

## ICT-Based Extension Services for Sustainable Agriculture

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## INTRODUCTION

There are various issues affecting agriculture such as climate change, depletion of soil fertility, water shortage, occurrence of pests, and fluctuation in market prices. Traditional methods of agricultural extension include farm visits, demonstration, and training programs that usually cover very little area. ICT has been found to be a viable solution where farmers receive information regarding their area in time through ICT applications. ICT in agricultural extension is helpful in enhancing communication between scientists, extensionists, and farmers.

The use of ICT has revolutionized the agricultural extension system through the provision of timely transfer of knowledge, improved availability of information, and sustainable farming practices. Though the traditional extension systems are very effective in various parts of the world, there exist certain limitations like lack of proper manpower, delay in information transmission, and poor accessibility in far-off places. ICT based extension services fill up the gap that exists through the use of ICT tools and methods like internet, mobile applications, remote sensing, artificial intelligence, IoT, social media, and decision support system. ICT tools help in providing real-time advice on crop production, weather forecast, pest and diseases, market information, and conservation of resources. With the use of ICT along with sustainable agriculture practices, farmers can optimize the use of their resources, maximize productivity, conserve natural resources, and mitigate risks associated with climate change.



## 2. Concept of ICT in Agricultural Extension

Information and Communication Technology (ICT) is a technology that deals with the use of digital technology in acquiring, processing, storing, and transmitting information. In agricultural extension, ICT blends the communication technology of today with the conventional advisory system in order to offer faster, accurate, and easily accessible information to farmers.

## 3. Objectives of ICT-Based Extension Services

The objectives of ICT-based agricultural extension services include provision of timely agricultural information, access to scientific agricultural practices, communication facilitation, sustainable resources management, climate-smart agriculture, market accessibility, improved farmers' decision-making, and reduction of production risks through early warning systems.

The major objectives include:

- Deliver timely agricultural information to farmers.
- Improve access to scientific farming practices.
- Enhance communication between researchers, extension workers, and farmers.
- Promote sustainable management of soil, water, and biodiversity.
- Support climate-smart agricultural practices.
- Improve farm profitability and market access.
- Strengthen farmers' decision-making capacity.
- Reduce production risks through early warning systems.

## 4. Important ICT Tools in Agricultural Extension

### 4.1 Mobile Phone & Smart Phones

Smartphones contain weather predictions, crop advice, pest warnings, market prices, irrigation schedules, and information about government schemes.

### 4.2 Mobile Application

Applications for agriculture help with crop production advice, fertilizer advice, pests advice, irrigation scheduling, and managing records on farms.

#### Major Functions

- Weather advisory
- Pest and disease alerts
- Crop management
- Market information
- Government scheme updates

### 4.3 Internet & Web Portals

The web portal has technical information, publications of research, online training, market information, and advisory services in digital form.

### 4.4 Social Media Sites

Sites like WhatsApp, Facebook, YouTube, Telegram, and X help in sharing knowledge, showing video demonstrations, discussing among farmers, and training online.

### 4.5 Artificial Intelligence (AI)

Artificial intelligence helps in diagnosing diseases, predicting yields, giving fertilizer advice, pest forecasting, and precision irrigation.

### 4.6 Internet of Things (IoT)

IoT devices measure soil moisture content, weather patterns, irrigation, greenhouse climate, and livestock.

### 4.7 Remote Sensing and GIS

Remote sensing and GIS technology helps in monitoring crops' growth, droughts, lack of nutrients, and land use change for precision agriculture.

### 4.8 Drone Technology

Drones are employed in monitoring crops, spraying pesticides, fertilization, assessing plant health, and estimating the yield.

## 5. ICT Uses in Sustainable Agriculture

ICT contributes to climate-smart agriculture through weather forecasts and climate advisories. ICT technology is used to practice precision agriculture through effective

utilization of fertilizers, pesticides, and irrigation. The digital technology enhances pest management, water management, monitoring of soil quality, and market information system in agriculture production.

## 6. Advantages of ICT Extension Services

ICT extension services ensure higher crop yields, lower costs of production, greater market access, and increased earnings for farmers. The service ensures efficient usage of fertilizers and water, reduction in the usage of pesticides, helps in environmental conservation, empowerment of farmers with better access to information, and makes agricultural extension services more efficient.

### Economic Benefits

- Increased farm productivity
- Reduced production costs
- Improved market access
- Higher farmer income

### Environmental Benefits

- Efficient use of fertilizers
- Water conservation
- Reduced pesticide use
- Lower greenhouse gas emissions

### Social Benefits

- Better farmer education
- Women's empowerment
- Youth engagement
- Faster technology adoption

### Institutional Benefits

- Improved extension efficiency
- Better monitoring and evaluation
- Wider outreach
- Lower extension costs

## 7. Challenges

Some of the challenges include lack of internet connectivity, digital illiteracy, expensive smart devices, language barriers, limited localization of content, lack of digital infrastructure, privacy

issues related to data, and scarcity of skilled extension workers.

## 8. Strategies for ICT Extension Services

The strategies required to make ICT-based extension more effective involve enhancing rural internet connectivity, creating multi-lingual advisory platforms, increasing digital literacy, encouraging public-private partnership, usage of AI and IoT technology, development of FPOs, and increased collaboration between research organizations and extension services.

## 9. Future Prospects

Future prospects of ICT-based agricultural extension depend on implementation of new emerging technologies like Artificial Intelligence, Big Data Analytics, Blockchain, Cloud Computing, Robotics, Digital Twins, and 5G communication networks. These technologies would allow providing personal advisory services, predictive analytics, automated farm management, and traceable agricultural value chains.

The introduction of smart villages using ICT-based digital agriculture is considered as a tool for sustainable rural development. ICT plays an important role in the achievement of SDGs, namely Zero Hunger (SDG 2), Climate Action (SDG 13), and Responsible Consumption and Production (SDG 12).

## CONCLUSION

ICT-based extension services can be viewed as a completely new paradigm of agricultural knowledge dissemination through the use of digital technologies and traditional extension systems in order to provide up-to-date and scientifically sound advice to farmers to promote sustainable agriculture development. Utilization of mobile technologies, artificial intelligence, IoT, remote sensing, drones, and digital advisory services makes it possible to enhance productivity without destroying natural resources. Despite some challenges

related to digital illiteracy and lack of proper infrastructure, rapid technological innovations and supportive government policies accelerate the digital revolution in agriculture.

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