MANAGE Agricultural Extension "Evening4Learning (E4L)" Webinar Series

Theme: "Innovative Technologies for Advancing Agricultural Extension"

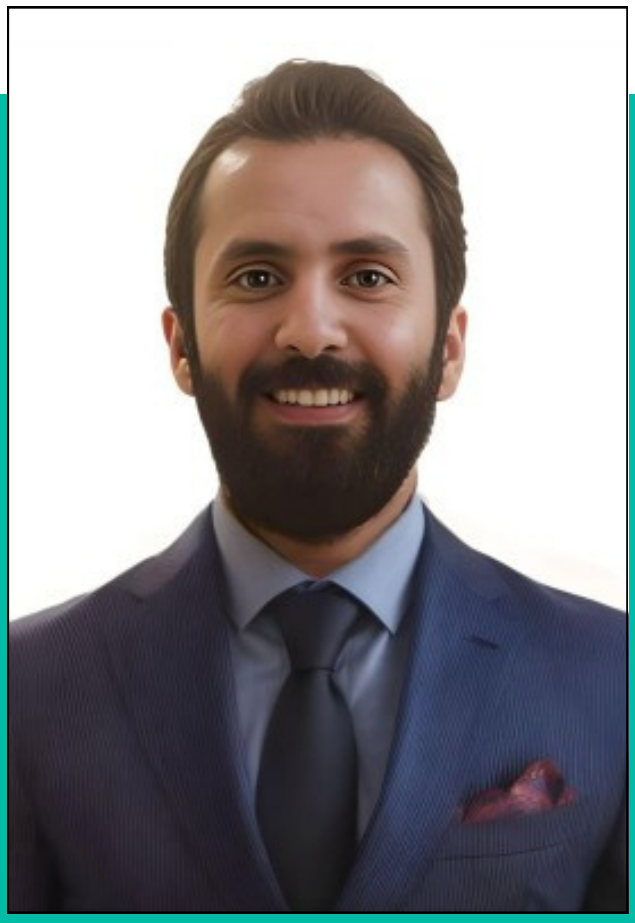
Topic: "Augmented Reality (AR) & Virtual Reality (VR) in Agricultural Extension"

Schedule:
29-12-2024, 19:00–20:30 PM

MANAGE - Center for Agricultural Extension Innovations, Reforms and Agripreneurship (MANAGE- CAEIRA)
National Institute of Agricultural Extension Management (MANAGE)
Rajendranagar, Hyderabad- 500 030, INDIA

About the Program

The MANAGE Agricultural Extension "Evening4Learning" Webinar Series is aimed at enhancing knowledge and professional engagement in the field of agricultural extension. The four day series is structured with each day focusing on a distinct topic under a common theme, allowing participants to gain comprehensive insights into key areas of extension. The programme is intended for a diverse audience, including postgraduate and doctoral students, agricultural faculty, and industry professionals. It covers broad themes ranging from entrepreneurship and sustainability to emerging technologies in agriculture.



Speaker

Mr. Hetendra Singh Rathore
Founder of Segritech
hetendra@segritech.com

Hetendra Singh Rathore

About the Speaker

Mr. Hetendra Singh Rathore is the founder of Segritech. He is an electronic engineer with seven years of startup experience and has worked with four successful ventures across artificial intelligence, educational technologies, e-commerce, and agri-tech. As an agri-tech enthusiast, he is driving innovation in agriculture through the use of AI-powered smart machines for quality inspection of fresh produce, addressing key inefficiencies in the agricultural supply chain.

Background

Agricultural extension is undergoing rapid transformation due to the integration of emerging digital technologies. Innovations such as Augmented Reality (AR) and Virtual Reality (VR) are increasingly being explored to address persistent challenges in agriculture related to productivity, resource efficiency, knowledge dissemination, and farmer capacity building. These technologies have the potential to significantly transform agricultural extension by making advisory services more interactive, precise, and accessible. When effectively integrated with extension systems, AR and VR can bridge knowledge gaps, improve decision-making, and enhance farmer livelihoods.

Augmented Reality (AR)

Augmented Reality refers to the integration of digital content with real-world environments through devices such as smartphones, tablets, or AR-enabled glasses. AR allows users to overlay information, images, or models onto physical objects in real time.

Examples include:

- Visualizing crop health conditions through mobile camera inputs
- Overlaying pest or disease information on live crop images
- Farm layout visualization and equipment guidance

Virtual Reality (VR)

Virtual Reality creates a fully immersive digital environment, enabling users to interact with a simulated world using VR headsets and motion controllers. VR provides experiential learning by simulating real-life scenarios.

Examples include:

- Virtual farm visits and exposure to global best practices
- Training simulations for machinery operation
- Pest and disease lifecycle simulation

Critical challenges in agriculture addressed through immersive technologies

- Lack of real-time data for crop health
- Inefficient resource management (water, fertilizers, pesticides)
- Pest and disease identification challenges
- Limited access to modern farming techniques and training
- High machinery downtime due to maintenance issues
- Inefficient farm layout and irrigation planning
- Difficulty in accessing with global markets and understanding quality standards
- Challenges in remote monitoring of large-scale farms
- Lack of visualization tools for precision agriculture
- Knowledge gaps in using advanced agricultural equipment

Applications of AR and VR in Agriculture

Augmented Reality (AR) Applications

1. **Real-time crop monitoring:** Displays crop health information such as soil quality, moisture levels, and pest infestation directly on the farmer's field view using a mobile phone or device.
2. **Precision farming:** Helps identify exact areas requiring fertilizers, pesticides, or irrigation, reducing wastage and improving efficiency.
3. **Equipment maintenance:** AR-based guides provide step-by-step instructions for machine repair and maintenance, reducing downtime.
4. **Weather and market updates:** Displays real-time weather forecasts and market prices to support informed farming and marketing decisions.
5. **Supply chain tracking:** Tracks produce from farm to market by displaying origin, quality checks, and transportation status.

Virtual Reality (VR) Applications

1. **Virtual training:** Enables farmers to learn new farming techniques, machinery operation, and pest management methods through immersive experiences.
2. **Farm layout planning:** Allows planning of farm layouts, greenhouse structures, and irrigation systems in a virtual environment before field implementation.
3. **Pest and disease simulations:** Provides a safe, risk-free environment to practice pests and diseases identification and management.
4. **Market access:** VR-based virtual exhibitions enable farmers to showcase produce and improve market linkages.
5. **Remote farm management:** Enables monitoring and management of large or multiple farm locations remotely, improving efficiency and decision-making.

Challenges in Implementation

Despite the potential benefits, several challenges were identified:

- Limited internet connectivity in rural and remote areas
- High cost and limited availability of VR hardware
- Low levels of digital literacy and awareness among farmers
- Resistance to adopting new technologies
- Limited availability of localized agricultural data
- Hardware limitations, including graphics processing constraints

Possible Solutions and Way Forward

To enhance adoption of AR and VR technologies in agriculture, the following measures were suggested:

- Development of offline and edge-based AR/VR solutions
- Promotion of affordable and farmer-friendly hardware
- Government subsidies and policy support
- Strengthening awareness campaigns and training programs through KVKs and extension institutions
- Integration of AR/VR modules into capacity-building initiatives
- Encouraging public–private partnerships for technology development

Key Highlights

1. AR and VR technologies offer innovative, immersive solutions to address major challenges in agricultural extension, including crop monitoring, resource management, pest control, and farmer training.

2. These technologies enhance learning and decision-making by enabling real-time visualization, virtual training, farm planning, and simulation of crop growth, pests, and diseases.

3. AR and VR applications can support farmers, FPOs, and extension systems across the entire value chain from production and post-harvest management to market linkage and global buyer connectivity.

4. Despite strong potential, adoption faces challenges such as limited rural connectivity, high hardware costs, low digital literacy, and lack of localized data.

5. With affordable technologies, government support, capacity building through KVKs, and public–private partnerships, AR and VR can significantly strengthen agricultural extension and improve farmer livelihoods.

Interactive session

1. Can AR and VR be used in agriculture for method demonstrations, such as showing how to prepare Jeevamruth and Beejamruth for natural farming?

Yes, definitely. AR and VR can be effectively used for method demonstrations in agriculture. These technologies can help create small, interactive modules that visually demonstrate step-by-step processes, such as the preparation of Jeevamruth and Beejamruth for natural farming. Using AR and VR, farmers and researchers can learn these methods in a digital environment without the need for costly, high-end physical equipment. Such virtual demonstrations make learning more accessible, affordable, and easy to understand.

In addition, AR and VR can be used to simulate agricultural research activities, including disease detection and crop treatment methods. These simulations allow users to observe outcomes and practices in a risk-free and controlled virtual setting, making them highly valuable for the farming community as well as agricultural research and extension systems.

2. How can AR and VR technologies be implemented at the field level for small and marginal farmers, and how can they be encouraged to explore and adopt these methods?

AR and VR technologies can be introduced to small and marginal farmers through simple mobile-based applications, such as crop monitoring tools where farmers upload leaf images to identify pests and diseases in real time. Although challenges such as limited smartphone access, low digital literacy, and lack of trust exist in villages, adoption is gradually improving due to better connectivity and government subsidies. Awareness and trust can be built through Krishi Vigyan Kendras (KVKs), extension workers, FPOs, and village-level meetings, supported by demonstrations, CSR initiatives, and government programmes. As farmers observe practical benefits and peer success, acceptance of these technologies is likely to increase.

3. How can AR and VR technologies support small and marginal farmers in India, considering the high cost of these technologies?

AR and VR technologies can support small and marginal farmers in India by enabling low-cost, mobile-based applications that focus on digital planning and visualization of farm activities such as crop layout, irrigation design, and resource utilization. By allowing farmers to simulate decisions digitally before actual implementation, these tools help reduce financial risks and prevent losses caused by poor real-time planning. Although initial solutions may offer moderate accuracy, they still provide good value by improving decision-making efficiency. As farmers experience tangible benefits, trust in these technologies gradually increases, leading to wider adoption through phased and affordable implementation.

4. How can AR and VR technologies enhance the learning experience for farmers in agricultural extension programmes?

AR and VR technologies enhance farmer learning by providing immersive and interactive experiences. In conventional webinars or classroom sessions, interaction is often limited to listening and asking questions. However, VR enables farmers to actively participate by seeing, moving, and interacting with virtual objects.

For example, through VR, farmers can:

- Practice farm operations in a virtual environment
- Learn machinery handling, pest management, or crop practices by doing rather than only listening
- Experience simulations similar to virtual science laboratories, such as observing crop growth stages or pest behaviour

This immersive learning approach increases engagement, understanding, and knowledge retention, and allows farmers to learn effectively from anywhere without physically visiting training centres or fields.

5. Are there any AR or VR-based initiatives that digitally show agricultural post-harvest processing units—such as ketchup manufacturing or dairy and milk product processing? Also, is there scope for using such technologies to give farmers and youth practical exposure to agriculture?

At present, there are very limited examples of AR and VR technologies being used specifically to digitally showcase agricultural post-harvest processing units in India. While similar immersive technologies are commonly used in sectors such as medical science and industrial training, their application in agricultural processing and awareness-building is still at a nascent stage.

However, there is strong future potential for using AR and VR to create virtual demonstrations of post-harvest processing units for farmers, students, and children. These technologies can also help address the challenge faced by urban children who lack on-ground exposure to farming. Although only a few institutions or training programs currently offer such experiences, there is considerable scope to develop dedicated AR/VR-based agricultural learning modules and training centers. Such initiatives can help farmers and youth understand agriculture better, build interest in farming, and encourage innovative agricultural solutions in the long term.

6. Is there any special application available for Farmer Producer Organizations (FPOs) that provides end-to-end support?

Yes. Specialized digital applications are available for FPOs that provide end-to-end support across the agricultural value chain. These include post-harvest management, crop advisory and pest management services, sorting and grading as per quality standards, market linkage, and connectivity with global buyers. Such platforms help FPOs improve production efficiency, reduce post-harvest losses, ensure quality compliance, and access better domestic and international markets.

7. Is AR/VR technology applicable to protected structure farming as well as open field conditions? Can it be effectively used in large-scale open farms?

Yes, AR and VR technologies are applicable to both protected structure farming (such as greenhouses and polyhouses) and open field conditions. These technologies are especially useful for large-scale farms, as they support farm planning, monitoring, management, and detection of crop conditions.

For example, in crops such as oranges, traders or FPOs usually visit multiple farms to inspect plants and assess fruit quality before making purchase decisions. This process is time-consuming and labour-intensive. By using technologies such as cameras, drones, and AR/VR-based visualization, the same assessment can be conducted remotely. Farm conditions and crop quality can be monitored from a central location, allowing users to view multiple farms, track crop status, estimate produce, and generate reports without physically visiting each field. Such solutions are currently under development and are expected to be available in the near future.

YouTube link: https://youtu.be/JTfcGiqKiuc

E4L Report Prepared by:
Dr. Vavilala Priyanka,
MANAGE Fellow