



Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists



**MANAGE, Hyderabad and
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Pantnagar and MANAGE, Hyderabad**

Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists

2024

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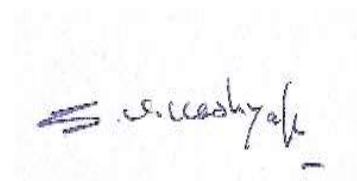
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FORWARD



Enhancing the nutritional capabilities of scientists in agriculture requires a strategic utilization of Information and Communication Technologies (ICTs). In an era marked by technological progress, scientists have the opportunity to leverage ICT tools to access real-time data, exchange research findings, and collaborate on inventive solutions. Utilizing online platforms, webinars, and digital repositories, scientists can remain abreast of the latest developments in nutrition-sensitive agriculture, creating a dynamic knowledge-sharing ecosystem. Embracing technology is not merely an option but a strategic imperative in the ever-evolving landscape of agricultural research. Incorporating new ICT tools into their busy lives can significantly strengthen the capacities of scientists.

In this regard, I commend the Department of Agricultural Communication and MANAGE, Hyderabad, for their admirable efforts in organizing the joint training on "Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists." This initiative aims to bring forth innovative ideas that will enhance the capacities of scientists in nutrition-sensitive agriculture. I extend my appreciation to the organizers for selecting such a crucial subject for training, and I am confident that the participants will benefit from the valuable insights shared by the distinguished speakers. I believe that this e-book will inspire and empower our scientists to effectively leverage ICTs, contributing to a future where agriculture and technology collaborate for the advancement of global nutrition and sustainable agricultural development.

A handwritten signature in black ink, appearing to read "S. K. Kashyap". The signature is written in a cursive style and is positioned above the printed name.

Dr. S. K. Kashyap
Dean,
College of Ag,
GBPUA&T, Pantnagar

PREFACE

This e-book provides a thorough exploration of the utilization of Information and Communication Technologies (ICTs) in enhancing the capacities of scientists on nutrition-sensitive agriculture. The content is presented with clarity and supported by ample examples, elucidating the pivotal role that ICTs play in empowering scientists within the domain of nutrition-sensitive practices. In light of the global imperative to address nutrition challenges and promote sustainable agricultural practices, this compilation explores the multifaceted applications of ICT tools.

The information contained in this e-book is also intended to provide the brief overview of three days (22-24 Jan, 2024) training on Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists organized by MANAGE, Hyderabad and GBPUA&T, Pantnagar. This also offer comprehensive information on use of media, ICTs, communication and Extension strategy for Nutri-Sensitive Agriculture.

The editors extend their sincere thanks to all the experts who had contributed different chapters for this e-book. The editors also thank MANAGE, Hyderabad for the financial support to the training programme. It is expected that the academic community will benefit from this e-book, especially students, professors, and researchers interested in gender mainstreaming and extension services.

Editors

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Brief Report:
MANAGE and Govind Ballabh Pant University of Agriculture and Technology,
Pantnagar
Collaborative On-Line Training Program on
Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists

(22th – 24th January, 2024)

Introduction:

Role of agriculture and food systems features as a central focus of the Rome Declaration on Nutrition signed during the Second International Conference on Nutrition and the United Nations Decade of Action for Nutrition. Government efforts to make agriculture and food security policies and programs “nutrition-sensitive” are growing and ministries of agriculture and rural development are increasing their contribution to multi-sectoral nutrition strategies. Nutrition-sensitive agriculture and food systems in practice. In the University system senior professionals are engaged in their profession at early morning to late night. They are less conscious about the nutrition and the balanced diet. There are different ICTs tools which are providing knowledge regarding diet according to their work but people are not aware about this. Nutrition-sensitive agriculture is an approach that pursues to ensure the production of a variety of inexpensive, nutritious, culturally appropriate and safe foods in suitable quantity and quality to meet the dietary requirements of populations in a sustainable manner. Deep knowledge of this concept is necessary to all the professionals. Keeping all these in mind, three days training on “Use of ICTs in strengthening Nutrition Sensitive Agriculture Capacities of Scientists” was organized with the collaboration of GBPUA&T, Pantnagar and MANAGE, Hyderabad.

Objectives:

The objectives of this three-day training were as follows:

[1] To create awareness on Nutrition Sensitive Agriculture.

[2] To educate use of different ICTs tools in Strengthening Nutrition Sensitive Agriculture Capacities of scientists.

[3] To promote various information technologies in fortification of Nutrition Sensitive Agriculture

Expected outcomes

On successful completion of this training, the learner will be able to:

1. Understand the use of different communication and extension strategies for NSA.
2. Know the use of AI in NSA.
3. Conscious about the life style diseases.
4. Awake Gender inclusive Nutri-Sensitive Agriculture
5. GOI Schemes and Emerging ICTs for smart Agriculture and Livestock farming

Participants' Profile

The training participants included Assistant Professors, Scientists, Government Officials etc.

Resource Persons' Profile

The team which delivered sessions during the training comprised of twelve experts. Given below is a brief description of the trainers along with the sessions conducted by them:

Name	Designation	Session title
Dr. S. K. Kashyap	Dean, College of Agriculture, GBPUA&T, Pantnagar	Extension Strategies for promotion of Nutrition Sensitive Agriculture
Dr. Veenita Kumari	Deputy Director (Gender Studies), MANAGE, Hyderabad	Nutritional Sensitive Agriculture for Sustainable Development
Dr.V.L.V. Kameswari	Head, Deptt of Agril Comm, College of Agriculture, GBPUA&T, Pantnagar	Communication Strategies to enhance the Nutritional Status

Dr. Mahesh Chander	Principal Scientist and Head, Division of Extension Education IVRI, Bareilly	Use of media to promote nutri- sensitive agriculture
Dr. M.A. Ansari	Professor, Deptt of Agril Comm, College of Agriculture, GBPUA&T, Pantnagar	Empowering Agriculture Scientists for Nutritional-Sensitive Agriculture-Role of ICTs
Dr. R. R. Burman	ADG, Agril Ext, ICAR Hqrs, New Delhi	Use of Social Media to enhance the Nutritional Status
Dr. Lipi Das	Principle Scientist (Agril Ext) ICAR-Central Institute for Women in Agriculture, Bhubaneswar	Augmenting Nutritional Security through Gender inclusive Nutri-Sensitive Agriculture
Dr. Rupasi Tiwari	Joint Director, Ext. Edu, IVRI, Bareilly	Emerging ICTs for smart Agriculture and Livestock farming
Dr. B.K. Jha	Head, Dept. of Agril Ext.Edu. Birsa Ag University, Ranchi	Use of Artificial Intelligence in strengthening Nutritional Status
Dr.C.K. Panda	Assistant Pro-cum-Jr. Scientist, Dept. of Ext Edu, BAU, Sabour	Exploring Big Data for better Analytics in Nutri- Sensitive Agriculture
Dr. Arpita S. Kandpal	Asstt. Prof. Dept. of Agril Comm, College of Agriculture, GBPUA&T, Pantnagar	GOI Schemes and Agriculture Extension and Communication Approaches to strengthen Nutritional status

Dr. Archana Singh	MBBS Doctor, Siddhi Vinayak Hospital, Haldwani	Combating life style diseases through Nutri- Rich Food
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Venue and Date

The training was organized online platform on Google meet meet.google.com/nyt-wzpx-svs.

About Sessions

Three days training programme was organised from 22th January 2024 to 24th January 2024 at 9.30 am to 5:00pm. The training began with virtual lamp lightening and recitations of Holy Mantras keeping in view the diversity of group. It was formally initiated by Dr. S. K. Kashyap, Dean, College of Agriculture, Dr. Veenita Kumari, Deputy Director (Gender Studies), MANAGE, Hyderabad, Dr. VLV Kameswari, Head, Dept of Agril Comm. Training Coordinator from GBPUA&T, Pantnagar, Dr. Arpita Sharma Kandpal warmly welcomed the guests. Dr. Veenita Kumari, Deputy Director (Gender Studies), MANAGE, Hyderabad shared the objectives of training and importance of training programme. Dr. VLV Kameswari, Head of the Department of Agricultural Communication has also highlighted the importance of training programme and Dr. S. K. Kashyap, Dean of the College of Agriculture at GBPUA&T, Pantnagar, offers his blessings to this program and elaborated the significance of training programme.

Training Sessions

Day 1

Communication Strategies to enhance the Nutritional Status-Dr. V.L.V. Kameswari, Head, Deptt of Agril Comm, College of Agriculture, GBPUA&T, Pantnagar

Dr. V.L.V. Kameswari, presented a comprehensive session on communication strategies aimed at enhancing nutritional status. Participants gained insights into tailored communication approaches to promote awareness and understanding of the importance of nutrition among diverse stakeholders.

**Empowering Agriculture Scientists for Nutritional-Sensitive Agriculture-Role of ICTs-
Dr. M.A. Ansari, Professor, Deptt of Agril. Comm, College of Agriculture, GBPUA&T,
Pantnagar**

Dr. M.A. Ansari, delivered a session focused on empowering agriculture scientists in the realm of nutritional-sensitive agriculture through the strategic application of Information and Communication Technologies (ICTs). His presentation delved into the pivotal role of ICTs in advancing agricultural practices that contribute to improved nutritional outcomes. Participants gained insights into leveraging technology for enhanced productivity and sustainable agricultural development.

**Exploring Big Data for better Analytics in Nutri- Sensitive Agriculture-Dr. C. K. Panda,
Assistant Pro-cum-Jr. Scientist, Dept of Ext Edu, BAU, Sabour**

Dr. C.K. Panda, shared valuable insights on the utilization of big data for improved analytics in nutrition-sensitive agriculture. He also shed light on how the vast amount of data generated in the agricultural sector can be effectively analysed to make informed decisions that positively impact nutritional outcomes. Participants gained a deeper understanding of the potential of big data in shaping more efficient and responsive agricultural practices.

**Nutritional Sensitive Agriculture for Sustainable Development- Dr. Veenita Kumari,
Deputy Director (Gender Studies), MANAGE, Hyderabad**

Dr. Veenita Kumari, addressed the critical aspect of nutritional-sensitive agriculture for sustainable development. Her session explored the intersectionality of gender and nutrition in agricultural practices, emphasizing the importance of inclusivity and gender-sensitive approaches. Participants gained insights into designing agricultural strategies that contribute not only to nutritional goals but also to the broader objectives of sustainable and equitable development.

Day2

**Extension Strategies for promotion of Nutrition Sensitive Agriculture, Dr. S. K. Kashyap,
Dean, College of Agriculture, GBPUA&T, Pantnagar**

Dr. S. K. Kashyap, in his insightful session, shed light on effective extension strategies aimed at promoting Nutrition Sensitive Agriculture. He emphasized the crucial role of agricultural extension in disseminating knowledge and practices that enhance the nutritional quality of agricultural produce.

Use of Social Media to enhance the Nutritional Status, Dr. R. R. Burman ,ADG, Agril Ext, ICAR , New Delhi

Dr. R. R. Burman explored the contemporary relevance of social media in elevating nutritional status. His session highlighted the potential of social media platforms as powerful tools for disseminating nutritional information, engaging with stakeholders, and fostering awareness. Participants gained a comprehensive understanding of leveraging digital platforms to effectively communicate and promote nutritional practices.

Emerging ICTs for smart Agriculture and Livestock farming, Dr. Rupasi Tiwari, Joint Director, Ext. Edu, IVRI, Bareilly

Dr. Rupasi Tiwari delved into the realm of emerging Information and Communication Technologies (ICTs) and their application in smart agriculture and livestock farming. The session explored how innovative technologies can be harnessed to enhance agricultural productivity, livestock management, and overall sustainability, contributing to the evolution of a technologically advanced and efficient agricultural sector.

GOI Schemes and Agriculture Extension and Communication Approaches to strengthen Nutritional status. Dr. Arpita S. Kandpal, Asstt. Prof. Deptt of Agril Comm, College of Agriculture, GBPUA&T, Pantnagar

Dr. Arpita S. Kandpal, an Assistant Professor in the Department of Agricultural Communication at GBPUA&T, Pantnagar, provided valuable insights into the Government of India (GOI) schemes and communication approaches for strengthening nutritional status. Her session highlighted the role of policy interventions and effective communication strategies in achieving nutritional goals within the framework of agriculture extension. Participants gained a comprehensive understanding of the initiatives and mechanisms in place to address nutritional challenges at the national level.

Day 3

Augmenting Nutritional Security through Gender inclusive Nutri-Sensitive Agriculture, Dr. Lipi Das, Principle Scientist (Agril. Ext), ICAR-Central Institute for Women in Agriculture, Bhubaneswar

Dr. Lipi Das presented a compelling session on augmenting nutritional security through a gender-inclusive approach to nutri-sensitive agriculture. She highlighted the importance of considering gender dynamics in agricultural practices to enhance overall nutritional outcomes. Participants gained valuable insights into strategies for ensuring gender equity and inclusivity in the pursuit of nutritional security within the agriculture sector.

Combating life style diseases through Nutri-Rich Food, Dr. Archana Singh, MBBS Doctor, Siddhi Vinayak Hospital, Haldwani

Dr. Archana Singh, shared her insights on the role of nutri-rich food in promoting health. She emphasized the vital connection between dietary choices and lifestyle diseases. Her session provided participants with practical information on incorporating nutritionally dense foods into daily diets as a proactive measure against prevalent health issues associated with modern lifestyles.

Use of Artificial Intelligence in strengthening Nutritional Status, Dr. B.K. Jha, Head, Dept. of Agril Ext.Edu. Birsa Agril. University, Ranchi

Dr. B.K. Jha, presented an enlightening session on the integration of Artificial Intelligence (AI) to strengthen nutritional status. Dr. Jha discussed innovative ways in which AI can be applied in agriculture to optimize nutritional outcomes. Participants gained insights into the potential of cutting-edge technologies to revolutionize nutritional strategies, making them more efficient and adaptive to contemporary challenges.

Use of media to promote nutri- sensitive agriculture, Dr. Mahesh Chander, Principal Scientist and Head, Division of Extension Education, IVRI, Bareilly

Dr. Mahesh Chander, provided valuable perspectives on utilizing media for the promotion of nutri-sensitive agriculture. His session highlighted the role of various media platforms in

disseminating information and creating awareness about nutritional practices. Participants gained practical insights into effective communication strategies, utilizing media as a powerful tool to reach diverse audiences and foster positive changes in nutritional behaviours within communities.

Valedictory Session

The valedictory session was organized on 24 October 2024 at 5.00 Pm. The Guests of the valedictory function were Dean, College of Agriculture Dr. S. K. Kashyap. Dr. Veenita Kumari, Deputy Director (Gender Studies) at MANAGE, Hyderabad, Dr. V.L.V. Kameswari, Head of the Department of Agricultural Communication. Training co-ordinator at GBPUA&T, Pantnagar, Dr. Arpita Sharma Kandpal warmly welcomed all the Guests and participants.

During the welcome address of the function, Dr. Arpita Sharma Kandpal, Training co-ordinator and Assistant Professor has informed that the training was attended by more than 50 participants. Distinguished speakers have delivered their presentation on Extension, Communication approaches, Big Data, AI, use of social media, ICTs for Nutri-sensitive agriculture, Gender sensitive nutrition etc.

After that some of the participants presented their views, understanding and feedback on the three days sessions and they also shared their ideas for improvement. With regards to training, participants shared that training was very helpful and the content and exercises used in training helped them understand the topic and its significance. Other factors such as time division and topics covered in during the training were well-received by the participants.

The Dean, College of Agriculture Dr. S. K. Kashyap, in his address emphasized on Importance of NSA and significance of training in capacity building for scientist. Dr. Veenita Kumari, Deputy Director (Gender Studies) at MANAGE, Hyderabad has also emphasized the significance of training programme. Dr. V.L.V. Kameswari, Head of the Department of Agricultural Communication also highlights the importance of training programme in 21st century.

Dean, College of Agriculture has also congratulated all the participants on successful completion of the training programme and hoped that the knowledge gained would help in the effective and efficient implementation of the activities.

The programme concluded by vote of thanks delivered by Training Co-ordinator Dr. Arpita Sharma Kandpal. She thanked the all the Guests and participants for their active participation in the training.

Training Evaluation and Post-Test

At the end of the training, Training coordinator shared the online link of feedback form and course examination among the participants. In addition a post-training assessment test was also conducted to help gauge the perceived change in knowledge by the participants at the end of the training.

Guest Lectures

Extension Strategies for promotion of Nutrition Sensitive Agriculture

Dr. S. K. Kashyap

Dean, College of Ag, GBPUA&T, Pantnagar

In India, approximately 70% of the population relies on agriculture for their livelihood, making it a vital source of sustenance. Agriculture not only fulfils the basic needs of both humans and animals but also serves as a crucial supplier of raw materials for agro-based industries. India's geographical conditions, including plain areas, fertile soil, a lengthy growing season, and diverse climatic variations, provide an advantageous environment for agricultural activities. Additionally, India has consistently employed science and technology to innovate and boost production. Despite achieving self-sufficiency in food grain production, ensuring an improvement in the nutritional status of the population, particularly women and children, remains a challenge. Food security is contingent upon access to food and purchasing power, yet only 40% of India's population consumes 80% of the energy required. The contemporary lifestyle in rural area reflects considerable labour mobility and work pressure, with individuals dedicating a significant portion of their time and energy to seeking job opportunities to enhance their livelihoods. This lifestyle shift has led to health challenges, including obesity, malnutrition, increased cost of living, and production.

Nutrition extension is presented as a crucial tool for achieving nutrition security. The paper contends that extension programs, particularly in developing nations, are indispensable for addressing rural development issues. Nutrition extension is seen as the key to combating malnutrition in rural areas, enhancing awareness, and positively influencing various aspects such as food consumption patterns, processing, storage, nutrition knowledge, healthcare, and sanitation services.

Extension Strategies: Hawks and Ruel (2006) outlined an extension strategy with the primary objectives of creating opportunities for knowledge acquisition, discussion, and action. The aim was to address unsolved problems and ultimately bring about positive changes in behaviour and practices. The identified strategies encompass various aspects of coordination, capacity building, food supply enhancement, food processing, accessibility promotion, and health

improvement. These strategies form a comprehensive framework for effective nutrition extension.

Coordination and Management: Cross-sectoral policy coordination and database management.

Capacity Building: Decentralization of food and nutrition planning and implementation.

Food Supply Enhancement: Implementation of agro-ecological zonal farming systems based on comparative advantage analysis.

Food Processing and Quality Control: Increasing food processing and preservation capacity, along with food standard and quality control.

Accessibility promotion: Development of support physical infrastructure to promote accessibility to affordable and nutritious foods.

Market Integration competitiveness: Improving domestic market access and export competitiveness through market integration and private sector participation.

Social equity and Disaster Management: Improving nutrition status and social equity through gender mainstreaming and affirmative action support. Strengthening disaster management, food reserve, and food monitoring mechanisms.

Health Promotion: Promoting good health through improved nutrition and preventive care practices. Promoting good nutrition and healthy lifestyles through improved health care and sanitation practices.

Information, Education and Communication: Promoting proper food and nutrition practices through information, education, and communication.

Research and Development: Improving food security and nutrition through effective research and development programs.

Effective Implementation Strategies:

To ensure the effectiveness of nutrition education, a comprehensive approach is required, going beyond the dissemination of basic nutrition information. Consideration of person-related factors such as perceptions, beliefs, and attitudes is essential. Implementation of effective nutrition education programs should be grounded in theory and research evidence, facilitating behavioural change. The process should involve assessing current practices and policies related to nutrition education, followed by the establishment of an overall instructional plan.

1. **Participatory Planning:** Involving the target audience in the planning process.
2. **Data Collection:** Gathering relevant data to inform the educational program.
3. **Education through Sensitization:** Sensitizing the audience to key nutrition-related issues.
4. **Training of Trainers:** Equipping trainers with the necessary skills and knowledge.
5. **Demonstration:** Conducting practical demonstrations to illustrate key concepts.
6. **Incentives:** Providing incentives to encourage participation and adherence.
7. **Collaboration strengthening:** Strengthening collaboration among various stakeholders.
8. **Organizing Nutrition Day:** Hosting events focused on nutrition awareness.
9. **Exchange Experience:** Facilitating the exchange of experiences among participants.
10. **House Visit:** Conducting visits to individuals' homes for personalized education and support.

In conclusion, the pivotal role of agriculture in fostering inclusive growth is widely recognized, as evidenced by its significance in frameworks like the 12th five-year plan approach. Acknowledging agriculture's importance in achieving faster, more inclusive, and sustainable growth, the sector faces various challenges, including the imperative for a Second Green Revolution to rejuvenate agricultural growth and enhance farmers' income. Crucially, for agricultural development to have a profound impact on human welfare, policies must encompass nutritional considerations. By recognizing the interconnectedness of agriculture and nutrition, implementing effective research and development initiatives, and ensuring that extension programs are nutrition-sensitive, we can move towards a more sustainable and inclusive model of agricultural development that positively impacts human welfare.

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Communication Strategy for Nutrition Sensitive Agriculture

V.L.V. Kameswari,

Professor and Head

Department of Agricultural Communication, GBPUA&T, Pantnagar

Sustainable Development Goal 2 aims to create a hunger free World by 2030. Despite efforts by multilateral agencies, national governments, and non-profit organizations, two billion people in the World did not have access to safe, nutritious and sufficient food in the year 2022. Extreme hunger and malnutrition remains a barrier to sustainable development and leads to less productive individuals, who are more prone to disease and are unable to earn and improve their livelihoods. Global population increase has thrown up twin challenges of production gap and nutrition gap. While Green Revolution has increased food production thereby bridging the production consumption gap, the World has a long way to go in ensuring nutrition security. Nutrition security is a much more serious challenge and concern across the World as myriad number of social, economic, political and environmental factors limit access to nutritious food. According to FAO (2023) around 2.4 billion people, mostly women and people living in rural areas did not have access to safe, sufficient, and nutritious food. An increasing number of people in South Asia and Eastern and Western Africa are unable to afford a healthy diet.

The self-sufficiency in the production of major food crops has provided an added benefit to India in the context of the affordability of healthy diets as the cost of a healthy diet is relatively low in India in comparison to other countries. Despite the affordability, there is a significant portion of the Indian population who cannot afford and access a healthy diet due to income disparities, around 74 per cent of the Indian population cannot afford a healthy diet (Fig 1.3) (FAO, 2023). Nutrition security also depends on nutrition education or awareness of the individuals to choose from the myriad foods available to them. The Nutrition Awareness Index (NAI) of the Indian population reveals that around 53 per cent of young Indians (18-35 years) face difficulty in accessing nutritious foods while approximately 50 per cent of Indians claiming to consume a balanced diet were unable to identify nutrition food sources correctly (NAI, 2023). India ranks 68th out of 113 countries in the Global Food Security Index, 2022. Agriculture has a strong and direct association with nutrition security. Majority of the World's poor reside in rural areas, mostly comprising of smallholder farmers. Developmental efforts aimed at this section of the population are likely to have incremental effect in mitigating factors that lead to nutrition insecurity. Also, agriculture sector provides access to nutritious food, by supporting the farmers through increased production, improved post-harvest storage and

processing, etc. which lowers food prices for poor consumers and makes nutritious food available to them at affordable prices. According to Herforth & Harris (2014), agriculture effects nutrition via three pathways:

- Food Production (Pathway 1): Agriculture determines availability and consumption of nutritious food and farm household income.
- Agriculture income (Pathway 2): Agriculture helps the farm household buy additional nutritious food items and make non-food purchases and services.
- Women empowerment (Pathway 3): Agriculture leads to improvement in women's nutritional status through allocation of resources for food, healthcare, and education.

Hence, the role of agriculture is pivotal in achieving nutrition security (especially in developing countries) and this realization gave rise to the concept of Nutrition Sensitive Agriculture (NSA). Nutrition Sensitive Agriculture is concerned with making food systems more resilient and better equipped to produce good nutritional outcomes. Nutrition Sensitive Agriculture (NSA) stresses upon multiple advantages of consuming a variety of foods, identifying their nutritional value and social significance of food and agricultural sector for supporting rural livelihoods. Nutrition Sensitive Agriculture (NSA) can be implemented in three ways. Firstly, an increase in agricultural production directly leads to increase in food availability and affordability. This in turn will influence the health and economic status of the community as increase in income will have a significant effect on reducing malnutrition. Secondly, cultivation of diverse food items along with sustainable practices can improve nutrition levels of the food without depleting natural resources. Initiatives such as home gardens and homestead food production can have a significant impact on the variety of food items produced at the local level and their consumption. Lastly, food fortification through processing, plant breeding and improved soil fertility can improve micronutrient content in food items. By virtue of their job, agricultural extension workers have direct and regular interaction with farmers. This gives them a unique opportunity as well as the ability to disseminate messages regarding production and consumption of nutritious foods. Nutrition sensitive extension (NSE) is a food-based educational approach to the farming community where they are sensitized on the nutritional aspects of their farm produce by imparting nutritional literacy, capacity building, and training thereby making them the anchor of nutritional security to combat hunger and malnourishment.

Being a new area, the Public Extension Advisory Services (EAS) lack the capacity for disseminating nutrition messages.

Designing a communication strategy for Nutrition Sensitive Extension comprises of eleven sequential steps. They are:

(1) Researching the topic: NSA is relatively new area and extension personnel do not have an in-depth knowledge about the field. The nutritional status is highly location specific and it varies widely at regional, local and household levels. An understanding of the agri-food system is essential to design the strategy. The agri-food system comprises all those activities related to the production, processing, distribution and consumption as a direct result of agricultural activities. Understanding the agri-food system is a good starting point analysing and determining the status of household food and nutritional security of the area. Specific components of nutrition-sensitive extension can include topics such as biofortification, value addition, nutrition education, nutrition literacy, agri-nutri entrepreneurship, etc. Communication strategy for NSA can focus on;

(2) Availability: The extent to which food is within reach of the household and its members in terms of sufficient quantity and quality.

Accessibility: The ease with which the household and its members can acquire safe and nutritious food.

Utilization: It refers to the usage pattern and practices followed by the household and its members with respect to the consumption of nutritious food.

Stability: It refers to the extent of volatility and uncertainty of availability food items to the household and its members.

Analyse: the preferences of the community and subgroups: There is likely to be a wide inter household and intra household variation. It is also important to keep in mind that unlike developed nations, food consumption in India is determined by several taboos, norms, locational restrictions, cultural and social factors. The communication strategy should negotiate these issues to be successful. This step also includes studying the demographic profile of the audience. Analysing the audience is important as determines the core message, media selection, treatment of the topic, and exposure.

(3) Assess the information needs of the farmers; Communication strategy should be demand driven. In other words, it should be based on the audience's needs. Hence, find out the existing

knowledge and skill level of farmers. Their knowledge and skills will vary. So, find out what the subgroups know. Rural communities may have limited technical knowledge but have a wealth of tacit knowledge. They have a wealth of ITK regarding nutrition and consumption of nutritious food. It is essential to anchor the communication strategy to the existing knowledge, attitude and behaviour of the community members.

(4) Write down the goals: Start with clear goals that the strategy aims to achieve. Set up SMART goals that align with what you want to achieve. The goals must be set according to the sub audience and prioritize the target audience based on acuteness of the problem. It is important to take gaps knowledge, attitude and practice into consideration while setting the goals. The goals have to be further divided into short and long term goals.

(5) Selection of media: A wide range of media is available in today's World. While selecting the media, exploring beyond conventional media and methods will help in creating an effective and innovative communication strategy. Studies indicate that a large number of rural audience possess digital media along with conventional media. Rural communities have a significant ownership of smartphones with internet connectivity and social media usage has also increased rapidly in recent years. While selecting the media, keep cost, usage, topic, objectives, skills, reach, and ownership to develop an optimal and innovative media mix.

(6) Design a creative strategy: In communication, creativity is as important as content. Therefore, how to communicate should be given due consideration. Creative strategy will determine audience attention and comprehension to a great extent. While deciding upon the creative strategy, the communication team can rely on ethos (ethics), pathos (feelings) or logos (logic). Whatever be the choice, it should be appropriate according to the topic and audience and should be limited to one approach to avoid confusion.

(7) Write message specifications: Based on the creative strategy, prepare an outline which specifies the goal, content and format. Writing these specifications will ensure that everyone involved in the activity are on the same page. This step also involves writing specifications for a series of communication messages as effective communication strategy requires some degree of redundancy. Depending upon the media and methods selected, this step can involve more detailed outputs like script, storyboard, etc.

(8) Pre-test: Before launching the communication strategy, test your content on small but similar audience. Pretesting will tell you how well your communication product is going to work with the intended audience. This step involves checking the communication material it

in terms of attention, comprehension, novelty, usefulness and creativity. Sometimes pretesting may seem like superfluous activity, but if the strategy is faulty, it can save a lot of time, cost and effort.

(9) Make modifications: The results of pretesting should be used to make changes in format, content, etc. at this stage and finalize the title, characters, sets, etc. The team will also lock in the script, message, etc. based on the results of pretesting. Now that the final decisions have been taken, the team is ready to go ahead with the production and should make arrangements accordingly. This may include hiring the talent, locations, and other facilities. Schedule for final production can be drawn up and communication material(s) is produced.

(10) Monitor exposure: Even the best communication strategy can fall flat if the audience do not hear or watch the program. Therefore, it is important to schedule the exposure based on seasonality, timing, etc. Keep in mind that media ownership and media exposure may differ significantly in rural areas. This is especially true in case of women. Media exposure is often determined by class and gender. The team should ensure that intended audience sub-groups are exposed to the communication material. Create communal facilities for media exposure, if required.

(11) Evaluation: Outcome refers to change in knowledge, attitude or practice. Communication evaluation may be defined as the change in outcomes due to communications outputs (i.e. material). Measure these against the goals set by you initially to know if your strategy has been effective. Mostly likely that the results will be a mixed bag, succeeding in achieving some goals, but not all. If goals have not been achieved, find out the reasons and use the findings for designing better communication strategy in future. While no two situations are identical, successful communication campaigns serve as roadmap for future. Thus, evaluation completes the cyclic process through feedback.

According to FAO, India not only the second largest producer of food in the World, but is also home to the second largest population of undernourished people in the World. Hence, there is an urgent need to develop food systems that are resilient and can meet the nutritional requirements of the people. There is a need to develop food systems that are resilient and can meet the nutritional requirements of the population. Hence, there is a need to integrate nutrition into agriculture through an effective communication strategy.

Augmenting Nutritional Security through Gender inclusive Nutri-Sensitive Agriculture

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Women farmers are one of the major stakeholders of the agriculture sector and play a predominant role in various on-farm and off-farm activities. They have abundant roles and responsibilities in the sector and can play instrumental in transforming the face of agriculture. Their magnitude of participation though un-quantified but speaks bound when retrospect in terms of quantum of operations carried both on-farm and off-farm. Constituting an enormous segment of Indian agricultural workforce, farm women represent a paradoxical, highly heterogeneous and complex entity, wherein there are illustrations of successful women farmers to representation of the most vulnerable section in the society. In such irony, the paramount concern is the proportion of farm women who are still struggling to have an equal access and opportunity to grow and represent themselves. With this background, it is essential to highlight the plight of farm women, facing the issues of gender inequality. India has achieved an overall rank of 127 out of the 146 countries in the 2023 edition of the report. India has closed 64.3% of the overall gender gap. But, the country has reached only 36.7 % parity in economic participation and opportunity. It has been estimated that if provided with equal opportunity as compared with their male counterparts, the efficacy of farm women will increase many folds which will foster economic development. A study commissioned by the World Bank illustrates that gender equality in earnings could enhance human capital wealth by 21.7% globally and total wealth by 14% (Wodon and de la Briere, 2018). Additionally, economic inclusion of women can improve distributional dynamics within households (Ianchovichina and Leipziger, 2019). The increased evidences of gender gap demonstrate the status of women, which is indeed a global concern as raised under United Nations Sustainable Developmental Goals (SDGs), where ensuring ‘Gender Equality’ represents the 5th SDG.

Empowering and educating women has positive implications for children’s health and nutritional status, which in turn influences the demographic dividend, and that is what India aims to harness in the medium to long run. Many experts consider women to be at the nexus of agriculture, health and nutrition, and thus gender and nutrition are increasingly being viewed as priority areas for research and extension.

Women often hold dual roles as consumers and food managers at home, influencing intra-household management of both food and nutrition security, as recognized by India's National Food Security Act (NFSA). They also play a substantial role as producers, and contribute a significant share to farm labour all over the world. It is important to find ways to mainstream gender in nutrition into the field of agriculture, so as to create gender and nutrition linkages in the food systems.

The agriculture sector in India employs 80 per cent of all economically active women. In India, farm women comprise 33 per cent of agricultural labour force and 48 per cent of self-employed farmers. Nearly, 85 per cent of rural women are engaged in agriculture but on an average only 13 per cent of them own land (Census, 2011). But, women centric agricultural policies, Research, and training and capacity building programs are often ignored.

The magnitude of women's work participation in agriculture is often curtailed by prevailing socio-cultural taboos which create perceptible gender disparity. The traditional patriarchal customs, norms and taboos have relegated women to a secondary status within the household and workplace which has resulted in a huge gender gap.

The socially constructed gender roles of men and women interact with their respective biological roles which in turn affect the nutrition status of the entire family and also of each gender. In Indian rural milieu, women by and large have limited access to land, education, information, credit, technology, and also the decision making opportunity. In contrast, their primary responsibility covers mainly the child rearing, doing household chores and performing farm related operations of crops, livestock and others. As a result, they rely on developed social networks that act as an informal safety net for the family in times of crisis. On the other hand, even in formal employment rural women typically command lower remuneration rates than their male counterpart, despite they possess the same level of skills. The three pronged burden i.e., productive, reproductive, and social roles, women have less time to attend to their own needs, leisure related or otherwise including food and nutrition. The relatively poor nutrition level of female in their early life reduces learning potential, increases reproductive and maternal health risks, and lowers the productivity and efficiency. Indicators of the level of agricultural performance on income have established a strong and significant negative relationship with indices of under-nutrition, suggesting that improvement of agricultural productivity can be a powerful tool to reduce under-nutrition across vast majority of the population.

Identification of the Problem

- Agricultural interventions in India from the 1960s till the early 1990s were focused on increasing food grain production and productivity to attain self-sufficiency and address more important issues like food shortage and hunger.
- But however, self-sufficiency in food production has not translated into nutritional security, indicating missing link between agriculture production and nutritional security.

The 2 Big Questions??

1. Why a Country like India which is having agriculture as the predominant occupation and surplus in food grains production, is having significant share of malnourished people?
2. Why there are missing links between agriculture and nutrition?

Conceptual Approach

1. **Need to focus on the nexus between Agriculture, Nutrition and Gender.**

Agriculture-Nutrition-Women Continuum

Promotion of innovation in application of information & communication technology in agriculture and dissemination of knowledge plays a critical role in knowledge-based growth of Nutrition Sensitive Agriculture (NSA). Therefore, it is imperative to update the skills of female farmers in the latest knowledge and techniques of Nutrition Sensitive Agriculture (NSA) to bring about the desired qualitative improvement and necessary orientation to contemporary problems to make research and productivity more relevant. The basic objective in the competency framework is that female farmers not only have the required competencies for the professions but are also able to promote development and delivery of need based research and production programmes that would enhance the livelihood security and build up an easy, accessible and cost effective knowledge intensive information system. Learning progression of female farmers is also linked with periodic exposure to capacity building programmes. The capacity building in deficient areas of contemporary relevance and anticipated future is addressed by this framework. Training of the female farmers in the cutting edge areas of Nutrition Sensitive Agriculture (NSA) is required to meet capacity building demands in terms of production, storage & marketing. In order to augment agricultural extension and capacity

building activities towards improved and gender inclusive dissemination of NSA based practices, capacity building centres should be established in already existing ICAR institutions all over the country.

Considering the significance of holistic development of agriculture, ensuring gender equality and equity is critically vital. Hence, it is imperative to identify and assess critical gender gap indicators which will serve as a fundamental basis on which gender-sensitive programs and approaches can be designed.

There are five core areas that run through the SDGs which nutrition can contribute to, and in turn, benefit from:

1. Sustainable Food Production
2. Strong Systems of Infrastructure
3. Health Systems
4. Equity and Inclusion
5. Peace and Stability

The nutrition needs of a family are not often kept in mind in deciding the cropping pattern. If agriculture is to be integrated with nutrition, automatically multiple cropping, crop rotation, integrated farming system would emerge, which also provide solution for many of the farmers problem today.

Nutrition-sensitive agriculture is an approach that seeks to maximise agriculture's contribution to nutrition. It encompasses more than just cereal crop production—from horticulture to forestry and fisheries, agriculture should be seen not only a means but, it is an essential process for improving the quality of foods available to the community and ensuring healthy soils and ecosystems for farming in the future. Nutrition-sensitive agriculture also leads to targeting poor households, promoting gender equity, and providing nutrition education.

Gender Gap in Health and Nutrition

In the context of Health and nutrition security aspect, the dominant gender gap assessed was BMI (Body Mass Index) related issue, wherein the majority of farm women (92.5%) reported that the BMI (Body Mass Index) of a female is not at par with the recommended BMI, followed by higher nutritional deficiency-related problems among them.

One third of women of reproductive age in India are undernourished, with a body mass index (BMI) of less than 18.5 kg/m². In rural areas 40.6% women compared to 25% in urban areas are undernourished. The rate of under nutrition is three times higher in low income groups compared to high income groups.

Malnutrition has intergenerational consequences because undernourished women give birth to low-birth-weight babies. Such children can face cognitive and other limitations all their lives, making it difficult to escape from poverty. When women face food discrimination on a national scale, the human capital of the nation is put at risk.

In spite of vulnerability to malnutrition, women are in a unique position to improve nutrition in their households. They are often primarily responsible for growing, purchasing and preparing foods and child-rearing although they have limited access to nutrition information and the resources they need to improve food security, such as income, land, equipment, financial services and training. Despite these extensive roles, most developing countries' extension systems do not sufficiently address the needs of female farmers or rural workers.

The concept of nutrition-sensitive agriculture was initiated for promoting gender equity and providing nutrition education by targeting poor households. Introducing gender and nutrition as a new cross-cutting theme of Agricultural Extension helps to build more robust, gender-responsive and nutrition-sensitive institutions, projects and programmes to assist in considering and responding to the needs of both men and women of a community.

Recommendations suggested that to prevent malnutrition a family approach rather than a group or individual approach was required, along with more efforts to sensitize grassroots-level workers about nutrition; sensitization of more women and men Village Level Workers (VLWs) about gender and nutrition perspective.

We also know there are three main pathways that potentially improve nutrition: agricultural production, agriculture-derived income, and women's empowerment. Extension workers are often considered as a promising vehicle for the delivery of nutrition knowledge and practices

to improve the nutritional health of rural communities because they reach and interact closely with farmers in different settings and act as significant service providers of crop, livestock, and forestry aspects of food security, consumption and production.

Leveraging Extension Services in empowering women and enhancing nutrition

Access to income and equal employment opportunities for women enhances the household's access to food and nutrition. A fundamental step forward in that direction involves removing the constraints faced by women with regard to their access to information, dissemination, and extension facilities. Information asymmetries tend to limit the ability of women farmers to harness the potential of agriculture, as they often do not have access to the appropriate technological know-how and inputs, as well as information on weather patterns and best agronomic practices. In this context, the roles of extension services become significant. Extension agents often fail to reach out to women farmers due to structural impediments such as staffing and funding shortages that make it difficult to reach resource-poor, remote farms (as women's barriers to credit and land titles usually leave them with marginal lands). Existing cultural and social barriers also discourage women farmers from interacting with male extension workers. Enhancing women's skills and knowledge through extension systems is a prerequisite for increasing their decision-making capacity and income, which lead to better nutritional outcomes.

Within agriculture extension services, agri-nutrition-related education and communication have a very critical and important role to play if we want food security to translate into nutritional security and gender empowerment. Extension has a facilitating role in multi-sectoral convergence for leveraging agriculture with regard to nutritional security and gender empowerment. Information and Communication Technology (ICT), together with traditional media, offer a platform for promoting extension for agri-nutrition. Although extension services in India have started integrating modern ICT tools to disseminate information, yet gender bias exists due to poor access of women to these resources.

Nutrition-sensitive information is still not a mandate for the extension system of India. It is necessary to deviate from just the conventional information about staple crops and agronomic practices and include information that incorporates a diversified production system. For example, to enhance household nutrition, it is important to promote labour-saving technologies

and a variety of allied activities, such as kitchen gardening, wadi (orchard), livestock, poultry, and fisheries. This can help in creating gender-driven diversification of production activities.

Potential Approaches for Nutrition Smart India

- 1. Food-based approaches** can focus on cultivation and availability of nutrition-rich crops at the farm level, linking farmers to markets and value chains at the farm gate level, knowledge for preservation of nutrient content of food through cooking, storing, and processing at household level.
- 2. Non-food based approaches** such as providing women with the gender-friendly tools and technology to improve their own livelihoods and reduce their labour and time, generating income through raising livestock by improved husbandry practices, and by adopting sustainable agricultural practice which have a direct impact on nutrition and health.

Role of Extension in Addressing Malnutrition

The multi-agency extension service can address hunger and malnutrition through strengthening capacity of the public agency, supporting private sector in marketing extension through extensive use of media, internet and IT in information and technology dissemination to the farm women. Farmer to farmer extension to India is very important mean for dissemination of knowledge with negligible time lag for diffusion of technology and innovations. This potential of social capital building can be harnessed for lessening the under nutrition and poverty.

We require improved knowledge on the agriculture-nutrition-health nexus and move beyond a pursuit of agricultural growth to focus on distribution and diversification. Important steps to build up this knowledge base include investments in research, evaluation and education systems capable of integrating information from all three sectors. As the National Commission on Farmers mentioned, there is a yield gap and knowledge gap of the prevailing technology, which can be bridged up using string of extension system for improving agricultural productivity. This demands that scope of extension become wider, covering all aspects of farming, from seeds to market. Farmers also need information about post-harvest tasks including processing, marketing, storage and handling.

Measures to augment agricultural extension and capacity building activities towards improved and gender inclusive dissemination of NSA based practices

- Innovative Practices to Promote Nutrition Sensitive Agriculture and Food Security
- Enabling Suitable Governance and Policy
- Value Chain and Village Trade Related Issues
- Improving Maternal and Child Nutrition
- Strategies to Improve Complementary Food and Feeding
- Nutrition Literacy
- Capacity Development of Women Institution/ SHGs/ FIGs/FPOs

Institutional Mechanism for Promoting Gender inclusive Nutri-Sensitive Agriculture

The Central Institute for Women in Agriculture along with its AICRP (Women in Agriculture) has a greater responsibility for planning and implementation of such programmes. In this context many such programmes have been developed and implemented in women perspective for creating awareness and augmenting nutrition.

- i) Gender Sensitive Extension Model:** The Gender Sensitive Extension Model was designed to promote gender friendliness to the existing extension services. The model focuses on Gender Sensitive Extension as the central core of any developmental programme considering the strength, weakness, opportunity and threat (SWOT analysis) of women farmers. The pillars of the model are ‘Women farmers & farming community, R & D Organizations in a convergence mode and Market/ Commercialization’. It is essential to link all the pillars for holistic development keeping in mind to meet the basic needs *viz.* ‘Nutritional Security, Livelihood enhancement and Environmental Sustainability’.
- ii) Gender Sensitive Agri-Nutri (GSAN) Farming System Model** including four components *viz.*, Nutri-Farming System, Agri-Nutri Education, Skill-based Capacity Building and Institutional Convergence for developing Multi -Stakeholders Value Chain.
- iii) Three-tier Approach for bridging Gender Gap and addressing Livelihood, Nutrition and Entrepreneurship**

iv) **Nutrition Smart Village Programme: An Innovative Model” to strengthen the POSHAN Abhiyan:** This new initiative aims to reach out 75 villages in 23 districts across India through the network of AICRP on Women in Agriculture which is in operation at 13 centres in 12 States of India besides the coordinating institute located at Bhubaneswar.

Major Outputs

Sl. No.	Major Output	Practical Relevance
1.	Identified Critical Gender Gap Indicators in Health and Nutritional Security	<ul style="list-style-type: none"> • Implication for policy makers, researchers, academicians and extension workers
2.	Gender Sensitive Extension Model	<ul style="list-style-type: none"> • Relevant for achieving higher inclusive development
3.	Agri-Horticulture Model for addressing Livelihood, Nutrition and Entrepreneurship	<ul style="list-style-type: none"> • Gender sensitive farming system model of practical significance for addressing Livelihood, Nutrition and Entrepreneurship
4.	Family Farming Approach	<ul style="list-style-type: none"> • Part of the Solution to the Hunger Problem.
5.	Seventy Five Nutri-Smart villages will be developed focusing on the concept of nutri-village / nutri-food /nutri-diet/ nutri-thali etc. for strengthening the POSHAN Abhiyan.	<ul style="list-style-type: none"> • The Program of Nutri-Smart villages proposed to be established with peoples’ partnership will assist in achieving the most cherished goal of a <i>Kuposhan Mukth Bharat</i>.

The efforts to improve women’s nutrition status will be most powerful if undertaken in conjunction with public policies and programs that aim to improve the status of women and to address gender inequalities. Public policies that aim to improve women’s status can promote gender neutrality either by creating a level playing field with a hope that women will catch up.

Hence, there is a need to ensure that extension services and extension tools and materials are gender and nutrition inclusive. Enhancing women's skill and knowledge through a targeted extension system is a prerequisite for achieving the goal of improved decision making in the context of increased feminization of agriculture. Farmer-to-Farmer extension programs can be more focused on engaging women lead farmers, who can then reach out to other women farmers.



Empowering Agriculture Scientists for Nutri-Sensitive Agriculture: Role of ICTs

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Nutri-sensitive agriculture (NSA) is an approach that aims to integrate nutritional considerations into all aspects of agricultural production, from seed selection to post-harvest handling. This is essential to ensure that food production not only meets quantity needs but also contributes to improved dietary diversity and quality, leading to better nutritional outcomes for individuals and communities. Agriculture scientists play a crucial role in NSA by developing and promoting nutritious crop varieties, optimizing farming practices for nutrient retention, and educating farmers and consumers about the nutritional value of different foods. However, empowering these scientists with the right tools and knowledge is essential to maximize their impact. This is where Information and Communication Technologies (ICTs) come in.

Nutri-Sensitive Agriculture (NSA) is an approach to agricultural development that prioritizes the production and consumption of nutritious food as a means to improve dietary diversity, combat malnutrition, and boost overall health outcomes. It goes beyond simply focusing on increasing food quantity and instead emphasizes the quality and nutritional value of what is being produced.

Here are some key features of NSA:

- **Focus on nutrition:** NSA prioritizes crops and farming practices that deliver essential vitamins, minerals, and other nutrients needed for good health. This includes promoting a diverse range of nutrient-rich fruits, vegetables, legumes, and biofortified varieties.
- **Contextual considerations:** NSA takes into account the specific nutritional needs of local communities, considering factors like dietary patterns, cultural preferences, and soil conditions. This ensures interventions are adapted and relevant to address local challenges.
- **Integration with other sectors:** NSA recognizes the role of other sectors like health, education, and social protection in achieving good nutrition. Collaboration and coordination between these sectors are crucial for sustainable impact.

- **Empowering farmers and communities:** NSA promote farmer participation and knowledge sharing, empowering communities to make informed decisions about food production and consumption. This includes fostering local food systems and improving market access for nutritious foods.
- **Sustainability:** NSA encourages environmentally friendly practices that maintain soil health, conserve water, and minimize environmental impact. This ensures long-term food security and nutrition for future generations.

Why is NSA important?

The world faces significant challenges related to malnutrition. Over 2 billion people suffer from micronutrient deficiencies, hindering their health and development. Additionally, unsustainable agricultural practices can further exacerbate these issues. NSA offers a solution by shifting the focus from just producing enough food to producing food that is also good for people and the planet.

Benefits of NSA:

- **Reduced malnutrition and improved health:** Increased access to nutritious foods can lead to better dietary diversity, micronutrient intake, and improved health outcomes for all.
- **Enhanced farmer livelihoods:** NSA empowers farmers to grow and sell nutrient-rich crops, fetching higher prices and contributing to improved economic well-being.
- **Sustainable food systems:** NSA practices like crop rotation and integrated pest management contribute to soil health, water conservation, and climate resilience, making agriculture more sustainable in the long run.
- **Stronger communities:** NSA empowers communities to take control of their food systems, make informed choices about their diets, and contribute to overall social development.

NSA is not just a set of techniques; it's a comprehensive approach that recognizes the complex relationships between food, health, and the environment. By integrating nutritional considerations into all aspects of agriculture, NSA has the potential to create a world where everyone has access to the nutritious food they need to thrive.

ICTs as game-changers for NSA

ICTs offer a plethora of tools and platforms that can empower agriculture scientists in numerous ways:

1. Data collection and analysis:

- **Mobile apps:** Scientists can use mobile apps to collect data on soil health, crop diversity, pest and disease incidence, and farmer practices. This data can be used to identify areas for improvement and develop targeted interventions.
- **Remote sensing:** Satellite imagery and drones can provide valuable insights into crop growth patterns, water stress, and nutrient deficiencies. This information can be used to optimize irrigation and fertilizer application, leading to more efficient and nutritious food production.
- **Big data analytics:** By analysing large datasets from various sources, scientists can identify correlations between farming practices, environmental factors, and nutritional outcomes. This knowledge can be used to develop evidence-based recommendations for improving the nutritional quality of crops.

2. Knowledge sharing and communication:

- **Online platforms:** Online platforms like e-learning modules, webinars, and discussion forums can be used to share best practices, research findings, and new technologies with agriculture scientists and farmers alike. This fosters collaboration and knowledge exchange, leading to faster adoption of NSA practices.
- **Social media:** Social media can be a powerful tool for raising awareness about NSA and engaging with a wider audience, including policymakers, consumers, and the general public.

3. Precision agriculture:

- Precision agriculture technologies like GPS-enabled tractors, sensors, and automated irrigation systems can help farmers apply fertilizers, pesticides, and water more precisely, reducing waste and optimizing resource use. This leads to increased yields and improved nutritional value of crops.

4. Market Access and linkages:

- **E-Marketing Platforms:** ICT platforms enable farmers to directly connect with buyers, reducing the need for intermediaries and ensuring fair prices for their produce.
- **ICT-based platforms** can connect farmers directly with consumers or retailers interested in purchasing nutritious foods. This can improve market access for farmers growing nutrient-rich crops and incentivize them to adopt NSA practices.
- **Mobile Applications:** Farmers can access market information, commodity prices, and weather forecasts through mobile applications, helping them make informed decisions about when and where to sell their produce.

5. Extension Services and Training:

- **E-Learning Platforms:** ICTs provide online platforms for agricultural extension services, offering training materials, best practices, and guidance on nutrition-sensitive agricultural techniques to farmers, especially in remote areas.
- **Mobile Advisory Services:** Farmers receive timely and personalized advice on crop management, pest control, and nutrition-sensitive practices through SMS, voice messages, or mobile apps.

Challenges and considerations

While ICTs offer immense potential for empowering agriculture scientists, there are also challenges that need to be addressed:

- **Digital divide:** Unequal access to and knowledge of ICTs can exacerbate existing inequalities between farmers and scientists. It is crucial to bridge the digital divide through targeted training programs and infrastructure development.
- **Data privacy and security:** Ensuring the privacy and security of sensitive data collected through ICTs is essential to build trust and encourage participation.
- **Sustainability:** The long-term sustainability of ICT-based interventions needs to be considered, including the environmental impact of hardware and software production and disposal.

Conclusion

Nutri-sensitive agriculture (NSA) is being considered as a transformative approach to agriculture that prioritizes not just food production, but also better nutritional outcomes. It goes well beyond just simply increasing the yield and focuses on producing and accessing diverse, nutritious foods to combat malnutrition and improve diets for everyone. We stand at the precipice of a transformative era. We have explored the vast potential of information and communication technologies (ICTs) to revolutionize the way we approach food production, placing nutrition at the heart of agricultural development.

Equipped with the relevant and appropriate knowledge and skills gleaned from this note, the dedicated agriculture scientists are now armed to champion this crucial mission of propelling NSA into mainstream of agriculture education and research. Now, you will wield ICTs as your tools, leveraging:

- **Data-driven insights:** To optimize soil health, track crop yields, and analyse nutritional content, paving the way for precise farming and nutrient-rich harvests.
- **Knowledge dissemination:** To bridge the gap between science and practice, empowering farmers with best practices and innovative techniques for NSA.
- **Precision agriculture:** To utilize GPS, sensors, and automation for efficient resource management, minimizing waste and maximizing the nutritional value of every crop.
- **Market linkages:** To connect farmers directly with consumers and retailers seeking nutritious produce, creating a sustainable and equitable food system.

ICTs have the potential to revolutionize the way agriculture is practiced, making it more nutritious, efficient, and sustainable. Embrace the spirit of collaboration, working alongside farmers, policymakers, and communities to bridge the digital divide and ensure equal access to these powerful tools. By empowering agriculture scientists with the right tools and knowledge, we can accelerate the transition to NSA and ensure that everyone has access to a healthy and nutritious diet. But remember, the journey doesn't end here. Your dedication and continuous learning will be your guiding compass.

Recommendation for Policy makers:

- Invest in programs that train agriculture scientists in using ICTs for NSA.

- Develop and disseminate ICT-based tools and platforms tailored to the specific needs of different regions and contexts.
- Bridge the digital divide to ensure equitable access to ICTs for all stakeholders involved in agriculture.
- Support research and development efforts to harness the full potential of ICTs for NSA.

By working together, we can leverage the power of ICTs to create a future where nutritious food is available and accessible to all.

Use of Social media to enhance the nutritional Status

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Introduction:

In the ever-evolving landscape of technology, the internet has become an integral part of our daily lives, transforming the way we communicate, work, and access information. The latest data, as reported by the Telecom Regulatory Authority of India (TRAI) in 2023, provides a glimpse into the widespread adoption of internet services across the country. With a staggering 895.83 million internet users, the report delves into the preferences between broadband and narrowband, wired and wireless connections, and the urban-rural divide in connectivity. The data reveals a significant preference for broadband services, with 861.47 million subscribers, dwarfing the 34.36 million narrowband users. This underscores the growing demand for high-speed and reliable internet connectivity. Wired internet, with 35.54 million users, coexists with the much more widespread wireless connectivity, boasting an impressive 860.29 million users. This showcases the prevalence and convenience of wireless technologies in connecting the masses. In urban areas, a staggering 530.12 million people are connected, reflecting a connectivity rate of 108.01 per 100 residents. This emphasizes the integral role of the internet in urban life, influencing everything from work to entertainment. Rural areas, though lagging behind urban counterparts, still boast a substantial 365.71 million users, marking a connectivity rate of 40.66 per 100 residents. This points to the increasing importance of digital inclusion in rural development. Presence of 165,727 public Wi-Fi hotspots, illustrating efforts to expand internet accessibility beyond traditional means and make connectivity more ubiquitous. The total data consumed nationwide stands at a staggering 69.5 petabytes (69,508 GB). These statistics not only highlight the sheer scale of internet usage but also underscore its pivotal role in shaping the socio-economic fabric of both urban and rural communities. As of June 2023, a staggering 95.93% of the total internet subscribers prefer accessing online services through mobile devices, overshadowing the meagre 3.97% accounted for by wired internet connections. This pronounced reliance on mobile devices underscores the transformative impact of smartphones and other portable gadgets in shaping our digital experiences. The ubiquity of mobile connectivity has not only revolutionized the way individuals access information but has also become the primary conduit for various online activities, from socializing to conducting business transactions propelled by factors such as

convenience, accessibility, and the rapid proliferation of affordable smartphones. The ease of carrying a powerful internet-enabled device in one's pocket has democratized access to information, making the digital realm an integral part of everyday life for millions.

As of 2021, India recorded a higher nationwide internet usage rate among men than women, at respectively 48.70 percent of male population and 33.3 percent of female population. The gender internet usage gap was also evident in rural India, with only one out of four women aged between 15 and 49 years having ever used the internet before, compared to just under 49 percent of their male counterparts in the region (Statista,2021). In rural India, internet usage stands at 24.60% for women and 57.10% for men. These statistics highlight a notable difference in digital access between genders in rural areas, emphasizing the need for targeted efforts to promote widespread internet adoption and inclusivity. However, amidst these challenges, there is a positive aspect in recognizing the progress made and the potential for inclusive digital growth. The fact that over a third of the female population accessed the internet signifies a growing trend in bridging the gender gap. The increased participation of women in the digital realm reflects a changing landscape where more women are becoming active contributors to the online community. Moreover, the data also suggests that efforts are needed to enhance internet accessibility, especially in rural areas. While only one out of four women aged 15 to 49 in rural India had used the internet, there is an opportunity for targeted initiatives to empower more women with digital skills and connectivity. This presents a positive challenge for policymakers, organizations, and communities to work collaboratively in closing the gender gap in digital access. Internet usage has notably increased among individuals aged 35-54 years (from 29% to 40%) and those aged 55 years and older (from 7% to 26%) between 2013-2019 and 2019-2025, signalling a growing adoption trend in these older age groups.

Social Media:

Social Media is the internet-based digital tools facilitate the sharing and discussion of information among individuals, enabling communication in all directions through various digital means at any time. These web-based tools of electronic communication empower users to interact, create, share, retrieve, and exchange information and ideas in any form. In the dynamic landscape of social media, the trajectory of active social network users in India has witnessed remarkable growth over the years. From 2018 to 2023, the user base surged from 269.62 million to an impressive 862 million, signifying a consistent upward trend in digital engagement. Notably, platforms like WhatsApp, Instagram, and Facebook have played pivotal roles in shaping this surge, with WhatsApp leading with 531.46 million users, closely followed

by Instagram at 516.92 million and Facebook at 492.70 million. Telegram, too, has marked its presence with a substantial 384 million users. As of 2022, India claimed for the highest number of Facebook users, boasting a massive user base of 496 million. This dominance underscores the platform's widespread adoption and influence in the Indian digital landscape. Looking forward, projections estimate a staggering 1041 million social network users in India by 2025, reaffirming the country's status as a major hub for online social interaction. The average time spent on social media by an Indian individual is approximately two and a half hours per day, reflecting a significant engagement with digital platforms. Furthermore, the average Indian social media user dedicates around 17 hours each week to online interactions, underscoring the integral role of social media in shaping daily routines and communication patterns. These figures highlight the pervasive influence of social media in the lives of Indians, serving as a key channel for communication, information consumption, and social connectivity.

The GFRAS Global survey on social media usage in Agricultural Extension and Advisory Services (AEAS) identified Facebook as the predominant platform, with stakeholders primarily engaged in searching for news, events, and information sharing. Despite its potential for bridging gaps in Agricultural Innovation Systems, concerns about the authenticity of online information emerge as a major impediment, highlighting the need for strategies to enhance credibility. The survey underscores that social media is not just a tool for broad outreach but a valuable opportunity to cultivate meaningful relationships within the agricultural community.

Nutritional Status:

As per Food and Agriculture Organization (FAO), about 735 million people globally suffer from hunger. 148.1 million children under the age of five face stunted growth due to insufficient nutrition. Conversely, 676 million adults contend with obesity, depicting diverse nutritional challenges across different age groups. Alarming, healthy diets remain elusive for 3 billion people, underscoring the urgent need for comprehensive strategies to address global disparities in food access and promote better nutrition outcomes. In India, 34.7% of children under 5 are affected by stunting, surpassing Asia's average (21.8%). Additionally, 17.3% of children under 5 are affected by wasting, higher than Asia's average (8.9%). On the positive side, India has 1.6% overweight children under 5, indicating a relatively lower prevalence and the importance of sustained efforts for healthy habits. This data emphasizes the multifaceted nature of the global nutrition crisis and the necessity for coordinated international efforts to ensure food security and improved well-being for all.

Social Media for improving nutritional status:

Social media plays a crucial role in supporting farmers in enhancing nutritional aspects through a holistic approach, encapsulated by the 4E concept:

1. **Educate:** Share knowledge and information about nutrition, sustainable farming practices, and modern agricultural techniques through various content formats on social media.
2. **Empower:** Equip farmers with practical skills, resources, and confidence needed to implement effective nutrition strategies and enhance their agricultural practices.
3. **Engage:** Foster a sense of community and collaboration among farmers on social media platforms, encouraging the exchange of experiences, insights, and solutions.
4. **Entrepreneurship:** Promote entrepreneurial opportunities by connecting farmers directly with consumers, highlighting cost-effective solutions, and creating a marketplace for nutritional products and practices.

By leveraging social media's reach and interactive capabilities, farmers can not only stay informed and empowered but also actively contribute to and benefit from a supportive online community focused on improving nutritional aspects in agriculture.

1. Educate:

In the context of social media for farmers and nutrition, "Educate" involves leveraging online platforms to disseminate valuable information, knowledge, and insights related to agriculture, nutrition, and sustainable farming practices. This can be achieved through various content formats, including text-based posts, images, infographics, videos, and live sessions.

Content Creation:

- **Articles and Posts:** Share informative articles or posts discussing the importance of nutrition in crops, livestock, and overall agricultural practices.
- **Infographics:** Create visually appealing infographics that simplify complex nutritional concepts and farming techniques.

Online Workshops/Webinars:

- **Live Sessions:** Conduct live workshops or webinars to address specific topics, allowing farmers to interact in real-time, ask questions, and receive immediate feedback.
- **Tutorial Videos:** Produce video content that demonstrates practical aspects of implementing package of practice nutrition strategies, making it easier for farmers to understand and follow.

Expert Interviews:

-Collaborate with Experts: Bring in experts or experienced farmers for interviews or discussions, providing diverse perspectives and insights.

- Q&A Sessions: Host question-and-answer sessions with experts to address farmers' queries and concerns related to nutrition.

Interactive Learning:

- Online Courses: Develop or promote online courses that cover various aspects of agricultural nutrition, allowing farmers to deepen their knowledge at their own pace.

-Quizzes and competitions: Engage farmers with interactive quizzes or challenges that test and reinforce their understanding of nutritional concepts.

Through these educational efforts on social media, farmers can access a wealth of information, stay updated on industry trends, and continuously enhance their understanding of nutrition for improved agricultural outcomes.

2. Engage:

In the context of social media for farmers and nutrition, "Engage" emphasizes fostering a vibrant and interactive online community. This involves creating opportunities for farmers to connect, share experiences, and collaborate. Here's how engagement can be implemented:

Community Building:

- Social Media Groups: Establish dedicated groups or forums on platforms like WhatsApp, Facebook where farmers can join, participate in discussions, and share insights.

- Hashtags: Encourage the use of specific hashtags to unite farmers discussing similar topics, making it easier for them to find and engage with each other's content.

Live Interaction:

- Live Q&A Sessions: Conduct live question-and-answer sessions, allowing farmers to ask questions, share their experiences, and receive immediate feedback.

-Webinars and Panel Discussions: Organize live webinars or panel discussions featuring experts or experienced farmers, fostering real-time interaction and knowledge exchange.

Collaborative Projects:

- Showcasing Success Stories: Highlight success stories of farmers who have successfully implemented nutritional practices, inspiring others within the community.

- Competitions: Create friendly challenges or competitions related to nutrition, recipes encouraging farmers to actively participate and showcase their achievements.

By emphasizing engagement on social media, farmers can build a supportive online community where they actively participate, share knowledge, and collectively contribute to the advancement of agricultural nutrition.

3. **Empower:**

In the context of social media for farmers and nutrition, "Empower" focuses on equipping farmers with the knowledge, skills, and resources needed to take control of their agricultural practices and enhance nutritional outcomes. Here's how empowerment can be achieved:

Practical Skills Development:

- Tutorial Videos: Create and share instructional videos that guide farmers through the practical aspects of implementing effective nutrition strategies in their fields or farms such as package of practice of growing millets.

Resource Access:

- Information Hubs: Establish online platforms or sections within social media groups that serve as hubs for curated, reliable information and resources on agricultural nutrition such as website or application for the institute.

Peer Support:

- Mentorship Programs: Facilitate mentorship programs where experienced farmers or agricultural experts guide and support those looking to enhance their nutritional practices or through social media groups.

By empowering farmers through social media, the aim is to build their capacity to make informed decisions, implement best practices, and navigate the complexities of agricultural nutrition, ultimately contributing to the overall success and sustainability of their farming.

4. **Entrepreneurship:**

In the context of social media for farmers and nutrition, "Entrepreneurship" refers to fostering a business-oriented mind-set and creating opportunities for farmers to thrive economically. It involves utilizing social media platforms to connect farmers directly with consumers, promote cost-effective solutions, and facilitate a marketplace for agricultural products and practices. Here's how entrepreneurship can be implemented:

Direct-to-Consumer Connections:

- Marketplace Platforms: Utilize social media platforms to create virtual marketplaces where farmers can directly showcase and sell their agricultural products.

- Online Ordering Systems: Implement systems that allow consumers to place orders directly through social media channels, promoting a direct connection between farmers and buyers.

Promotion of Cost-Effective Solutions:

- Economic Strategies: Share information on cost-effective nutrition strategies and sustainable farming practices, emphasizing approaches that are economically viable for farmers.

- Budget-Friendly Tips: Provide tips and insights on managing agricultural operations efficiently without compromising the economic sustainability of the farm.

Brand Building and Marketing:

- Storytelling: Encourage farmers to share their stories and experiences related to agricultural nutrition, creating a brand narrative that resonates with consumers.

- Visual Content: Leverage visual content on social media to showcase the quality and uniqueness of agricultural products, attracting consumer interest.

Diversification of Products and Services:

- Product Innovation: and promote innovative agricultural products or services related to nutrition by value addition, expanding the range of offerings available to consumers.

- Bundle Offers: Create bundled packages or special offers to encourage consumers to try a variety of products, contributing to increased sales.

Access to Markets:

- Networking Opportunities: Facilitate networking between farmers and potential buyers or distributors through social media, opening up new markets for agricultural products.

- Collaborations: Encourage collaborations between farmers, allowing them to combine resources and expertise to access larger markets through Farmer producer Organisations.

Financial Education and Support:

- Financial Literacy Resources: Provide resources and information on financial literacy, helping farmers make informed decisions about pricing, budgeting, and financial management.

- Access to Funding: Share information about available grants, loans, or funding opportunities that can support farmers in developing and expanding their entrepreneurial initiatives.

By incorporating entrepreneurship into the social media strategy for farmers, the goal is to not only enhance agricultural practices but also to create economic opportunities, contributing to the overall prosperity and sustainability of the farming community.

Gender Inclusion:

To effectively engage women in rural areas through social media, the strategy involves delivering content in a visually appealing manner, incorporating infographics, images, and videos, and sharing compelling narratives of successful women farmers. This approach aims to make educational material relatable by integrating local examples and stories. Collaborating with local leaders establishes partnerships that enhance the credibility of the

initiative. Their involvement during events and workshops further builds trust within the community. Accessibility is prioritized through the translation of educational content into local languages, ensuring that information is disseminated in a manner easily understood by diverse audiences. The content is culturally tailored, considering local situations and traditions to resonate more deeply with the target audience. Interactive live Q&A sessions dedicated to addressing women's concerns facilitate real-time interaction with experts, offering personalized advice. The creation of online forums or community groups provides a platform for women to share experiences, recipes, and seek advice, fostering a positive and supportive online environment. Success stories of women who have excelled in agriculture and entrepreneurship can be showcased, providing inspirational role models and encouraging other women in the community to pursue similar paths of success.

Conclusion:

In conclusion, the intertwining forces of technology, internet accessibility, and the pervasive influence of social media present an unprecedented opportunity to address and improve nutritional status, particularly in the agricultural sector. With a vast and growing online community, the 4E concept—Educate, Engage, Empower, and Entrepreneurship—emerges as a powerful framework to harness the potential of social media. The statistics on internet adoption in India, coupled with the rising prevalence of social media platforms, signifies the reach and impact these technologies can have on rural communities. However, challenges, especially the gender digital divide, demand focused efforts to ensure inclusivity and equal access to digital resources. Bridging this gap requires collaborative initiatives from policymakers, organizations, and communities to empower women with digital skills. Leveraging the popularity of social media platforms to disseminate knowledge, foster community engagement, and promote entrepreneurial endeavours holds the key to revolutionizing agricultural practices and improving nutritional outcomes.

Use of Media to promote Nutri-Sensitive Agriculture

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With right agricultural policies & sincere efforts of agricultural scientists, extension services & rural development agencies, India has achieved food security. India is now producing sufficient food grains to meet the requirements of food of its huge population, no longer dependent on import of most of the agricultural commodities. But, now concern is of nutritional security, this means the food being consumed should meet the requirements of nutrition for good human health and well-being. Nutrition Sensitive Agriculture (NSA) places nutritionally rich food, dietary diversity and food fortification at household level in the centre for holistic nutritional security of the communities. NSA ensures food production in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. The approach also stresses the importance and social significance of the food and agricultural sector for supporting rural livelihoods. The overall objective of NSA is to make the food system better equipped to produce good nutritional outcomes. It's not good enough to eat food in big quantities but what we are eating; it should be rich in food quality in terms of nutritional traits. To achieve this goal, efforts are needed in two fronts- one at the level of farmers to motivate them to grow crops & varieties that are rich in nutrition and second is to motivate consumers to eat diverse & nutritionally rich food. How this can be achieved, by using media?

The extension services use extension methods & media to promote innovations in agricultural sector. Any new concept, innovations, new practices considered good for improving agricultural practices towards improving productivity need to use media so as to convey the relevant message to target audiences. Now, increasingly we are talking in terms of agri-food systems, wherein, farmer is not the only stakeholder in food chain, there are actors in between and at the end is one of the most important actors is consumer, who utilizes the fruits of agricultural production. So, it is equally important to sensitize the consumers for consuming food rich in nutrition. We can call this focus on consumers as Consumer centric extension. The focus of extension services has to be on both the farmers & consumers. Traditionally, extension services have been reaching to farmers through print media, radio, TV,

exhibitions, farm & home visits etc. In recent time, the Internet based Information & Communication Technologies (ICT) including mobile phones & social Media channels are increasingly being used to spread the information at shorter time with reduced transaction costs as involved in personal visits.

Many may say radio has lost its importance as a means to communicate with people. But, when we see the popularity of the new formats of radio programmes which are interactive like FM channels, community radio etc., we see it still has lot of potential to reach the unreached. Farm radio programmes, when we are involving farmers & consumers, create interest among listeners, so can be effectively used to transmit messages on nutrition sensitive agriculture. Likewise, TV programmes can be presented in user friendly entertaining formats by engaging the stakeholders in the discussions & interviews, role plays etc. Print medium can be effective for sharing success stories and package of practices relating to nutrition sensitive agriculture with farmers, while educating the consumers about role of consuming nutrient rich foods coming from diverse sources.

We are living in the age of Social Media, which has a variety of channels-WhatsApp, Facebook, Instagram, Tweeter/X, LinkedIn, Youtube, Telegram etc. These Social media applications can play a significant role by way of information sharing, communicating information related to nutrition sensitive agriculture. These Social Media applications can be used in a number of different ways, often using user friendly formats for different categories of stakeholders. Here are some of the ways in which social media can be utilized to promote nutri-sensitive agriculture among communities:

- Farmers can discuss farming techniques, share experiences, and seek advice through platforms like Facebook, WhatsApp, and Telegram by hosting & joining groups and forums to grow crops and crop varieties rich in nutrition.
- Professionals in the agricultural sector can connect on LinkedIn to network, share research findings, and discuss industry trends concerned with nutria-sensitive agriculture.
- Progressive farmers and traders often use Twitter to stay updated on market prices, weather conditions, and agricultural news. Agribusinesses and government agencies also share real-time information through tweets.
- Localized WhatsApp groups are popular for sharing market information, helping farmers make informed decisions about when and where to sell their produce. The

consumers too find these groups useful to get information on nutrition rich foods and sources from where they can find these.

- Agricultural extension services, universities, and experts create educational videos on YouTube, covering topics such as crop management, pest control, and new technologies. Youtube is currently very popular among farmers to learn new practices. The educational videos if produced on good nutrition, could be good for consumers to gain information on nutritive foods.
- Infographics and short videos on Instagram can provide quick tips and visual demonstrations for various agricultural practices.
- Meteorological agencies and agricultural experts use Facebook to share weather forecasts, helping farmers plan their activities accordingly.
- Farmers can use platforms like Facebook Marketplace to directly sell their produce to consumers or connect with local buyers.
- Farmers and agribusinesses can use these platforms to showcase their products visually, attracting potential buyers of nutri-foods.
- Social Media can be used to crowdsource information on pest outbreaks, diseases, and weather-related issues, allowing for a collective response from the agricultural community.
- Tools like Slack or Microsoft Teams can facilitate collaboration among agricultural researchers, extension services, and other stakeholders.
- Advocacy groups and organizations in agriculture can use Twitter campaigns to raise awareness about policy issues, sustainable practices, and community initiatives including messages relating to nutri-sensitive agriculture.
- Farmers & consumer as also the experts can use live-streaming features to provide virtual farm tours, showcasing their operations and engaging with a wider audience to share information on nutrition sensitive agriculture.

While social media offers numerous benefits, users- be it farmers or consumers of farm products should be cautious about the authenticity of the information passed on through these channels. Often, misinformation spreads more rapidly, which may adversely impact the farming or consuming decisions. Whatever channels are being used- they have their own strengths, limitations & weaknesses. So, as per the situation, these channels should be used either stand alone or in combination to draw maximum benefits in conveying the messages relating to nutrition sensitive agriculture.

Combating Lifestyle Diseases with Nutri Rich Diet

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Lifestyle diseases refer to chronic conditions primarily caused by unhealthy habits and choices such as sedentary lifestyles, coupled with poor dietary choices and heightened stress, smoking, tobacco chewing, alcohol consumption contribute to the rise of conditions such as obesity, Hypertension, diabetes, Infertility, cardiovascular diseases, respiratory diseases, liver diseases and certain cancers. Maintaining a healthy lifestyle is paramount as it is a potent preventive measure against lifestyle diseases. Adopting healthy habits like exercising regularly, consuming a balanced diet, getting adequate sleep, stress management, and abstaining from substances like tobacco and excessive alcohol significantly reduces the chances of developing conditions like heart disease, diabetes, obesity, and some kinds of cancer.

In the modern landscape of health and wellness, the prevalence of lifestyle diseases has reached alarming levels leading to about 70% deaths from non-communicable diseases. Amidst this health crisis, the adoption of nutrient-rich diets emerges as a powerful and accessible strategy for the prevention and management of these pervasive ailments.

Understanding nutrient-rich diets:

A nutrient-rich diet is characterized by the consumption of foods that provide a high density of essential nutrients, including vitamins, minerals, antioxidants, fibre, and healthy fats. This dietary approach emphasizes the quality of nutrition rather than mere caloric intake. Fruits, vegetables, whole grains, lean proteins, and dairy or dairy alternatives constitute the fundamental components of a nutrient-rich diet.

1. Fruits and Vegetables: The vibrant colours of fruits and vegetables signify a rich tapestry of nutrients. Beyond conventional vitamins and minerals, these foods harbour phytonutrients like antioxidants, carotenoids, polyphenols, flavonoids, isoflavones and phytosterols with diverse health benefits. Flavonoids, found in berries and apples, exhibit antioxidant properties

linked to heart health. Cruciferous vegetables contain compounds like sulforaphane, known for their cancer-fighting potential.

2. Whole Grains: Beyond providing sustained energy, whole grains contribute fibre, vitamins, and minerals. The role of fibre in regulating blood sugar levels and cholesterol is pivotal in preventing diabetes and cardiovascular diseases. Fibre also maintains the microbiome of gut.

3. Lean Proteins: Essential for muscle health, immune function, and hormone regulation, lean proteins from sources like poultry, fish, tofu, and legumes play a crucial role in weight management and the prevention of metabolic syndrome. About 1 g /kg body weight protein is required per day. This requirement may increase according to the physical activity. Animal protein with high fats like mutton, organ meat are not recommended

4. Healthy Fats: Fats can be saturated, monounsaturated and polyunsaturated. Saturated fats should not be more than 10% of the total fat intake. Trans fatty acids found in partially hydrogenated vegetable oils are hazardous to health and should not contribute more than 1% of the total fat intake. Monounsaturated and polyunsaturated fats should contribute to the major portion of fats. Omega-3 fatty acids, prevalent in fatty fish, nuts, and seeds, exhibit anti-inflammatory properties. Incorporating these fats into the diet helps combat conditions associated with chronic inflammation, such as arthritis and cardiovascular diseases.

5. Dairy products contributing to bone health through calcium and vitamin D, dairy or fortified alternatives also introduce probiotics, supporting gut health.

The science behind nutrient-rich diets:

Role of Antioxidants:

1. Oxidative Stress and Inflammation: Lifestyle diseases often stem from chronic oxidative stress and inflammation. Antioxidants, abundant in fruits and vegetables, neutralize free radicals, mitigating cellular damage and reducing inflammation.

2. Cancer Prevention: Specific antioxidants, like those found in cruciferous vegetables, demonstrate anti-carcinogenic properties. Understanding the interplay between antioxidants and the prevention of certain cancers provides insights into proactive dietary choices.

Fibre and Metabolic Health

1. Blood Sugar Regulation: Soluble fibre, prevalent in apples, oats, and beans, aids in regulating glucose absorption, making it a crucial dietary component in diabetes prevention and management.

2. Digestive Health: Insoluble fibre from vegetables, fruits and whole grains supports digestive health, preventing constipation and promoting a balanced gut microbiome. The implications of fibre extend beyond satiety to encompass long-term metabolic well-being.

Omega-3 Fatty Acids and Cardiovascular Health:

1. Inflammation and Heart Disease: Chronic inflammation contributes to the development of cardiovascular diseases. Omega-3 fatty acids' anti-inflammatory properties make them integral in maintaining heart health and preventing atherosclerosis.

2. Blood Pressure Regulation: The influence of omega-3s on blood pressure regulation further highlights their role in cardiovascular disease prevention. Understanding the mechanisms by which these fats impact vascular health is essential for comprehensive dietary recommendations.

Cultural Considerations:

1. Global Perspectives: Recognizing the diversity of dietary patterns across cultures is essential. Tailoring nutrient-rich diets to accommodate cultural preferences fosters inclusivity and adherence.

2. Local Sourcing: Emphasizing the importance of locally sourced, seasonal produce aligns with sustainable practices. The impact of nutrient-rich diets extends beyond personal health to environmental stewardship.

Adopting a healthy diet with carbohydrate intake of high glycaemic index values which release energy slowly, increased protein consumption, and limited oil can prevent and reduce the risk of lifestyle diseases. Lowering carbohydrate intake can regulate blood sugar levels and may stop the onset of type 2 diabetes and obesity. Adequate protein consumption aids in maintaining a healthy weight, promotes muscle development, and reduces cardiovascular disease risk. Limiting oil intake can lower cholesterol levels, improve heart health, and decrease the chances of developing conditions such as hypertension and heart disease. A healthy diet also provides

essential nutrients, antioxidants, and fibre, supporting overall health and strengthening the immune system.

People require assistance in balancing their dietary intake of various nutrients and making appropriate food choices. Food groups divide foods into several categories based on their kind, nutritional value and functions. These food groupings can be utilized to create diets that meet nutritional requirements according to RDA. A balanced diet should consist of foods from all food groups consumed throughout the day. These foods must be consumed in sufficient quantities and proportions to meet our daily nutritional needs (NIN Manual, 1998)

Other Lifestyle Changes for Prevention of Lifestyle Diseases

Physical activity

Regular exercise is pivotal in promoting good health and reducing the risk of lifestyle diseases. Engaging in consistent physical activity helps maintain a healthy weight by burning calories and building lean muscle mass, reducing the risk of obesity and related conditions such as heart disease and diabetes. Exercise strengthens the heart, improves blood circulation and lowers the risk of high blood pressure and heart attacks. It also enhances insulin sensitivity, aiding blood sugar control and reducing the chances of type 2 diabetes. Regular exercise boosts mood, reduces stress levels, lowers the risk of anxiety and depression & improves mental health. Additionally, it strengthens the immune system, improving overall resilience against various illnesses and diseases. Yoga improves strength, balance and flexibility. It is useful for joints, heart health, manages stress and helps sleep better. WHO recommends 30 – 60 minutes of exercise for 5-6 days in a week as per requirement?

Hydration

Sufficient hydration is required for a healthy lifestyle and is crucial in reducing the risk of lifestyle diseases. Adequate water intake ensures proper bodily functions and helps maintain optimal health. Hydration supports digestion, nutrient absorption, and detoxification, promoting overall gastrointestinal health. In addition, it aids in regulating body temperature, lubricating joints, and protecting organs. Optimal hydration supports cardiovascular health, prevents conditions like kidney stones, urinary tract infections, and constipation, promotes optimal cellular function and supports immune system function, thereby reducing the risk of infections and diseases. In addition, weight management can help reduce excessive calorie

intake, improve metabolism, and promote feelings of fullness. Our body contains 70% water forming the essential component for metabolism. We lose water through urine, sweat and faeces taking away most of the toxins of our body. At least 8-10 glasses of water (2-3 litres) is required by our body depending on the physical activity.

Vitamin D: The sunshine is a nutrient for a healthier life.

Vitamin D is essential for calcium absorption, promotes bone health and reduces the chances of osteoporosis. It also supports immune system function, reducing the likelihood of infections and autoimmune diseases. In addition, adequate levels of vitamin D are associated with a lower risk of cardiovascular diseases, certain cancers, type 2 diabetes, and mental health disorders. To incorporate vitamin D into a daily routine, individuals can expose their skin to sunlight for 10-15 minutes a day, consume foods rich in vitamin D such as fatty fish, fortified dairy products, and egg yolks, and consider taking vitamin D supplements if deficiency is identified through blood tests.

Good Sleep

Adequate sleep is needed for preventing lifestyle diseases and maintaining optimal health. Sufficient sleep supports various bodily functions, including immune system regulation, hormone production, and cellular repair. Lack of sleep and poor sleep quality are linked to an increased risk of obesity, diabetes, cardiovascular diseases, and mental health disorders. Sleep deprivation disrupts hormones that regulate appetite, leading to weight gain and metabolic dysregulation. It also impairs glucose metabolism, increasing the risk of insulin resistance and diabetes. Additionally, inadequate sleep negatively impacts mood, cognitive function, and overall well-being. Therefore, prioritising good sleep habits and aiming for 6-9 hours of quality sleep each night is essential for disease prevention and overall vitality.

Avoid Smoking

Smoking has severe detrimental effects on both health and well-being. It significantly increases the risk of developing life-threatening conditions like lung cancer, heart disease, stroke, respiratory diseases, and oral cancers. In addition, smoking damages the lungs and leads to chronic obstructive pulmonary disease (COPD), which reduces lung function. It also contributes to premature ageing, skin damage, and dental problems. Additionally, smoking negatively affects fertility and can cause complications during pregnancy. Quitting smoking is

crucial for restoring health and improving overall well-being. It reduces the risk of developing smoking-related diseases, improves lung function, enhances cardiovascular health, and increases life expectancy. Quitting smoking also leads to improved energy levels, better breathing, reduced risk of infections, and a sense of accomplishment and self-control.

Manage stress effectively

Stress management is necessary for maintaining good health and reducing the risk of lifestyle diseases. Chronic stress can harm the body, leading to increased blood pressure, a weakened immune system, hormonal imbalance, and inflammation. In addition, prolonged exposure to stress hormones like cortisol can contribute to developing conditions such as cardiovascular diseases, obesity, diabetes, and mental health disorders. Effective stress management techniques, like exercise, meditation, deep breathing, and engaging in hobbies, help counteract the negative impact of stress on the body. By reducing stress levels, individuals can improve their well-being, enhance immune function, regulate blood pressure, promote better sleep, and lower the risk of developing lifestyle-related diseases. Emerging research delves into the intricate connection between nutrition and mental health. Nutrient-rich diets are now recognized for their potential in alleviating symptoms of anxiety and depression, expanding the scope of dietary interventions to holistic mental well-being. The gut microbiome, influenced by dietary choices, plays a pivotal role in mental health. Unravelling the complexities of the gut-brain axis reveals how nutrient-rich diets contribute to a healthy mind.

Abstain From Alcohol and Substance Abuse.

Substance abuse severely affects health, making abstinence crucial for preventing lifestyle diseases. Drug and alcohol abuse damages vital organs such as the liver, brain, and heart, leading to liver disease, cognitive impairment, and cardiovascular problems. Substance abuse also weakens the immune system, making individuals more susceptible to infections and diseases. Moreover, drug abuse often leads to risky behaviours, increasing the risk of accidents, injuries, and the transmission of infectious diseases. Abstaining from substance abuse helps preserve mental and physical health, reduces the risk of chronic diseases, promotes better decision-making, enhances overall well-being, and fosters a healthier and more fulfilling lifestyle.

Maintain Healthy Weight

A healthy weight is optimal for an individual's height, age, and body composition. Weight management is crucial for a healthy lifestyle as it helps prevent lifestyle diseases. Excess weight, especially obesity, can increase the chances of developing conditions like type 2 diabetes, high blood pressure, heart disease, certain cancers, and joint problems. Maintaining a healthy weight with balanced nutrition and regular exercise promotes overall well-being. It improves cardiovascular health, enhances insulin sensitivity, regulates blood sugar, reduces inflammation, and lowers the risk of developing chronic diseases. Weight management plays a vital role in optimising health and preventing lifestyle-related illnesses.

BODY MASS INDEX (BMI) is a standard method of assessing healthy weight for an individual.

$BMI = \text{Weight (kgs.)} / \text{square of Height in meters}$

Underweight: < 18.5 BMI

Normal Weight: 18.5 – 22.9

Overweight: 23.0 – 24.9

Obese: 25.0 AND MORE

Waist circumference can also be used as a marker, measured at the level of belly (can measure at the level of umbilicus)

For Indian females > 80 cm. and for Indian males > 90 cm. waist circumference needs caution.

Regulate and monitor Blood Pressure and Blood Sugar

Regulating and monitoring blood pressure and blood sugar levels is crucial for maintaining a healthy lifestyle and reducing the risk of lifestyle diseases. For example, high blood pressure (hypertension) increases the risk of cardiovascular diseases, while elevated blood sugar levels contribute to developing diabetes-related complications. Regular monitoring helps detect abnormalities early, allowing for timely interventions and treatment. Regulating these vital markers allows individuals to mitigate the risk of stroke, heart disease, diabetes, and related complications. It empowers individuals to make informed diet, physical activity, and medication decisions. Proper blood pressure and blood sugar management promote long-term health and well-being. A Blood pressure of 140/ 90 mm Hg or above is considered hypertensive. It is preferred to maintain a blood pressure less than equal to 130/ 85 mm Hg.

Fasting glucose levels should be maintained less than 100 mg/dl. A fasting glucose of 126 mg/dl or above suggests diabetes.

Post-prandial glucose levels (PPBS) after 2 hours should be maintained less than 140 mg/dl. PPBS of 140- 199 is suggestive of impaired glucose tolerance (pre diabetic) and that 200 mg/dl or above is suggestive of Diabetes.

Challenges and Future Directions:

1. Ensures that the benefits of nutrient-rich diets are accessible to all whether rich or poor.
2. Nutritional education is paramount in empowering individuals to make informed dietary choices. Raising awareness about the impact of nutrient-rich diets on health is a crucial step in preventive healthcare.
3. Integrating nutritional counselling into healthcare practices fosters a holistic approach to patient well-being. Collaboration between healthcare professionals and nutritionists is essential in providing comprehensive care.
4. Ongoing research explores the intersection of genetics, personalized nutrition, and lifestyle diseases. Understanding individual variations in nutrient metabolism opens avenues for personalized dietary interventions

Conclusion

A healthy lifestyle is crucial for preventing diseases and promoting overall well-being. By incorporating tips such as regular exercise, a balanced diet, sufficient hydration, stress management, and monitoring vital health markers, one can pave the way for a vibrant, disease-free life. Therefore, prioritise health today and reap the benefits for a lifetime. In the intricate web of lifestyle diseases, nutrient-rich diets emerge as beacons of hope, offering a proactive and empowering approach to health. The exploration of antioxidants, fibre, omega-3 fatty acids, and the synergy with lifestyle factors provides a comprehensive understanding of the science behind these dietary choices. Beyond nutrients, the integration of exercise and the impact on mental well-being elevate nutrient-rich diets to holistic lifestyle interventions. Practical guidelines, cultural considerations, and the acknowledgment of challenges pave the way for the widespread adoption of these transformative dietary patterns. As we navigate the challenges and delve into future directions, nutrient-rich diets stand poised as catalysts for a

paradigm shift in healthcare, promoting not just the absence of disease but the cultivation of optimal well-being.

Emerging ICTs for Smart Agriculture and Livestock farming

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Smart farming is a livestock and farm-centric approach that aims to aptly address the concerns of various stakeholders viz. producers, processors and consumers in the agriculture industry. Real time monitoring using sensors helps to address livestock needs better, ensures animal welfare and good health, increases production control and optimizes management. The incorporation of smart-farming-technologies viz. location systems (GPS), sensors, robotics, artificial intelligence (computer systems helping with intelligent tasks like decision making), supply chain tracking (from farm to fork) and information communication systems (like mobile apps and other resources), will help in increasing the farm operational efficiency by lowering costs, optimizing labour requirements, improving product quality and reducing waste.

Information and Communication Technology (ICT) in agriculture refers to the integration and application of digital tools, communication networks, and data-driven solutions to enhance various aspects of farming practices. ICT in agriculture encompasses a broad spectrum of technologies, including but not limited to, farm management software, mobile applications, sensor-based systems, satellite imagery, and internet-based platforms. Information and Communication Technologies (ICTs) play a crucial role in the Fourth Industrial Revolution, utilizing digital technology to streamline processes. This transformation can significantly benefit livestock farmers by providing them with access to current and timely information. In

the context of agricultural innovation, the rapid evolution of ICTs and the widespread use of mobile phones have become increasingly prominent, extending beyond simple communication purposes (Henze and Ulrichs, 2016). These technologies hold immense potential to enhance the efficiency and effectiveness of agricultural extension services, especially in remote areas where physical access to information and experts may be constrained. The adoption of ICT in agriculture not only optimizes resource utilization but also promotes precision farming, sustainable practices, and resilience in the face of environmental challenges. The FAO has also stressed upon the significant role of ICT-based smart agricultural farming as an effective way to satisfy the higher demand of food for future population (Trendov et al. 2019). Some examples of ICT tools used in smart farming include precision feeding systems, sensors for monitoring environmental conditions and software for data management and analysis.

As per the TRAI telecom Subscription Data, the number of telephone subscribers in India as on 31st October 2023 were reported to be 1,182.31 million. The urban tele-density was found to be 133.45% compared to the rural tele-density of 58.11%. The *Nielsen India Internet Report 2023* stated that as of December 2022, India had around 700 million active internet users aged 2 years and above, with 425 million users from rural India alone, as compared to the 295 million users in urban areas. Furthermore, the report highlighted the remarkable growth in rural areas, surpassing urban areas with a 30% increase in active internet users, compared to the 10% growth observed in urban regions. The data revealed that nearly 90% of internet users were daily users; of which 93% of urban users and 86% of rural users were accessing the internet on a daily basis. The increase in mobile phone penetration coupled with the active embracing of internet usage lays ground for effective and impactful extension through the use of ICTs. That information is vital for development of agriculture and the well-being of the rural masses, the fact has been well recognised in the form of a number of initiatives taken to disseminate information on agriculture and related aspects by government, non-government, private and cooperative organizations.

Making smart-farming smarter

For a better categorical view, it can be stated that the ICTs are being currently used for the benefit of the agriculture and livestock sector across four domains: Information systems, Consultancy portals, Service delivery and e-Governance or Citizen support services.

I) Information services

The Government of India's **Farmer Portal** is an attempt to provide a one-stop-shop solution for all agricultural, animal husbandry, and fisheries-related information needs of Indian farmers. Through this platform, farmers no longer need to search a variety of websites. Instead, they can conveniently access all pertinent information on topics related to their village, block, district, or state in one centralized location. The delivery of this information is facilitated through diverse channels such as text, SMS, email, and audio/video, all in the language of their preference. The portal includes a user-friendly map of India, enabling farmers to effortlessly locate their specific areas. Furthermore, a dedicated Feedback module allows farmers to pose specific queries and provide valuable feedback. **KisanMitr** – 'Friends of the Farmers', is an initiative of the Office of the Principal Scientific Adviser, Government of India. This project aims to make Indian farmers more self-reliant by giving them insights and recommendations based on information from various data sources from different departments of the Government. KisanMitr, brings together all the key and important stakeholders from diverse fields (Central and State Government departments dealing with agriculture, Govt. R&D Institutions, Indian Academia, Industry, Startups and Incubators, Non-profit organizations, FPOs and other entities) to help the farmers of India. The KisanMitr platform intends to tap the energies of the startups ecosystem in India to solve and address some of the key social development challenges in the agricultural sector. This platform aims to facilitate the discovery of key challenges in agriculture which startups can attempt to solve, and will facilitate the trials and adoption of the solutions provided by startups to the farmers. The portal provides consolidated repository of the products and technologies from private and incubated startups and MSMEs also. The Online portal, connects the supply and demand for agricultural technologies and includes an e-commerce gateway, knowledge management support and dashboards. **KISAAN 2.0** (Krishi Integrated Solution for Agri Apps Navigation) by ICAR, is an application that serves as an aggregator for over 300 agricultural-related apps developed by ICAR Institutes, compiled into a unified Android mobile app. It offers a single interface in multiple Indian languages, providing farmers with access to comprehensive agricultural knowledge covering crops, horticulture, livestock, fisheries, natural resource management, agricultural engineering, education, and extension services. The **KVK Mobile App** delivers region-specific information to farmers. After registering on the app, farmers can choose their primary KVK (Krishi Vigyan Kendra) and access details about the KVK by selecting their state and district. Additionally, the app provides comprehensive information about all the facilities offered by the selected KVK.

A number of mobile applications have been developed by ICAR-IVRI, Izatnagar with the purpose of serving as an information tool for various stakeholders including farmers. The **IVRI- Animal Reproduction (Pashu Prajanan) App** is targeted to impart knowledge and act as a ready reckoner for the graduating veterinarians, field veterinary officers and livestock entrepreneurs about reproductive disease/ disorders in cattle and buffaloes and measures to treat and control them. The major reproductive diseases/disorders covered in the app are Anestrus, Repeat Breeding, Silent Heat/Silent Estrus, Uterine Torsion, Dystocia, Abortion, Uterine Prolapse, Retention of Foetal Membranes/ Placenta, Metritis, Brucellosis, Campylobacteriosis and IBR-IPV. The app is available in 11 languages viz., English, Hindi, Punjabi, Bangla, Gujarati, Marathi, Malayalam, Telugu, Tamil, Assamese and Kannada and is further supported with audio backup for three languages to support the illiterate clientele/ those who prefer to listen. The **IVRI- Dairy Manager App** has been developed with the purpose of imparting knowledge and skills to Graduating Veterinarians, Field Veterinary Officers, Developmental Organizations and Entrepreneurs for promoting dairy farming. This is an educational app providing information on breeds and housing, feeding, calf and general management, clean milk production and identification & vices of dairy animals. Educational videos on clean milk production and neonatal calf management have been included in the App for enhancing the knowledge and skills of the personnel's involved in dairy farming. The app is available in two languages viz., English & Hindi. The **IVRI-Pig Farming App** designed and developed by ICAR-IVRI, Izatnagar in collaboration with ICAR-NRC on Pig and ICAR-IASRI, New Delhi is targeted to impart scientific knowledge and skills to the graduating veterinarians, field veterinary officers, developmental organizations and entrepreneurs for promoting pig farming. This is an educational app providing information on breeds, housing, feeding, breeding, healthcare and general management of pigs. The app additionally supports for economic analysis and evaluation of various pig farming projects. The **IVRI- Vaccination Guide app** is targeted to impart knowledge and skills to Graduating Veterinarians, Field Veterinary Officers, Paravets, Livestock, Poultry & Pet Owners about vaccination in domestic animals, poultry and pets. The App provides basic information about vaccination in livestock, poultry & pets and covers specific information about vaccination related to all the major bacterial and viral diseases. For each of the disease in various species, the information on the causative agents, types of vaccines available, serotype / strain used for the vaccines, vaccination schedule and commercially available vaccines are provided in the app. The App also provides detailed information about the government and private institutions involved in vaccine production in the country. The **IVRI Waste Management Guide app** is designed to

impart information and knowledge to graduating veterinarians, field vets, general public, farmers and other stakeholders about management of waste originating from agriculture, livestock and household activities. The app covers information related to composting & its various methods viz., aerobic, anaerobic, rapid, large scale, in-vessel & miscellaneous methods. It also provides information on various compost related products, vermicomposting, its various methods & procedure, nutrient profile & use of the vermicompost for crops. The app provides detailed information on biogas production viz., setting up its plant, inputs required, procedure, advantages, classification, designs of bio-digester, biogas plant management & utilization of biogas and slurry and newer alternatives to waste management viz., organic farming, waste decomposer, liquid manures & technologies for crop residue management. It also provides information on the initiatives taken by government for waste management in India & by-laws and policies for organic waste management in India etc. The **IVRI- Disease Control App** is designed to impart knowledge and skills to Graduating Veterinarians, Field Veterinary Officers, Paravets, Livestock, Poultry & Pet Owners about important diseases of Livestock, Poultry & dogs, their symptoms, diagnosis, treatment, Prevention & Control. The livestock diseases covered include Bacterial Diseases viz., HS, BQ, Anthrax, Enterotoxaemia, Mastitis, Brucellosis, Glanders; Viral Diseases viz., FMD, Sheepox & Goatpox, BlueTongue, CCPP, Swine Fever, PPR, Parasitic / Protozoan Diseases viz., Fascioliasis, Amphistomiasis, Babesiosis, Trypanosomiasis, Mange and Anaplasmosis. The Poultry diseases covered include Salmonellosis/ salmonella paratyphoid, Ranikhet, FowlPox, Fowl Cholera, Mareks Disease, IBD, Duck Plague, Infectious Coryza, CRD while diseases of canines that are covered include CD and Rabies. The app also provides information about the Exotic & Emerging diseases apart from information on various Disease Diagnostic Laboratories in India, various Diagnostic facilities offered by ICAR-IVRI, Important organisations involved in disease control & Government schemes and guidelines for disease control in India. The app is available in two languages viz., English & Hindi. The **Parasite management guide App** provides knowledge on parasitic diseases in various species of domesticated and wild animals, the life cycle of the parasite, the organ system involved, pathogenesis, diagnosis, and management of these parasites. The application also provides insight into the deworming schedule and drugs that can be used along with their dose and dosage. The **Biosecurity and Biosafety app** designed and developed by ICAR-IVRI, Izatnagar, UP, and ICAR-IASRI, New Delhi is targeted to impart knowledge and skills to livestock and poultry farmers, field veterinarians and healthcare personnel about the concept of Biosecurity and Biosafety measures in Livestock and Poultry farms. This app covers the

biosecurity and biosafety of dairy, pig, and poultry farms. The various aspects covered under this app include the basic concept of biosecurity and its advantages, detailed information about the measures of biosecurity and biosafety in forms viz., location and design of farms, restricted movement, isolation and quarantine, cleaning and disinfection, management of feed and water, disposal of carcass, disposal of clinical and other wastes, disposal of farm effluents/manure, personal hygiene, health management, reproductive management, documentation and record keeping, actions during disease outbreak and examples of disinfectants used.

II) Consultancy services

The Ministry of Agriculture & Farmers Welfare has effectively utilized ICT as a consultancy aid in the form of "**Kisan Call Centres**" (KCCs) launched on January 21, 2004. The primary objective of KCCs is to offer farmers responses to their queries in their native language via a nationwide toll-free number (18000-180-1551). Operating in 21 locations, covering all States and Union Territories, these call centres deliver assistance in 22 local languages. Accessible from 6:00 AM to 10:00 PM daily, KCCs are manned by Farm Tele Advisors (FTAs) possessing excellent communication skills in the local language and holding graduate degrees or higher in agriculture or allied sectors. Unanswered queries by FTAs are escalated to higher-level specialists with the relevant expertise. The **mKisan SMS Portal** for farmers enables all central and State government organizations in agriculture and allied sectors to give information/services/advisories to farmers by SMS in their language, preference of agricultural practices and location. Users can get information on the Push SMS, Pull SMS, services, IVRS, mobile apps, etc. Users can also register for SMS services. The **Kisan SARATHI** is a System of Agri-Information Resources Auto-Transmission and Technology Hub Interface, joint initiative of Indian Council of Agricultural Research & Digital India Corporation providing intelligent online platform for supporting agriculture at local niche with national perspective. Intended to provide a seamless, multimedia, multi-ways connectivity to the farmers with the research and extension network of ICAR having: Latest Agricultural Technologies, Rich knowledge base of Agriculture, Pool of Agricultural Experts. Taking leverage of features of Interactive Information Dissemination System (IIDS) the system provides Pull and Push based Advisory system using Mobile Phones. 'Right Information' at 'Right Time' in desired 'Mode and Language'. Customizable and need based information delivery to Farmers. Know Your Farmers (KYF) facility to subject matter Experts. Enhances the outreach of National

Agricultural Research, Education and Extension System. The **IVRI- Online Veterinary Clinic App** is designed and developed by ICAR-IVRI, Izatnagar & ICAR-IASRI, New Delhi as an extension of Referral Veterinary Clinic services offered at IVRI premises. The major objective of the app is to provide the animal owner with easy and hassle-free access to IVRI veterinary polyclinic services at any given point in time from the comfort of their home, thus saving them the logistics, finance, and time incurred in bringing the animal to IVRI polyclinic. The app provides direct access to consultancy/advice from leading scientific experts in the fields of veterinary medicine, surgery, reproduction, pathology, parasitology, nutrition, breeding, and management. The app gives provision to the animal owner for sharing basic information like age, gender, and weight along with photos and videos of the animal(s) with the IVRI experts to enable accurate diagnosis of the condition and ensure effective prescription/remedies for the problem.

III) Service Delivery

The **Kisan Rath** mobile app by the Ministry of Agriculture & Farmers Welfare connects farmers, FPOs, and traders with transport service providers for Agricultural and Horticultural produce transportation. It offers trucks and tractor trolleys, allowing users to post part-load and full-load requirements. The app interfaces with major transport aggregators and individual transporters, facilitating registration and service provision. Users can post load requirements, receive responses, negotiate offline, and rate transporters post-trip. The **e-Gopala** portal also available as an app serves as a platform through which registered farmers can buy and sell dairy animals, get information on sources of quality semen doses for different breeds of cattle and buffalo, information and contact details for availability of sexed semen and IVF embryos. The **e-NAM** (National Agriculture Market) platform aims to create a unified national market for agricultural commodities by connecting existing Agricultural Produce Market Committees (APMCs) through an online portal. Marketing platforms like *Licious*, *Zappfresh*, *Tendercuts*, *Bakraw*, *Bigbasket*, *Country Delight*, *Doormilk* etc are being extensively used now for the sale of meat and dairy products and have created a niche market.

IV) e-Governance/ Citizen support services

The **UMANG** (Unified Mobile Application for New-age Governance) portal, by the Ministry of Electronics and Information Technology (MeitY) and the National e-Governance Division (NeGD), stands as a pioneering initiative to propel Mobile Governance in India. UMANG provides a single platform for all Indian Citizens to access pan India e-Gov services ranging from Central to Local Government bodies. The PM Helpline facility and state-level CM helpline facilities for addressing public grievances are yet another addition to the e-governance model.

Besides the aforementioned major domains, ICTs are being effectively used as hands-on tools for better farm managerial decisions like ration formulation, evaluation of farm biosecurity, farm parasite load etc. Apps like **Pashu Poshan** and **IVRI- Pig Ration App** aid in formulation of requirement based ration using locally available ingredients for bovines and swine. The **IVRI- Biosecurity and biosafety App** has a provision of an electronic score, which can be used by farm owners to assess the existing biosecurity level of their concerned farm and take measures accordingly.

In recent years, agricultural stakeholders have been found to increasingly rely on social media for swift information exchange due to cost-effectiveness, easy access to information without travel constraints. Better engagement with audience, especially progressive farmers (Sokoya et al., 2012; Muktar et al., 2015; Stanley, 2013) The Youtube Channels of ICAR, and ICAR-IVRI, KVK, Izatnagar broadcast informative content in various formats for the viewers. WhatsApp support groups for trainees and farmers part of various programmes of the institute like KVK, Agri-business Incubation Centre play pivotal role in providing an expert support system to the farmers. The institutional website and presence on Facebook and Instagram ensures better outreach and popularizing upcoming events, training programmes and opportunities that may helpful to the farming fraternity.

Digital tools for balanced learning for agriculture and veterinary scholars

Different digital tools for both synchronous and asynchronous learning serve not only as learning facilitators but also as communication strategies for Knowledge Sharing (KS), Knowledge Acquisition (KA), and Knowledge Transfer (KT). Tools such as threaded discussions, blogs, and instant messages enhance the classroom experience by fostering communication not only between instructors and learners but also facilitating peer-to-peer interactions among learners (Shahabadi and Uplane, 2015). Information system software and expert systems are capable of enhancing educational experiences and serving both students and

farmers. The Animal Health Information System (AHIS) for Dairy owners, Livestock and Poultry Disease Information System, Goat Health Management Information system (GHMIS) and Buffalo Reproduction Information System (BRIS) are some of the information system software developed at ICAR-IVRI, Izatnagar. **Massive Open Online Courses (MOOCs)** are popular e-learning platforms attracting numerous participants due to their open enrollment, free initiation, and online delivery, overcoming spatial limitations of traditional classrooms. Platforms like SWAYAM, Coursera and Udemy offer MOOCs in various subjects. Mobile Apps like IVRI-Research methods tutorial, Antimicrobial Resistance App, IVRI-Extension methods tutorial, Animal Genetics and breeding App, Zoonoses App and IVRI- Artificial Insemination App are created with the purpose of being used as an educative tool to both veterinary students and serving veterinarians.

The availability of **virtual assessment tools** in the veterinary field globally, creates avenues for translating similar developments for veterinary students in India, where there is an apparent lack of digital resources in veterinary medical education (Raffan et al., 2017). The use of educational games, virtual reality, and simulators offers the potential for interactive experiences that closely resemble hands-on activities (Richard et al., 2018). Less experienced students stand to gain more from simulators and virtual reality, as these technologies afford them extended periods of hands-on training, thereby enhancing their learning outcomes. (Sikder et al., 2015) **Haptic simulators**, technological instruments facilitating touch sensations analogous to real-life hands-on skills, are increasingly prevalent in human medical education. Some veterinary schools in Europe have already embraced the use of validated haptic simulators for teaching and assessment purposes. As per a report by Kinnison et al., (2009), the majority of students expressed the utility of a haptic simulator in learning bovine abdominal anatomy, emphasizing its effectiveness in tactile understanding of anatomical structures, in contrast to relying solely on cadavers. The domain of **Augmented and Virtual Reality** for Agriculture and Allied sectors is predicted to be extensively explored in the foreseeable future. Under NAHEP, IVRI is instrumental in developing a Virtual reality module regarding correction of uterine torsion and Artificial insemination as a digital learning and training tool for Veterinarians.

Way Forward

The recent thrust area has been the integration of Artificial Intelligence (AI) with ICT. India has ambitiously and effectively ventured into the integration of AI within various

sectors, witnessing notable deployments that enhance accessibility to public services and improve operational efficiency. The World Economic Forum's **AI for Agriculture Innovation (AI4AI)** initiative is aiding India's agricultural transformation through the application of artificial intelligence (AI) and related technologies. Led by Centre for the Fourth Industrial Revolution (C4IR) India, the initiative unites government, academia, and business to create and deploy innovative solutions in the agriculture sector. An example is the *Saagu Baagu* pilot project in collaboration with the Telangana state government, situated in the Khammam district. Supported by the Bill and Melinda Gates Foundation and executed by Digital Green, the initiative has significantly enhanced the chili value chain for over 7,000 farmers. The Integrated Agriculture Portal, **E-Krishi Samvad**, harnesses the power of AI to guide farmers in crop selection, pest control, and optimization. This incorporates predictive analytics for weather, monitoring soil health, and forecasting prices, contributing significantly to informed decision-making and boosting agricultural productivity. **AI powered chatbots** are being used in almost every sector now as they can automate repetitive and rule based tasks reducing the workload on government employees and minimizing errors in processes. AI algorithms can optimize workflow processes, leading to faster and more efficient service delivery. The **Artificial Intelligence based Disease Identification System for Crops (AI-DISC)** by ICAR-IASRI is a compressive AI-powered mobile application for automatic image-based disease and pest identification of disease and insect-pest of different crops. **KissanGPT**, a ChatGPT-powered chatbot, aids farmers by offering real-time advice in multiple languages, including Hindi, on crop cultivation, irrigation, pest control, and other farming concerns. ICAR-IVRI has developed two AI powered Chatbots till date namely, IVRI- Dairy SHRIA (Beta) and IVRI Sheep & Goat SHRIA. **IVRI- Dairy SHRIA**, the Smart Heuristic response-based Intelligent Assistant, has been exclusively developed for prompt redressal of queries by individuals engaged in dairy farming. Developed through a collaborative effort between ICAR-IVRI, Izatnagar, and ICAR-IASRI, New Delhi, this chatbot utilizes Natural Language Processing (NLP) and machine learning algorithms, delivering real-time and pertinent information to users. It supports 10 Indian languages, and has speech input and output features too, ensuring a seamless and accessible learning experience. Covering an extensive array of dairy farming topics, Dairy SHRIA includes breeding strategies, optimal feeding practices, preventative healthcare measures, general management techniques, calf-rearing procedures, organic dairy methodologies, training resources, insurance options, and economic considerations, thus serving as a comprehensive solution for all dairy farming needs. **IVRI Sheep & Goat SHRIA** covers a comprehensive range of sheep and goat farming topics, viz., breeding strategies,

optimal feeding practices, preventative healthcare measures, general management techniques, kid and lamb rearing procedures, marketing methodologies, training resources, insurance options, and economic considerations.

Block chain technology is a decentralized digital ledger recording secure transactions across a computer network. It forms an immutable chain with blocks of transactions linked by cryptographic hashes. There are examples of successful integration of block chain with IoT for traceability by utilizing IoT devices to record data, which is then fed into the block chain for provenance tracking as in *AgriBlockIoT*, a block chain-based traceability mechanism for the agro-food supply chain by Caro et al. (2018). In livestock agriculture, block chain assigns a unique identification to each animal, tracking farm history, transportation, veterinary checks, slaughter, and distribution. It ensures decentralized and automated transactions, improves auditing, enhances traceability, and meets consumer demands for supply chain transparency. This technology aids in detecting and tracking livestock diseases, addressing sustainability and ethics concerns, and ensuring food safety. Despite its potential, widespread use in livestock agriculture is in early stages, with limited studies exploring impacts.

In the current fast paced era of technological advancement, it is difficult to assess how long would it take for a certain technology or tool to become obsolete or be replaced by something better. What can be predicted with certainty however is that ICTs will continue to evolve and play a key role in effective extension of services and technologies?

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GOI Schemes and Agriculture Extension and Communication Approaches to Strengthen Nutritional Status

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Scientists grapple with various health challenges stemming from the demanding nature of their work. Prolonged hours spent on research and data analysis contribute to a sedentary lifestyle, potentially leading to obesity, cardiovascular issues, and musculoskeletal problems. Extended exposure to computer screens and microscopes poses risks of eye strain and vision-related discomfort. The high-pressure work environment, stringent deadlines, and the constant pursuit of breakthroughs can result in stress, anxiety, and burnout, with long-term implications for mental health. Irregular working hours, including nights and weekends, disrupt sleep patterns and may cause fatigue and a compromised immune system. Depending on their field, scientists may face exposure to harmful substances during experiments, underscoring the importance of strict safety measures. The nature of laboratory work and desk-bound research limits opportunities for physical activity, potentially contributing to conditions like obesity and cardiovascular problems. Social isolation, stemming from the solitary nature of scientific endeavours, can impact mental health, leading to feelings of loneliness and stress. Additionally, the publish-or-perish culture in academia creates high levels of stress and pressure to continually produce research findings, potentially compromising work-life balance. To address these challenges, adopting a balanced diet, staying hydrated, engaging in regular physical activity, and prioritizing mental well-being become crucial components of effective health management for scientists.

The Government of India (GOI) has implemented various schemes aimed at enhancing agricultural practices and improving the nutritional status of its citizens. These initiatives are

coupled with effective agriculture extension and communication approaches to ensure widespread dissemination of knowledge and adoption of best practices.

1. **National Food Security Mission (NFSM):** The National Food Security Mission (NFSM) is a centrally sponsored scheme launched in 2007 with the primary goal of increasing the production of rice, wheat, pulses, and coarse cereals to ensure food security in India. NFSM aims to increase the production of rice, wheat, and pulses to ensure food security. By promoting diverse crop cultivation, the scheme contributes to a more varied and nutritious diet for the population. The Key Components are: [1] Rice: Aims to enhance rice production through the adoption of improved technologies and best agricultural practices. [2] Wheat: Focuses on increasing wheat production through the dissemination of advanced technologies and management practices. [3] Pulses: Aims to bridge the demand-supply gap in pulses by promoting the cultivation of pulses and ensuring remunerative prices for farmers. [4] Course Cereals: Promotes the cultivation of coarse cereals like maize, jowar, and bajra to increase overall food grain production. [5] Implementation: The NFSM operates at both the national and state levels, with specific targets set for each component. It encourages the adoption of improved seeds, water management practices, and technological interventions to boost productivity.
2. **National Horticulture Mission (NHM):** NHM emphasizes the promotion of horticultural crops, including fruits and vegetables. Increased cultivation of these crops not only adds nutritional diversity but also supports income generation for farmers.
3. **Mid-Day Meal Scheme:** While primarily an education-focused program, MDMS plays a crucial role in improving the nutritional status of school-going children. By providing a cooked meal with essential nutrients, it addresses both education and nutrition simultaneously.
4. **Rashtriya Krishi Vikas Yojana (RKVY):** The Rashtriya Krishi Vikas Yojana (RKVY) is a centrally sponsored scheme that aims to provide holistic development to the agriculture sector by encouraging states to draw up their plans for agriculture and allied sectors. The key components are [1] Diversification: Encourages states to

diversify agriculture by promoting high-value crops, agro-processing, and allied activities. [2] Infrastructure Development: Focuses on creating and upgrading agricultural infrastructure, including irrigation facilities, rural roads, and post-harvest storage. [3] Capacity Building: Aims to enhance the skills and capabilities of farmers through training and extension services. [4] Research and Development: Supports research and development activities in agriculture to improve productivity and sustainability. [5] Implementation: RKVY provides flexibility to states to design and implement projects based on their specific agricultural needs and priorities. States are required to prepare perspective plans, which include strategies for agricultural development and diversification.

5. **Integrated Schemes on Oilseeds, Pulses, Palm oil, and Maize (ISOPOM):** The Integrated Schemes on Oilseeds, Pulses, Palm oil, and Maize (ISOPOM) is a government initiative that aims to increase the production of oilseeds, pulses, palm oil, and maize to meet domestic demand and reduce dependency on imports. The key components are [1] Oilseeds: Promotes the cultivation of oilseeds like soybean, groundnut, sunflower, and rapeseed-mustard to enhance edible oil production. [2] Pulses: Focuses on increasing the production of pulses such as gram, lentils, and peas to address protein deficiency. [3] Palm Oil: Aims to boost palm oil production by supporting cultivation and processing activities. [4] Maize: Encourages the cultivation of maize for both food and non-food purposes, including animal feed and industrial uses. [5] Implementation: ISOPOM involves a comprehensive approach to increase the productivity of target crops through the adoption of improved varieties, technologies, and agricultural practices. It also emphasizes value addition and post-harvest management.
6. **National Food Security Act (NFSA) 2013:** Is a law that provides food and nutrition security to the people of India. It covers about two-thirds of the population, who can get subsidized food grains through the Targeted Public Distribution System (TPDS). The NFSA also provides nutritional support to pregnant women, lactating mothers, and children up to 14 years of age. It also has a grievance redressal mechanism and provisions for transparency and accountability.

7. **POSHAN Abhiyaan (National Nutrition Mission):** Is India's flagship program to improve nutritional outcomes for children, pregnant women and lactating mothers. The program aims to ensure service-delivery and interventions by use of technology, behavioral change through convergence and lays down specific targets to be achieved across different monitoring parameters over the next few years. Launched by the Prime Minister on the occasion of the International Women's Day on 8th March 2018 from Jhunjhunu in Rajasthan, the POSHAN (Prime Minister's Overarching Scheme for Holistic Nutrition).
8. **Integrated Child Development Services (ICDS) Scheme:** Launched on 2nd October 1975, the ICDS scheme is the world's largest community-based program. The scheme is targeted at children up to the age of 6 years, pregnant and lactating mothers and women 16–44 years of age. The scheme is aimed to improve the health, nutrition and education (KAP) of the target community. The programs need more monitoring, evaluation, budget, expenditure, convergence, and coordination to address the challenges of maternal and child nutrition.
9. **Public Distribution System (PDS) and Nutritional Support:** The Public Distribution System (PDS) implemented by the Ministry of Consumer Affairs, Food, and Public Distribution is a program that aims to provide subsidized food grains to needy people. It covers commodities such as wheat, rice, sugar, and kerosene, and some states also distribute pulses, edible oils, iodized salt, spices, etc. through the PDS outlets. The PDS is operated by the central and state governments on decentralized levels.
10. **Promotion of Nutrient-Rich Indigenous Foods:** Indigenous foods provide essential nutrients that may be lacking in conventional foods. They can also offer variety and flavor to the local cuisine and enhance the cultural identity and food sovereignty of the indigenous communities. Furthermore, indigenous foods can support the agro ecological farming practices that preserve natural resources and ecosystems. Therefore, indigenous and nutritious foods should be valued and promoted as part of the global efforts to improve human and environmental health.
11. **New National Health Policy, 2017:** The new National Health Policy of the country was approved by the Cabinet on 15th March 2017, after a gap of 15 years. The Policy

seeks to advance the agenda of Universal Health Coverage through affordable and accessible healthcare for all through provision of a larger package of assured comprehensive primary healthcare through the Health and Wellness Centers (HWCs). One major commitment of the Policy is to raise the public health expenditure progressively to 2.5% of the GDP by 2025.

Agriculture Extension and Communication Approaches:

Farmers' Training Programme: Conducting regular training programs for farmers on modern and sustainable agricultural practices enhances their knowledge and skills. Extension services educate farmers on the importance of balanced nutrition in crops and livestock, contributing to improved food quality.

Demonstration Farm: Establishing demonstration farms showcases best practices in agriculture. Farmers can observe and learn about innovative techniques for nutrient management, crop rotation, and sustainable farming methods, fostering the adoption of improved nutritional practices.

Mobile based Agricultural Advisory Services: Leveraging technology, mobile-based platforms disseminate real-time information to farmers. This includes weather forecasts, market prices, and expert advice on crop and soil management, empowering farmers to make informed decisions that positively impact nutritional outcomes.

Community Radio and Audio-Visual Aids: Utilizing community radio programs and audio-visual aids helps in reaching remote areas where literacy levels might be lower. These mediums effectively communicate information on nutrition-sensitive agriculture, promoting dietary diversity.

In conclusion, the integration of GOI schemes with effective agriculture extension and communication approaches is vital for strengthening the nutritional status of the population.

By promoting sustainable and diversified agricultural practices, these initiatives contribute to both food security and improved dietary quality, ensuring a healthier and more resilient nation.

Exploring Big Data for Better Analytics in Nutrient-Sensitive Agriculture

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Introduction:

In the rapidly evolving landscape of agriculture, the integration of technology has become crucial for optimizing farming practices. Nutrient-sensitive agriculture, which focuses on tailored nutrient management, can benefit immensely from the insights provided by Big Data analytics. This article delves into the fundamentals of Big Data, its Six Vs, sources, and the sheer volume of data generated daily. Furthermore, we explore the applications of Big Data in agriculture, with a specific focus on nutri-sensitive agriculture, culminating in a comprehensive conclusion and recommendations.

1. What is Big Data?

Big Data refers to vast and complex datasets that exceed the processing capabilities of traditional databases and tools. It encompasses three primary dimensions: volume, velocity, and variety. These large datasets hold valuable information that, when analysed, can reveal patterns, trends, and insights that are otherwise difficult to discern.

2. Six Vs of Big Data:

The Six Vs of Big Data—Volume, Velocity, Variety, Veracity, Value, and Vulnerability—comprehensively define the characteristics of large datasets.







- Volume: Refers to the sheer size of the data, often measured in petabytes or Exabyte's.

- Velocity: Represents the speed at which data is generated, processed, and analysed in real-time.
- Variety: Encompasses the diverse types of data, including structured, semi-structured, and unstructured data.
- Veracity: Pertains to the reliability and accuracy of the data, ensuring that insights drawn are trustworthy.
- Value: Emphasizes the importance of extracting meaningful insights and value from the data.
- Vulnerability: Addresses the need to secure and protect data from potential threats.

Understanding these Vs is crucial for effectively managing and leveraging Big Data in various domains, including agriculture.

The six Vs of big data

Big data is a collection of data from various sources, often characterized by what's become known as the 3Vs: *volume, variety and velocity*. Over time, other Vs have been added to descriptions of big data:

VOLUME	VARIETY	VELOCITY	VERACITY	VALUE	VARIABILITY
The amount of data from myriad sources.	The types of data: structured, semi-structured, unstructured.	The speed at which big data is generated.	The degree to which big data can be trusted.	The business value of the data collected.	The ways in which the big data can be used and formatted.
					

3. Sources of Big Data:

Big Data in agriculture is sourced from a multitude of channels:

Satellite Imagery: Provides valuable insights into crop health, soil conditions, and weather patterns.

Sensors and IoT Devices: Collect real-time data on soil moisture, temperature, and crop health.

Climate Data: Includes historical and real-time weather data.

Market Trends: Information on market demands, prices, and consumer preferences.

Crop Genetics and Characteristics: Genetic data to enhance crop resilience and productivity.

4. How Much Data is generated per day?

The volume of data generated daily is staggering. As of now, it is estimated that the world generates around 2.5 quintillion bytes of data each day. This exponential growth necessitates advanced tools and technologies for effective processing and analysis.

5. What to Do with Big Data?

The potential of Big Data lies in its analysis. To derive actionable insights, organizations employ advanced analytics, machine learning, and artificial intelligence. In agriculture, these insights can inform decision-making, optimize resource allocation, and enhance overall efficiency.

6. Use of Big Data in Agriculture:

In agriculture, Big Data has revolutionized traditional farming practices:

Precision Farming: Utilizes real-time data to optimize planting, irrigation, and nutrient application, minimizing waste and maximizing yield.

Supply Chain Optimization: Enhances efficiency in the agricultural supply chain, reducing post-harvest losses and ensuring timely delivery of produce.

Predictive Modelling: Anticipates crop diseases, pests, and optimal harvesting times, improving overall crop management.

Market Intelligence: Analyses market trends, helping farmers make informed decisions on crop selection and pricing strategies.

7. Application of Big Data in Nutrient-Sensitive Agriculture:

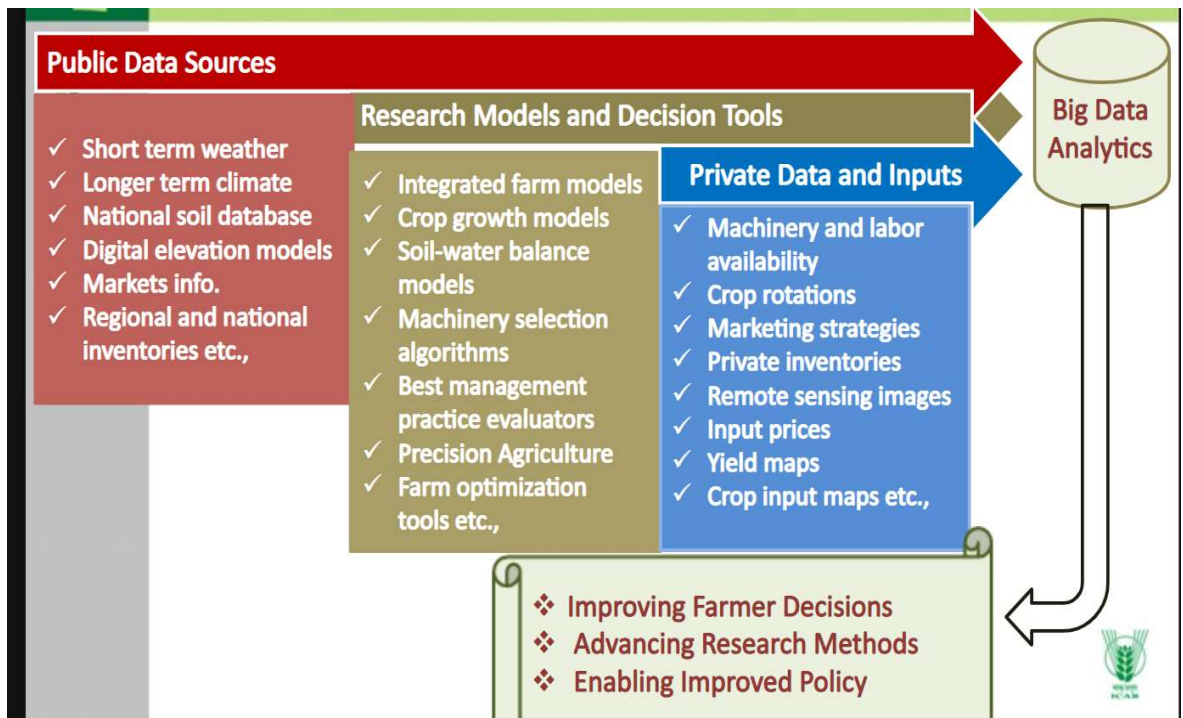
In nutri-sensitive agriculture, Big Data plays a pivotal role in fine-tuning nutrient management:

Precision Nutrient Application: Utilizes data on soil composition, weather, and crop requirements for targeted and efficient nutrient application.

Soil Health Monitoring: Analyses large datasets to assess soil health, enabling farmers to address nutrient deficiencies and promote sustainable soil practices.

Crop Rotation Strategies: Utilizes historical data to plan crop rotations that optimize nutrient utilization and reduce the risk of soil depletion.

Data-Driven Decision-Making: Empowers farmers with insights for informed decisions on fertilization, irrigation, and pest control.



8. Conclusion and Recommendations:

In conclusion, the integration of Big Data analytics in nutri-sensitive agriculture holds immense promise for the future of farming. It enables data-driven decision-making, reduces resource wastage, and enhances overall sustainability. As trainees in this field, it is imperative to develop a strong foundation in data analytics, machine learning, and agricultural sciences. Moreover, continuous learning and adaptation to emerging technologies will be essential for harnessing the full potential of Big Data in nutri-sensitive agriculture. By embracing these tools, we pave the way for a more efficient, sustainable, and resilient agricultural future.

Application of Artificial Intelligence in Agriculture

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Agricultural sustainability is the cornerstone of any economy [1]. In order to achieve long-term economic growth and structural transformation, it is imperative [2-4], although the process varies from country to country [5]. Structural transformation is a crucial component of economic development as it involves the shifting of an economy's productive structure towards higher value-added and knowledge-intensive industries. This shift promotes job creation, innovation, and productivity growth, leading to higher living standards and income per capita. Additionally, structural transformation also opens up new market opportunities, attracts foreign direct investment, and enhances competitiveness on the global stage. Traditionally, food and crop production were the only agricultural activities in the past [6]. Producing, marketing, and distributing crops and livestock products has been in focus over the past two decades. As of today, agricultural activities constitute the primary source of livelihood, contribute to economic growth [7], promote national trade, reduce unemployment, and provide raw materials for other industries [8-10]. In light of the global geometric growth of the population, agricultural practices must be re-evaluated in order to provide innovative approaches to safeguarding and

upgrading farming practices. One potential approach for upgrading farming practices through the use of artificial intelligence (AI) is the implementation of precision agriculture techniques.

What is Artificial Intelligence?

Artificial intelligence is the study of computer systems that attempt to **model** and apply the intelligence of the human mind. It is a branch of computer science that deals with the simulation of intelligent behaviour in computers. Artificial intelligence enables computers and machines to **mimic the perception, learning, problem-solving, and decision-making** capabilities of the human mind.

Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL):

Machine learning (ML) is a subset of AI that uses algorithms to learn patterns from data. Deep learning (DL) is a subset of ML that employs artificial neural networks for complex tasks. AI may or may not require large datasets; it can use predefined rules. ML heavily relies on labelled data for training and making predictions.

Overview of farming process:

The Indian economy is heavily dependent on the production of crops. In addition to providing food and raw materials, it provides employment as well. Throughout the decades, crop production has evolved into a more complex industry that encompasses marketing, processing, distribution, and after-sales services as a key component of the overall process. A lot of emphasis is being placed on crops and other primary industries in areas with a low real income per capita, thus creating environments conducive to farming. There appears to be a positive correlation between the increased crop production output and productivity of a country and its overall economic development.

Agriculture involves a lot of uncertainty and choices. Apart from the changes in the weather, there are also other factors that cause farmers' problems, such as the fluctuating price of farm materials, deteriorating soil, poor crop growth, weeds suffocating crops, pests damaging crops, and the change in the climate from one season to the next. This uncertainty is something that farmers have to cope with on a daily basis. Despite the fact that agricultural practice is a very broad term, the researchers in this study focus on the application of artificial intelligence to soil, crops, insects, and diseases as major contributors to agriculture success. A thorough

evaluation of AI applications to agriculture with respect to soil, crops, diseases, and pest management is of paramount importance.

Role of AI in Agriculture

AI enabled machines can easily mimic human intelligence as long as it is defined in such a way that it can be easily simulated and executed, ranging from the simplest to the most complex tasks. Examples of tasks that machines can easily mimic human intelligence include: speech recognition, language translation, problem-solving etc. These tasks require complex algorithms and data analysis that machines can replicate effectively.

AI can be used to analyse large amounts of data generated by sensors and IoT devices, enabling farmers to make data-driven decisions to optimize crop productivity, reduce water consumption, and minimize environmental impact. Another approach is the use of AI in robotic farming, where AI-controlled robots can assist in tasks such as planting, harvesting, and weeding, increasing efficiency and reducing labour costs. Furthermore, AI will be empowered by big data analytics, robotics, the internet of things, and drone technology, as well as having a broad coverage of the internet in dispersed fields and distributed networks. A predictive insight into which crops to plant in a given year and when to sow and harvest in a specific area can be provided by AI systems by analysing soil management data sources including temperature, weather, soil analysis, moisture, and historic crop performance. As a result, crops are more productive and water, fertilizer, and pesticide use is decreased. With the application of AI technologies, it can be possible to reduce the impact on the ecosystem and improve worker safety.

Recent application of AI in advisory services

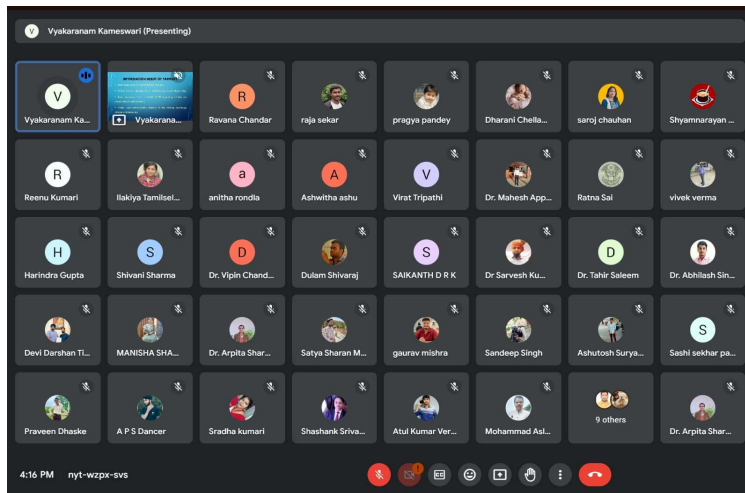
- 1. PM KISAN AI-Chatbot (Kisan e-Mitra):** The AI Chatbot acts as a comprehensive guide for the beneficiaries, providing them with timely and accurate responses to their queries related to the scheme. This is the first AI Chatbot integrated with a major flagship scheme of the Union government. It has been developed and improved with the support of the EKstep Foundation and Bhashini. The introduction of the AI chatbot in the PM-KISAN grievance management system is aimed at empowering farmers with a user-friendly and accessible platform. Currently, the Chatbot is available in English,

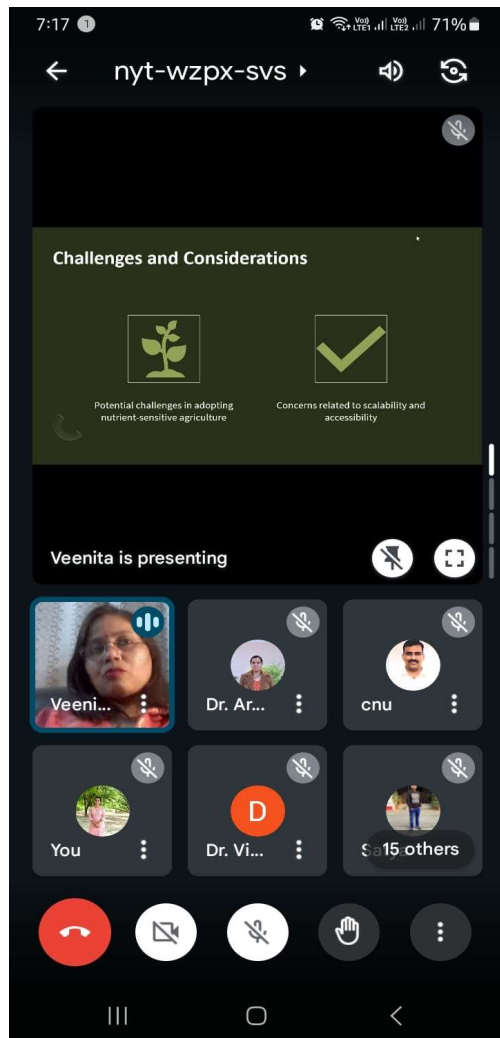
Hindi, Bengali, Odia, and Tamil. In a short period, it will be available in all 22 languages of the country (<https://chatbot.pmkisan.gov.in/Home/Index>).

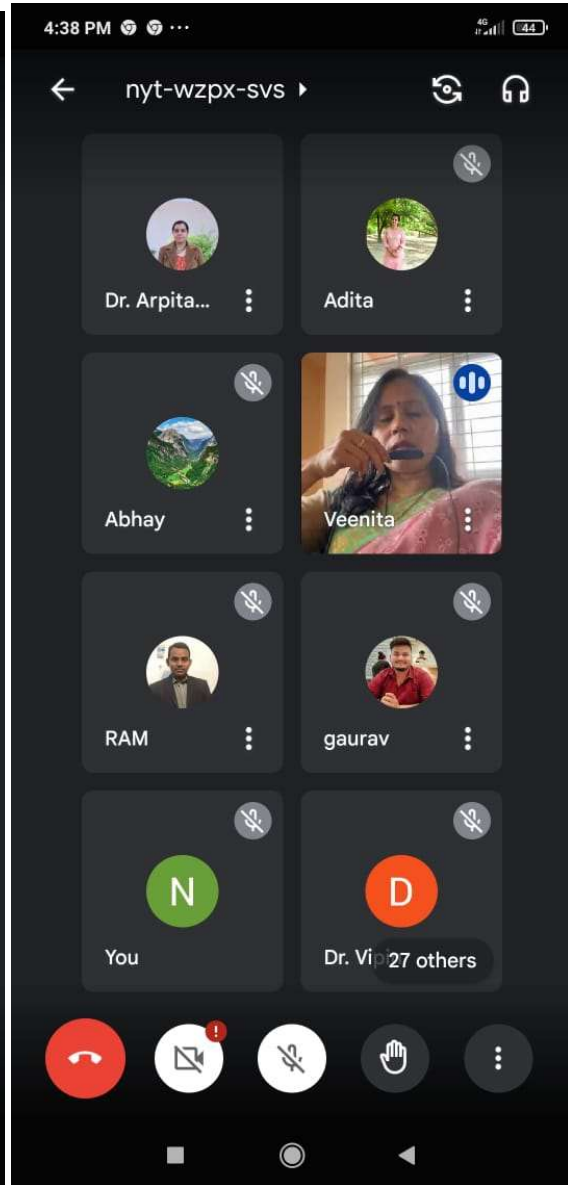
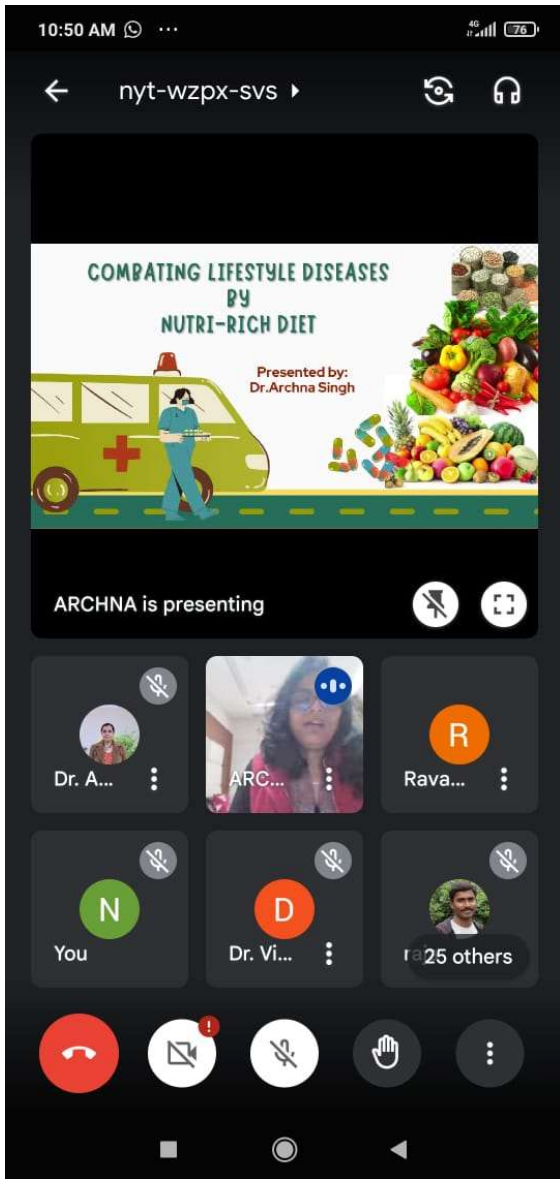
2. **Kisan AI:** Kissan AI is a multilingual AI Agriculture Assistant for Bharat (<https://kissan.ai/>).

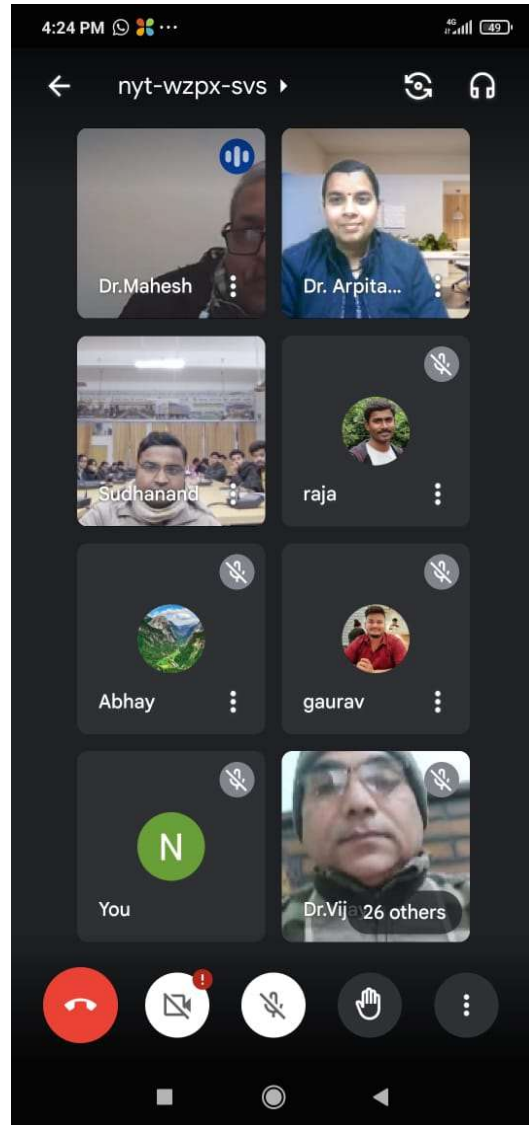
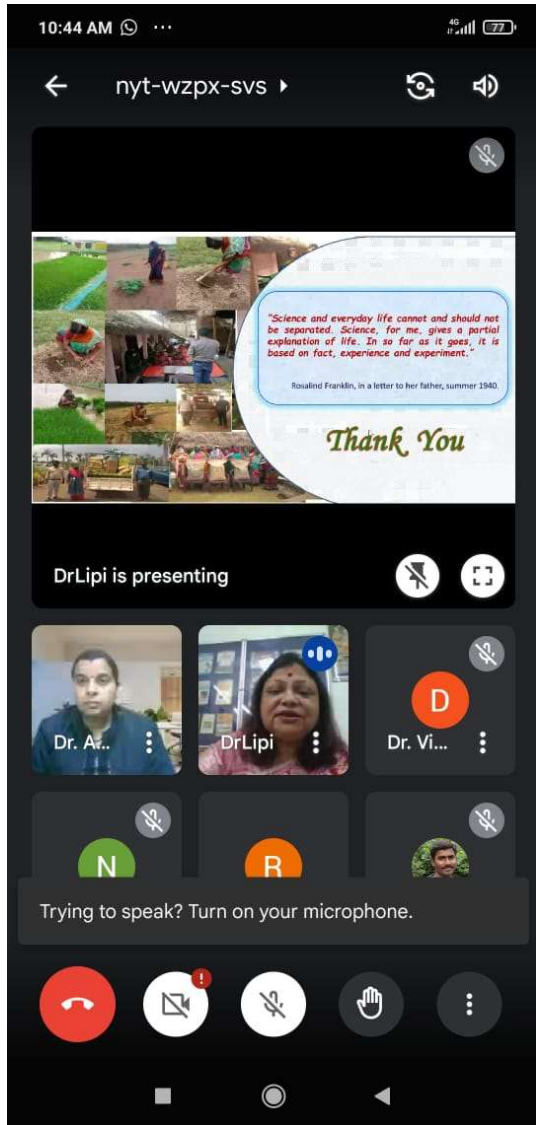
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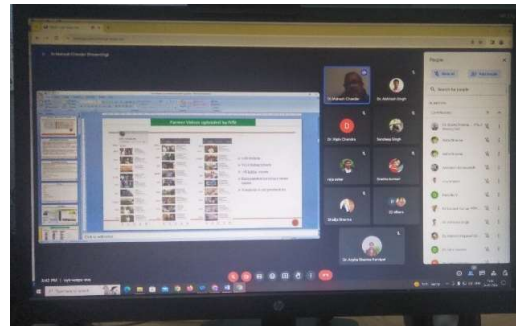
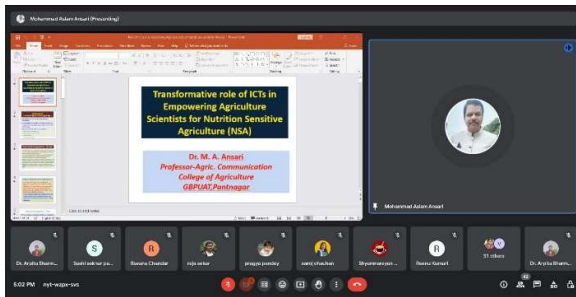
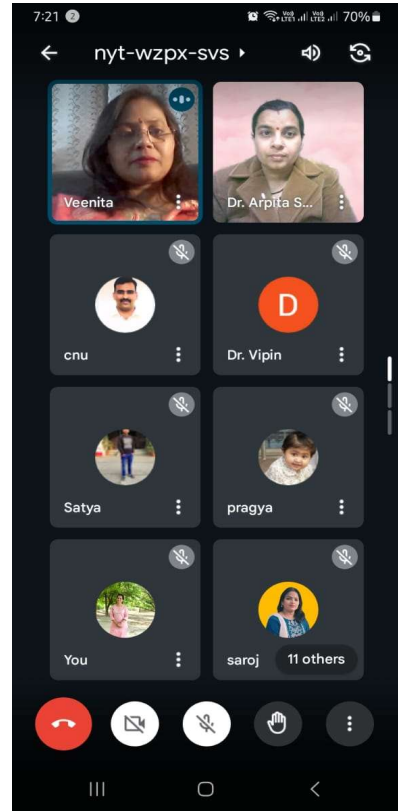
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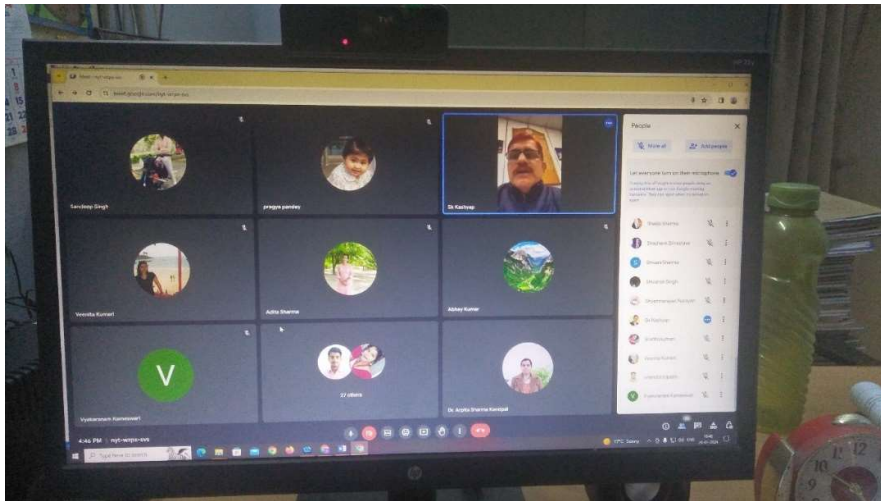












Vyakaranam Kameswari (Presenting)

INFORMATION NEEDS OF FARMERS

- Knowledge and skill level of farmers will vary.
- Find out hat the subgroups know – both tacit and explicit knowledge.
- Rural communities have a wealth of ITK regarding nutrition and consumption of nutritious food.
- Anchor your communication strategy to the existing knowledge, attitude and behaviour.

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Vyakaranam Kameswari	Ravana Chander
raja sekar	pragya pandey
Dharani Chelladurai	saroj chauhan
Shyamnarayan Narayan	Reenu Kumari
39 others	Dr. Arpita Sharma Kandpal