. The functioning of plant moisture monitoring devices is based on the difference in dielectric constants between water and dry soil. When the sensors are placed in the soil, they detect the quantity of electrical charge that may be stored there.

The amount of electrical charge that may be stored in the soil is related to its moisture content. By detecting the amount of electrical charge that can be held, plant moisture monitoring devices can consistently detect soil moisture content. This information may then be used to enhance irrigation and fertilization techniques.

Soil Moisture Sensors Important in crop production

Soil moisture sensors are important in agriculture because they provide information on the moisture content of the soil. This data may be used to determine when irrigation is required, how much water to apply, and whether or not plants are stressed as a result of dry conditions.

By giving information about the quantity of water accessible to plants, soil moisture sensors may also assist farmers in optimizing fertilizer usage. This may be used to change fertilizer application rates depending on plant demands. Soil moisture sensors may also be used to detect external parameters like temperature and rainfall. This data may be utilized to make crop management decisions such as planting, harvesting, and irrigation.

In case you missed it: Impact of Heat Waves on Agriculture: Affected Crops and How to Protect from Extreme Hot Weather

Different Types of Soil Moisture Sensors

1. **Capacitive soil moisture sensors:** These sensors assess the soil's dielectric constant. The dielectric constant quantifies the ease with which electricity may flow through a substance. The greater the dielectric constant, the greater the amount of water in the soil. The most common form is capacitive soil moisture sensors. They function by measuring the dielectric constant of the soil, which determines how readily electricity flows through it. These sensors are very precise and may be utilized in a variety of soil conditions. They are, however, costly and must be calibrated on a regular basis.
2. **TDR soil moisture sensors**: These sensors inject an electromagnetic pulse into the soil and then monitor how long it takes for the pulse to rebound back. The wetter the soil, the longer it takes for the pulse to return.
3. **Neutron probe soil moisture sensors:** These sensors attack the soil with neutrons and then count how many of them are absorbed by the soil's water molecules. The more water there is in the soil, the more neutrons are absorbed.
4. **Thermal conductivity soil moisture sensors**: These sensors determine how effectively heat moves through the soil. The more water there is, the greater the heat flow.
5. **Dielectric soil moisture sensors**: These sensors detect the electrical conductivity of the soil. They are less precise than capacitive sensors but far less expensive. They are also less difficult to calibrate and may be utilized in a broader variety of soils.

Soil Moisture Sensors Work

Moisture is one of the most essential soil qualities that farmers and agricultural experts monitor. Because water is required for plant development, the quantity of water in the soil has a significant influence on agricultural yields. Soil moisture sensors come in a variety of shapes and sizes, but they always function by detecting the electrical conductivity or dielectric permittivity of the soil. The electrical conductivity of the soil evaluates how readily electricity travels through it. The greater the electrical conductivity of a soil, the more water it contains.

Dielectric permittivity, on the other hand, quantifies the amount of an electric field that may enter a material. High dielectric permittivity soils will enable more water to be pulled up deep under the earth. Soil moisture sensors are typically made up of two metal electrodes implanted at varying depths into the soil. To detect the moisture content of the soil, the sensor measures the electrical resistance between two electrodes.

There are numerous varieties of soil moisture sensors, but they all measure the soil's dielectric constant. The dielectric constant quantifies the capacity of a material to store electrical energy. The high dielectric constant of water allows it to store more electrical energy than arid soil. An electrical current is transmitted through the sensor when it is embedded into the soil. The current that can pass through the sensor is determined by the soil's dielectric constant.

The greater the soil moisture, the greater the dielectric constant and the greater the current passage through the sensor. By measuring the amount of current flowing through the sensor, soil moisture content can be determined. In agriculture, soil moisture sensors are utilized to optimize irrigation.

Farmers can ensure their plants receive sufficient water by monitoring soil moisture levels and watering neither too much nor too little. This improves crop yields and reduces water consumption.

Components of Soil Moisture Sensor

Soil moisture sensors monitor the amount of water in the soil. They consist of a metal rod placed into the soil and a sensor that measures the electrical conductivity of the soil. The sensor is linked to a data recorder, which records and saves sensor values for later examination. The metal rod is often made of stainless steel, copper, or aluminum. The rod is put around 20 centimeters (8 inches) into the ground.

The sensor has a depth of 2 centimeters (0.8 inch). The sensor detects the electrical conductivity of the soil, which is related to its moisture content. The data logger is used to capture and save sensor values for further study. The data collector may be set to record measurements at predefined intervals or whenever an event happens, such as when soil moisture reaches a certain threshold.

Soil Moisture Sensor Applications

The sensor operates by sending a low-frequency electromagnetic signal into the ground and detecting the soil's dielectric constant. The dielectric constant, which is directly connected to soil moisture content, assesses how readily an electric field may permeate a substance. Soil moisture sensors have a wide range of uses in agriculture. Irrigation management is one typical use, where the sensor can monitor soil moisture level and automatically activate or deactivate irrigation systems depending on need.

Crop monitoring, yield prediction, frost warning, and other applications may all benefit from soil moisture sensors. Capacitive soil moisture sensors monitor the soil's dielectric constant, which varies with water content. They're usually made up of two metal plates separated by a dielectric substance like plastic or glass. As the water content in the soil varies, the electrical resistance between the two plates changes, enabling the sensor to quantify it.

Conductivity Soil moisture sensors assess the electrical conductivity of the soil, which is determined by the amount of dissolved salts and minerals in the soil solution. These sensors are generally made up of two electrodes that are submerged in the soil. As the concentrations of

dissolved salts and other minerals in the soil solution fluctuate, the electrical conductivity between the electrodes varies, enabling the sensor to quantify them.

Soil moisture sensors with dielectric permittivity assess how readily an electric field may permeate a substance. This attribute is closely connected to the amount of water in a substance; dielectric permittivity rises as water content increases. Typically, these sensors are made up of two metal plates separated by a dielectric substance (such as plastic or glass).

Advantages of Moisture sensor for soil

Following are the advantages of Moisture sensor for soil:

- ➞Simple method of measurement.
- ➞ It produces results immediately. Watermark sensors and tensiometers are incredibly affordable.
- ➞Offers accurate results.

The moisture reading range of Watermark sensors is 0 to 200 cb or kpa.

Disadvantages of Moisture sensor for soil

Following are the disadvantages of Moisture sensor for soil:

- ➞ Choosing the right moisture sensor entails first assessing local circumstances.
- ➞ It necessitates the insertion of an instrument into the soil. Labor is required for data collection and maintenance of measurement processes..
- ➞ The measured values are based on the characteristics of different materials. Data on moisture must be used correctly and interpreted.
- ➞ Large particles in sandy soils make watermark sensors less accurate. Large particles in sandy soils make watermark sensors less accurate. Each soil type's watermark sensor needs to be calibrated.
- ➞ Tensiometers also need routine maintenance service.

Conclusion

Soil moisture sensors are important for farmers because they allow them to monitor the moisture levels in the soil. Soil moisture sensors are important tools that farmers can use to manage their crops and reduce labour costs. They help improve crop yield and reduce the amount of water that is wasted.

ISSN : 2583-0910
Agri-India TODAY
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Peer reviewed
monthly newsletter

Article ID : 03/VI/17/0623

USE OF SOCIAL MEDIA AND ADVANCES IN DIGITIZATION IN THE MARKETING OF AGRICULTURAL COMMODITIES

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Abstract
Millions of people around the world are connected by the powerful instrument that social networking is becoming. Social media is used by farmers because it enables them to connect with other farmers, agribusinesses, and agricultural professionals over long distances. Social media in agriculture marketing offers some assistance with problems in this area. Major societal and industrial problems can now be solved using big data and artificial intelligence, according to current thinking Farmers are utilising social media to boost productivity at every stage. Social media and other forms of information and communication technology (ICT) transmit ideas, facts, and suggestions for a cause. Social media platforms like Facebook, Twitter, YouTube, LinkedIn, WhatsApp, and others are being used for disseminating information on agricultural marketing and agricultural products. eNAM has also been seen as an opportunity to bring farmers under a single umbrella. The COVID-19 pandemic is anticipated to accelerate the growth of the digital agricultural market (DAM) throughout the next years. In addition to producing 17% of the world's agricultural output, our nation also has the highest rate of malnutrition in the entire globe**.** More than 60% of people in India earn their living via agriculture, and the majority of them are small and marginal farmers. This market is anticipated to grow from $5.6 billion to $6.2 billion in revenue by the end of 2025, respectively. This will present an opportunity for the growth or establishment of a new DAM business.

Keywords: social media, agricultural marketing, agribusinesses, eNAM, ICT.

Introduction

The world we live in today can be termed as Online or internet driven world. With 160 million hectares of arable land, India has the second-highest amount of arable land behind the United States, but its agricultural yields are much lower than those of other major agricultural exporters. One key factor contributing to the low farm production in our nation is fragmented land holdings. However, because of the dominance of middlemen, supply-side constraints, and rising input costs, even major farmers are being forced to abandon farming and turn to real estate industries. The use of social media in agriculture marketing is rapidly expanding in the modern world. Numerous service providers are offering expanded services to farmers. Through social media, users can communicate directly with clients, service providers, information sharing organisations, and other users. Facebook, Twitter, YouTube, LinkedIn, WhatsApp, and other social media platforms that are

most favoured by farmers, the main purpose of all these constituents of social media is to spread information and increase awareness.

Fig. 1. Use of Social media in uplifting Agriculture(Source: LinkedIn)

They use social media on a personal basis, expressing their triumphs and setbacks, as well as updates on harvesting, post-harvesting, advertising agricultural produce, market information, and responding to farmer issues if they are connected to their identified areas. Traditional media and social media operate extremely differently. To share information, social media users create their own organisations, pages, groups, and blogs. They exchange and buy agricultural items within the group. Sending photos, URLs, and other sorts of media are acceptable methods. This information exchange makes networking and product promotion easier for farmers. A lot of blogs focus on agricultural marketing.

Traditional approaches and stigma around new technologies

Traditionally, agricultural products have been marketed by selecting the farm items, making them at the proper quality, storing them to ensure their availability, and then transporting them to the locations where they are needed. The majority of it consists of nonverbal exchanges between the producer and the consumer. The producer (farmer) conceptualises a product that consumers want, makes it in a way that seems to meet their needs, stockpiles it, and then distributes it to areas where there appears to be a sufficient demand.

Fig. A farmer using his mobile to talk to his customer(Source: NDTV)

The traditional marketing of agricultural products has been neglected over time, making the agriculture industry mostly unattractive to the present millennial population. Because of this, it is important to pay attention to a different kind of agricultural marketing in order to prevent agriculture's ability to generate income from being compromised. It seems sense to assume that social media's usage in the marketing of agricultural products will have a substantial impact on the demand for agricultural products and, consequently, on sales given the prevalence of social media use throughout the different age grades around the world.

Use of print and electronic media in advertising

Large corporations and the government have been known to promote their products through adverts in print and electronic media, in addition to the product-price-storage-distribution approach. The purpose of these commercials is to raise awareness of the items' availability, the areas where they are sold, and the anticipated advantages of utilising them, particularly if they may be used in place of other goods.

National e-Governance plan in agriculture (NeGP-A) and Establishment of e-NAM

Undoubtedly, digital technology has solutions to some of the key problems being faced by Indian farmers. The Committee on Doubling Farmers' Income (DFI) in its Reply to the Committee on Doubling Farmers' Income (DFI) Report stated that the aim of the centrally sponsored scheme is to achieve rapid development in India by using ICT for timely access to agriculture related information to the farmers. In 2014–2015, the scheme was further extended for all the remaining States and 2 UTs. The benefits of digital technology in agriculture have not yet materialised for small and marginal farmers, who make up a sizable portion of the rural population.

The Electronic National Agriculture Market (e-NAM) was launched in April 2016 in order to link the existing Agricultural Produce Market Committees (APMCs) and offer a unified national market for agricultural commodities. 1260 markets throughout 22 States and 3 UTs are covered. There are currently 237,799 traders and 17.4 million farmers registered on this website. It helps farmers sell their agricultural products directly to consumers across India while earning lucrative returns on their investment.

Fig. eNAM and Volume traded via eNAM. (Source: Department of Agriculture & Farmers Welfare Ministry of Agriculture & Farmers Welfare, Government of India)

To improve digital agriculture through pilot projects, the Union government has established the Digital Agriculture Mission 2021–2025. It seeks to support and expedite initiatives based on cutting-edge technology like robotics, artificial intelligence, block chain, remote sensing, geographic information systems, and drone use..

Around 1.2 billion mobile subscribers, including 750 million smartphone users, were registered in India as of 2021. Between 2021 and 2026, the Indian rural mobile market is projected to increase at a CAGR of 6%, compared to a CAGR of 2.5% for the urban market. The country's ambition to fiberize villages by 2025 under the Bharat Net initiative will also help the growth of internet-enabled products in rural markets. The mobile revolution will boost digital innovation in agriculture, but for us to profit, we also need a strong physical infrastructure to support the platforms for digital technologies.

Challenges of use of Social Media for farmers:

1) Using social media to advertise agricultural products.
2) Access to social media is limited due to constrains in data, networks, etc.
3) Training and education are required about the application of social media in agricultural marketing.
4) Using social media to buy and sell agricultural products online is less reputable.
5) The limitations of time, technology, networks, etc. apply to all operations.
6) Agricultural marketing with technology increases the costs for the farmers and producers

Income revolution

Green, white, yellow, and blue revolutions have all taken place since our country's freedom. An "income revolution" in agriculture using digital technology is urgently required. The efficient use of ICT will make it possible to scale up agricultural operations while cutting costs. Through digital technology, farmers will have direct market access, cutting out the middlemen and increasing their incomes. At the micro level, digital interventions in agriculture can address a number of issues that farmers encounter. Digital technology that is farmer-friendly and digital literacy are also crucial for this.

Conclusion

To ensure that digital technology efforts may be carried out without running afoul of the law, legislative steps must be taken to address the right to privacy issue. Since agriculture is a state concern, the federal government must take a cooperative stance in order to gain the States' support and cooperation in the real spirit of "cooperative federalism. “Niti Aayog” should be enlisted to serve as a mediator in this situation. Price insurance should be offered alongside farm insurance, and farmers should be encouraged to participate in commodities futures through their federations.

In order to cut out the intermediaries and give farmers direct market access with profitable rates, a robust rural supply chain must be established to provide forward linkages from farms to markets. One of these solutions that has to be investigated is upgrading and expanding the current PDS (Public Distribution System) infrastructure as a use-and-pay model (at a reasonable cost) for the farmers. Panchayats should actively participate in digital agricultural efforts, and panchayats should digitise the farmers' field-level primary data and the state of the soil. In the long run the maintenance and upgradation of the digital infrastructure platform to be made a self-financing model by collecting affordable user fees from the beneficiaries, i.e., farmers.

It goes without saying that all these digital technology initiatives should not only increase agricultural yield and improve farmers' incomes, but they should also prevent surplus labour in agriculture from migrating to cities. Since Indian agriculture has complex issues like

unemployment, underemployment, and disguised unemployment, the policy measures should aim at creating a value chain in agriculture, aligning the agriculture with allied activities, and agro-industry with the agricultural sector.

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ISSN : 2583-0910
Agri-India TODAY
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monthly newsletter

Article ID : 03/VI/18/0623

WETLANDS: IMPORTANCE AND CONSERVATION STRATEGY FOR THE LOOSING ECOSYSTEM

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Abstract
Wetlands are unique and productive ecosystems where terrestrial and aquatic habitats meet. They play a critical role in maintaining many natural cycles, provide enormous ecosystem services and also supports a wide range of biodiversity. Among various ecosystems, wetland appears to be one of the most important one, yet highly ignored. They are also amongst the earth's top carbon stores and their conservation can help in reducing global warming. They regulate water quantity, groundwater recharge, contribute to regulating floods and draughts and neutralize the waste brought by the rivers, so regarded as the 'Kidneys of the Earth'. India has lost nearly one-third of her natural wetlands to urbanisation, agricultural expansion and pollution over the last four decades. 75 wetlands have been declared as Ramsar sites till date in India. Therefore, immediate conservation measures is required to conserve this precious ecosystem. India has a number of regulatory mechanisms starting from the Environment (protection) Act 1986 to Wetlands (Conservation and Management) Rules, 2017 notified by the Ministry of Environment, Forest and Climate Change (MoEF&CC). However, every measures and polices will not succeeded until responsibility are performed at the individual level by every citizen.

Keywords: *Wetlands, ecosystem services, Kidneys of the Earth, biodiversity, citizen*

Introduction

Wetlands are ubiquitous ecosystems which are highly productive and unique in its own ways. They exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant species, soil and sediment characteristics (Space Applications Centre, 2011).It is neither truly aquatic nor terrestrial, but, it is possible that wetlands can be both at the same time depending on seasonal variability. They are typical areas of high habitat heterogeneity, rich in biodiversity and biological activity. Moreover, they are also ecologically sensitive and adaptive systems. Generally, wetlands are ecosystems defined by the presence of standing water and/or saturated soil at least part of the year, a condition that is subsequently responsible for the development of specialized vegetation (hydrophytes) and hydric soil. These factors (hydrology, vegetation, and soil) and their interaction create the signature characteristics of wetland ecosystems and communities, and can be used to differentiate and classify wetland types. One of the first widely used wetland classifications systems (devised by Cowardin et al., 1979) categorized wetlands into marine (coastal wetlands), estuarine (including deltas, tidal marshes, and mangrove swamps), lacustarine (lakes), riverine (along rivers and streams), and palustarine

ISSN : 2583-0910
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('marshy'– marshes, swamps and bogs) based on their hydrological, ecological and geological characteristics. However, Ramsar Convention on Wetlands, which is an international treaty signed in 1971 for national action and international cooperation for the conservation and wise use of wetlands and their resources, defines wetlands (Article 1.1) as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Overall in the world, there are 2,492 number of wetlands covering an area of 256, 637, 813 ha among the 172 contracting nations have been identified as Ramsar sites or wetlands of International importance (Ramsar.org, 2023). As per the Ramsar Convention definition most of the natural water bodies (such as rivers, lakes, coastal lagoons, mangroves, peat land, coral reefs) and man-made wetlands (such as ponds, farm ponds, irrigated fields, sacred groves, salt pans, reservoirs, gravel pits, sewage farms and canals) in India constitute the wetland ecosystem. But, only 75 of these numerous wetlands have been designated as Ramsar Sites, although, there are about 115 and 1053 nos. (Fig. 1)of significant and other smaller wetlands in India (Wetlands of India portal, 2023). As many of these wet lands which perform potentially valuable functions are continued to be ignored in the policy process. As a result many freshwater wetlands ecosystems are threatened and many are already degraded and lost due to urbanization, population growth, and increased economic activities (Central Pollution Control Board, 2008).

Distribution and extent of wetlands in India

India, with its varying topography and climatic regimes, supports diverse and unique wetland habitats (Prasad et al., 2002). The available estimates about the areal extent of wetlands in India vary widely from a lowest of 1% to a highest of 5% of geographical area, but do support nearly fifth of the known biodiversity. These wetlands are distributed in different geographical regions ranging from the floodplains of rivers like Ganga and Brahmaputra to the high altitude wetlands of the Himalayas, lagoons and mangrove marshes on the coastline and reefs in marine environments, among others. According to the latest estimate of wetlands in India, the human-made inland wetlands cover about 37% area (3941,832 ha) and the remaining 63% are the natural wetlands (6623,067 ha). There are also 4140,116 ha of coastal wetlands (of which the intertidal mudflats of Kutchh alone contribute about 51%) and 555,557 ha of wetlands smaller than 2.25 ha each. It is noteworthy that the paddy fields were included as wetlands in this inventory. In terms of the proportion of the geographical area, Gujarat has the highest proportion

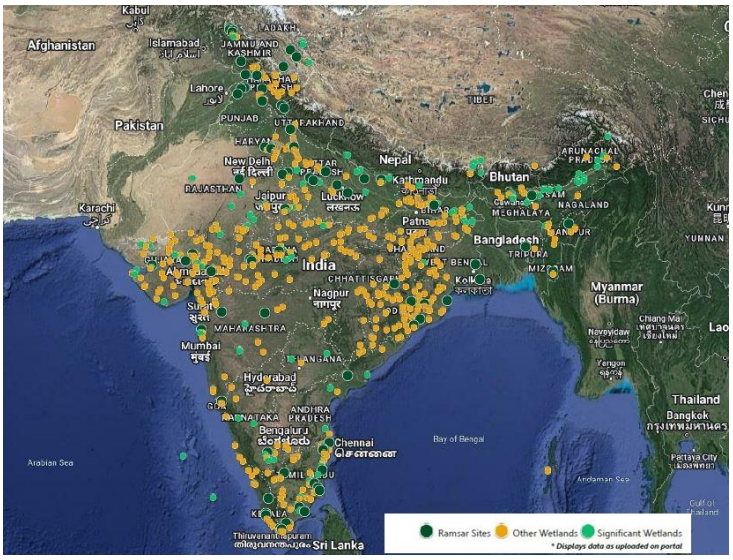

Fig: 1. Ramsar sites and different wetlands in India (Source: Wetlands of India portal, 2023)

(17.5%) and Mizoram has the lowest proportion (0.66%) of the area under wetlands (Space Applications Centre, 2011).

Fig. 2. Zaimeng Lake, a hill top wetlands in Manipur (Altitude: 2215 m.s.l.)

Importance of wetlands

Wetland are the most important biologically productive ecosystem of the biosphere. The Ramsar Convention Bureau (2008) described wetlands as being one of the most productive ecosystems supporting life. Humans use wetlands in several ways but also benefit from them indirectly. Various kinds of benefits derived from an ecosystem by the people and the society have recently been termed as ecosystem services. These benefits are often categorised into Provisioning (food, fiber, fodder, fuel, water, and other materials), Regulating (regulation of biogeochemical cycles including climate), Supporting (e.g., soil formation, supporting biodiversity) and Cultural (aesthetics, recreational and spiritual activities) services. These services accrue from the ecosystem functions and depend largely upon the biodiversity of that ecosystem. Wetlands are also described as "biological supermarket" owing to the enormous food materials produced in the system.

Among the direct and most important benefits from wetlands to humans are the production of rice and fish which are the staple food for more than half of the world's human population. Many other wetland plants are used for food e.g., *Trapabispinosa*, *Nelumbonucifera* (lotus), *Euryale ferox*, *Eleocharisdulcis*, *Colocasia* sp., species of *Cyperus, Scirpus, Echinochloa*, and *Ipomoea aquatica.* Jute, *Aeschynomene*, reeds, cattails (*Typha*sp.), *Calamus*and many grasses are used for fibre; woody plants such as *Tamarix*sp. are used for fuel, whereas species of *Echinochloa,Paspalum*and duckweeds are important animal feeds. Many plants e.g., *Acoruscalamus, Bacopamonieri, Hygrophilaspinosa, Ecliptaalba*, *Cyperusrotundus*, etc. are used in medicines. Among the animals, fish, birds, amphibians, and large invertebrates (crustaceans and molluscs) are common in human food. Macrophytes are also used for extracting several vitamins and essential oils (e.g., *Vetiveriazizanioides*). Wetlands are known to be among the most productive systems and some macrophytes as *Arundodonax*may produce up to 20 tonnes per ha

of biomass annually. Algae with very small biomass have only negligible direct use but several of them (e.g., *Chlorella, Spirulina*, *Scenedesmus, Dunaliella*) can be cultured for food and medicine (Gopal, 2015). Wetlands such as tanks, ponds, lakes, and reservoirs have long been providing multiple-use water services which include water for irrigation, domestic needs, fisheries and recreational uses; ground-water recharge; flood control and silt capture. Tanks are also very important from the ecological perspective as they help conserve soil, water and bio-diversity. In addition, tanks contribute to groundwater recharge, flood control and silt capture. Lakes also contribute to ground water recharge and support a rich and diverse variety of aquatic flora and fauna. Reservoirs also support a wide variety of wildlife. Many of the reservoirs such as Govind Sagar Lake formed by diverting river Satluj (Bhakra Dam, Punjab) and Hirakud reservoir (Sambalpur, Orissa) are a major tourist attraction. Swamps, mangroves, peat lands, mires and marshes play an important role in carbon cycle. While wet land sediments are the long-term stores of carbon, short-term stores are in wetland existing biomass (plants, animals, bacteria and fungi) and dissolved components in the surface and groundwater. Though wetlands contribute about 40% of the global methane (CH_4) emissions, they have the highest carbon density among terrestrial ecosystems and relatively greater capacities to sequester additional carbon dioxide (CO_2). Wetlands act as a sink for contaminants in many agricultural and urban landscapes. From an economic perspective too, wetlands have been suggested as a low cost measure to reduce point and non-point pollution. Natural wetlands, such as riparian wetlands, reduce the nutrient load of through-flowing water by removing nitrate and phosphorus from surface and subsurface runoff. Wetlands play an important role in flood control. As with any other natural habitat, wetlands are important in supporting species diversity. Some vertebrates and invertebrates depend on wetlands for their entire life cycle while others only associate with these areas during particular stages of their life. In India, lakes, rivers and other freshwater bodies support a large diversity of biota representing almost all taxonomic groups. Wetlands acts as an important breeding areas for wildlife and provides refuge for migratory birds.

Threats

Despite the fact that wetlands harbour high levels of biodiversity, disproportionate to their areal extent would imply that these hotspots would receive top priority for the conservation of biodiversity. However, both wetland attributes fail to draw human interest in conserving them. The world has lost around 87% of natural wetlands since the 1700s and 35% have disappeared since the 1970s (Tandon, 2021). The figures for the extent of wetlands in India noted earlier indicate that only 4.5% of India's land area is under wetlands against the global average of above 6 percent. If the rivers are excluded that make up 80% of the total natural wetlands, the total area of wetlands in India is reduced to less than 3 percent. An earlier study had estimated that about 38% of inland freshwater wetlands had been lost in recent decades only. The wetlands which come to lie within the urban limits are the most threatened for their existence. Urbanization exerts significant influences on the structure and function of wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. Wetlands are used as regular land fill sites or are gradually filled up by dumping solid wastes. The recent floods in Kashmir valley and Kedarnath valley are cruel testimony to the loss of floodplain wetlands and their encroachment by short-term economic interests.

Wetlands are often victims of large scale widespread hydrological alteration. The sources and pathways of their water supply, whether surface runoff from the surrounding areas or inflow through channels or both, have been eliminated or blocked or their supply has been greatly altered. Another major factor causing degradation of wetlands is the discharge of untreated domestic and industrial wastewaters in the wetland. It is not readily appreciated that the upstream wastewater discharges affect the wetlands downstream. Wastewaters also facilitate siltation and alter the hydrological regime besides bringing in various pollutants. In most of the major river basins of India, the increase in area for both agricultural and non-agricultural use was at the cost of conversion of flood plain areas, primary forests, grasslands and associated freshwater ecosystems to meet demands of growing population. Moreover, numerous wetlands are also infested with the uncontrolled growth of exotic species, particularly water hyacinth. Death and decay returns the nutrients and pollutants back into water while huge quantities of undecomposed organic matter accumulate, fill in the water body, eliminate dissolved oxygen and cause mass fish kills. Thus, wetlands - both natural and human-made –are lost and degraded primarily because they do not receive attention in the development plans – whether they are concerned with land use changes or are related to the development of water resources, and wetlands are treated as dustbins for the discharge of wastewaters as well as the disposal of solid wastes.

Conservation strategy

Conservation of wetlands with the objective of protecting their biodiversity, specific biophysical characteristics and obtaining optimum benefits from them requires a major shift in polices related land and water use. Joining the Ramsar Convention is only being a part of the international community to express solidarity with its objectives. Designation of a few wetlands under the Ramsar Convention and enlisting a few other large ones as important wetlands does not ensure the conservation of all wetlands. Studies show that many small wetlands together support more biological diversity than one large wetland though some species may occur only in large wetland. Just as drops make an ocean, each small wetland has a bit to contribute. No two wetlands are entirely similar like a photocopy or identical twins (Gopal, 2015).

Recommendations

- Natural and human-made wetlands should be declared as specific land use category and their hydrological characteristics (sources and regimes) should be identified and maintained.
- Converting the wetlands to any other land use or any reduction in their area or alteration in their water regime should be prohibited, except for strategic reasons after exploring other options and providing for compensatory measures.
- The total biodiversity of all wetlands should be assessed and periodically monitored.
- All ecosystem services of all wetlands should be assessed and valued in economic terms.
- All development projects such as those related to urban or industrial development, or those concerned with storage, diversion and abstraction of water from any source should consider all kinds of wetlands to be affected directly or indirectly, within the project area or far away from them. In the case of interventions on rivers, the hydrological changes may cascade down to the entire river course downstream (e.g., on floodplains). These projects should take into account especially the changes in biodiversity and the ecosystem

services of wetlands, and their economic valuation should be integrated into the cost-benefit analysis of the project.

- The assessment of ecosystem services and their economic valuation should particularly address the benefits to the local community and their livelihoods.

Conclusion

Globally, wetland ecosystems support diverse and unique habitats and are distributed across various topographic and climatic regimes. They are considered to be a vital part of hydrological cycle and are highly productive systems in their natural forms. Wetlands not only support large biological diversity but also provide a wide array of ecosystem goods and services (Wetlands Rules, 2010). Wetlands provide multiple services, including irrigation, domestic water supply, freshwater fisheries and water for recreation. They are also playing important role in groundwater recharge, flood control, carbon sequestration and pollution abatement. However, management of wetlands has received inadequate attention in the national water sector agenda. As a result, many of the wet lands in urban and rural areas are subject to anthropogenic pressures, including land use changes in the catchment; pollution from industry and households; encroachments; tourism; and over exploitation of their natural resources (Bassi, 2014). Majority of research work on wetland management in India relates to the limnological aspects and ecological/environmental economics of wetland management. But, the physical (such as hydro-logical and land-use changes in the catchment) and socio-economic (such as population growth and changes in economic activities) processes leading to limnological changes have not been explored substantially. Further, the institutional aspects (policies, rules, regulation and organizations) of wet land management have received limited attention and attracted the imagination of research scholars only recently. Thus more research emphasis on the physical, socio-economic and institutional factors influencing condition of wetlands and their use is required in order to arrive at better and comprehensive management strategies for wetlands that are facing growing stress from a variety of anthropogenic and climatic factors.

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