

ITU webinar - Digital transformation for cities and communities

Episode 14: Accelerating agricultural digital transformation through AI and IoT

Session 1: Digital Agriculture and Sustainable Food Systems: Trends and Opportunities

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Need of Digital transformation in Agriculture

- The United Nations (UN) estimates that around 68% of the world population (expected to be around 9.7 billion) will live in urban areas by 2050.
 - There will be massive urbanisation.
 - Land area for agriculture will reduce.
- New innovative techniques will be required to increase the agriculture production for such a large population.
- Technologies should be cheaper to have large scale adoption
- Key technologies for Digital transformation – IoT, ICT, AI/ ML, Cloud computing etc.

The role of IoT and ICT in various applications in rural areas



Source: ITU

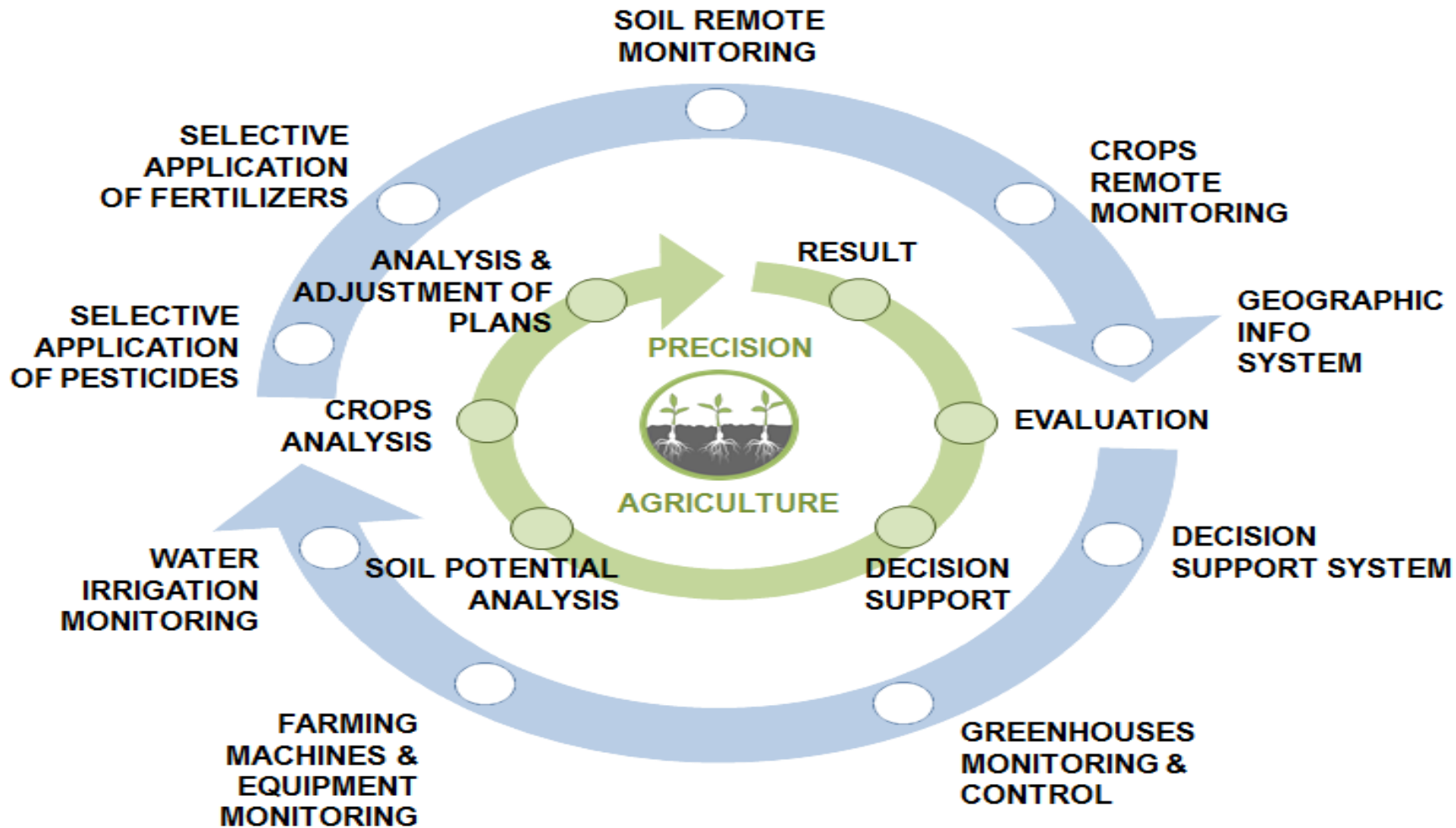
Expected smart services in various verticals in rural communities

S. No.	Vertical	Smart Applications
1	Agricultura	Smart irrigation, livestock monitoring, weather monitoring and forecasting, sensor based precision agriculture, remote crop monitoring, remote monitoring of soil quality, smart warehousing, logistics and distribution, remotely controlled irrigation pump
2	Food processing	Production & Storage, better food safety, wastage reduction
3	Aquaculture	Water quality (dissolved oxygen, ammonia, pH, etc.) management, intelligent feeding, aquatic animal health management
4	Animal Husbandry	Animal tracking, remotely monitoring the health of an animal using wearable health devices
5	Health Care	Remote monitoring of a patient after surgery (e-health), remote diagnostics, medication reminders, Tele-medicine, wearable health devices, e-ICU

Advantages of using IoT / ICT in agriculture

- Water management can be efficiently done using IoT to reduce the water waste.
- Soil management such as measuring pH level, moisture content, nutrients etc. can be done by using IoT sensors so that farmers can plant seeds according to soil quality.
- Crop monitoring can be done to observe the growth of crops and also to recognize the diseases occurred in plants and crops.
- Crop sales will be increased in the global market. The farmer can be connected to the global market without the restriction of any geographical area.
- Drones with sprayer may be used to handle locust attack e.g. such locust attack incident has already been managed in Rajasthan, India in 2020. Edge Computing may help in creating intelligence at the drone level which may improve the efficiency of the system in decision making.

Precision Agriculture



In the past, precision agriculture was limited to larger operations which could support the ICT infrastructure and other technology resources.

Now a days, mobile applications, smart devices, drones and cloud computing makes precision agriculture possible for farming cooperatives and even small family farms

Major challenges in technology implementation for Smart Agriculture



Source: IEEE

Challenges to be addresses for the development of Smart rural community

- Lack of adequate infrastructure like electricity, communication/internet facility, health care, education etc. in rural areas.
- Digital divide: there is a urban–rural digital divide. It is due to non availability/poor access of telecom and internet services in the rural areas. A lot of work has been done but more is required to be done.
 - An individual living below poverty line cannot afford a computer/smart phone to harness the benefits of e-governance and other online services. As the digital divide narrows, broader adoption of e-governance in the public domain becomes possible.
 - Economic poverty is not the only cause of digital divide. This can also be caused by the lack of awareness among the people.
- Majority of population in rural areas depends on agriculture, animal husbandry, fisheries, dairies etc. to earn their livelihood. Income of the rural households needs to be increased.
- Language Dominance

The dominance of English language over the internet limits the access of non-English speaking population. Smart phones as well as the content in local language will help the use of electronic media and smart services.

Technologies for smart agriculture solutions include

- Wide coverage for mobility for end-user, technician apps for data reporting, workflow automation.
- IoT devices with edge computing facility at the gateway router
- AI/ML for vision-based analysis of camera feeds from drones.
- Cloud for IoT devices data management and analytics at the application platforms.

IoT/ICT requirements in rural communities – 1/3

1. High-speed communication network, preferably optical fibre network, to provide at least 100 Mbps in a village, for a cluster of villages, generally 2 – 3 villages. This bandwidth may be required to further increase to 1 Gbps/10 Gbps in future.
2. To provide services to the rural community at the door step, it is required to further extend the connectivity in the village or nearby villages using Wi-Fi hotspots.
3. The connectivity may be further extended to the nearby villages which are not accessible through OFC (optical fibre cable) by radio link.
4. The connectivity to hilly and remote areas may be provided using satellite links.
5. It is required to further extend the bandwidth to other location by laying OFC by telecom service providers for commissioning new mobile towers (BTS) to provide mobile coverage in the rural area.

IoT/ICT requirements in rural communities – 2/3

6. Sharing of passive/active infrastructure, and also the unused spectrum in the rural areas is recommended, which will help in reducing the overall cost of the project.
7. It is recommended that one infrastructure provider install the infrastructure such as tower of 20/40/60-meter height (as per requirement), diesel generators set, battery set, and container, etc. which may be used by telecom service providers/LPWAN providers. Cost effective solar panels capable of replacing electric generators may be a solution for fast expansion of mobile network in rural area.
8. Towers and the bandwidth be also used by FM broadcasters for transmitting regional programmes. Besides entertainment, FM channels may play important role in spreading important news such as cyclone/ heavy rains weather forecast etc., to alert the people and civil agencies for moving to safer areas. It may save thousands of lives during such pandemics.
9. Role of equipment manufacturer is also very important. Due to poor electricity condition, poor condition of roads and distant location of petrol pumps in rural areas, it is quite difficult and expensive to run the rural BTS with even 90% availability. For those reasons, it is recommended that low power BTS & Transmission equipment are used to reduce the overall power consumption.

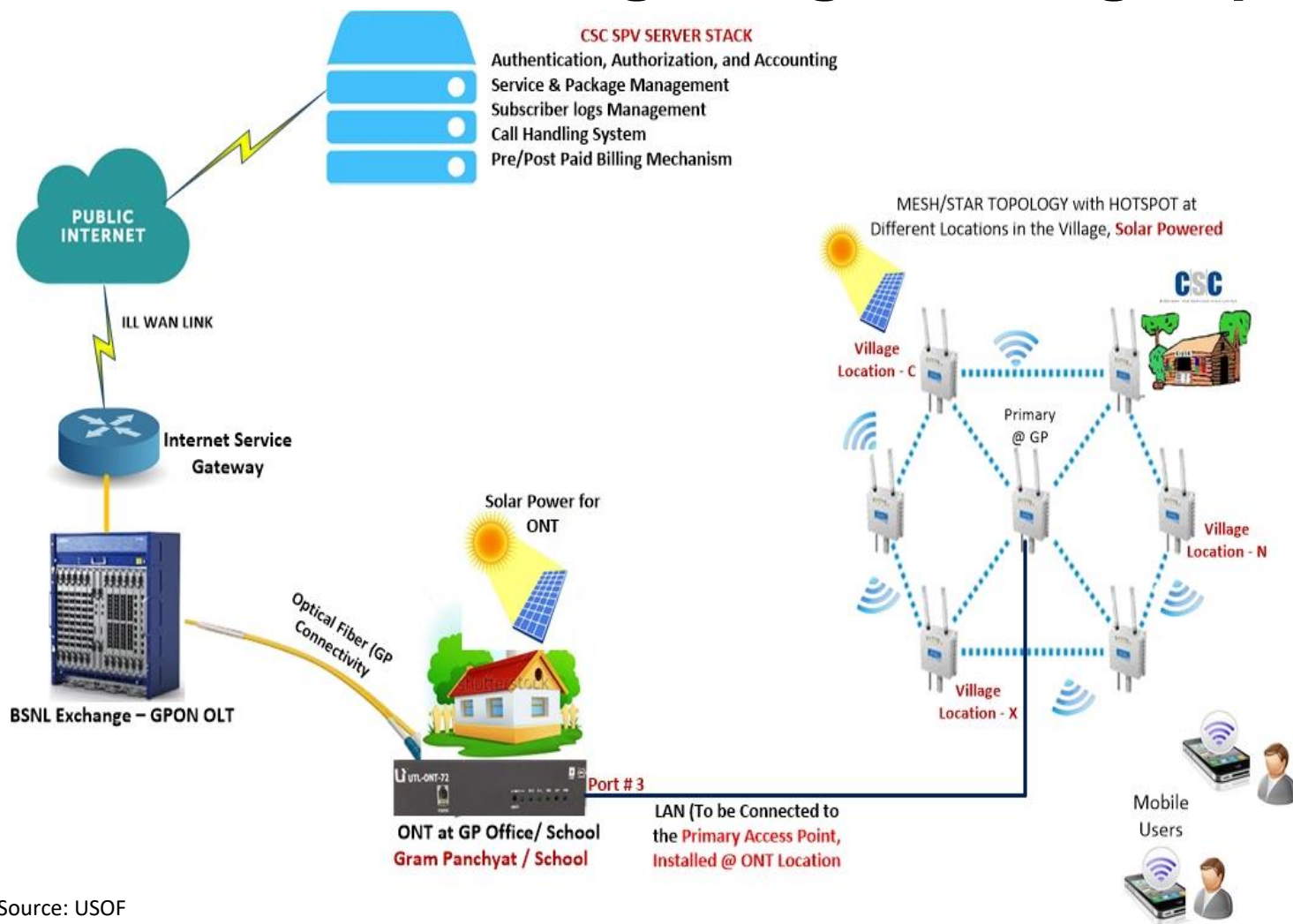
IoT/ICT requirements in rural communities – 3/3

10. Smart phones/Tablets/Laptops may be out of the budget of the economically poor households. Low cost devices with minimum features such as Wi-Fi, Bluetooth, cellular connectivity and long battery life are required to accelerate the use of technology in various applications in rural areas.
11. An eco-system may be created for the research & development of sensor based connected devices (IoT devices) to harness the advantages of using IoT in agriculture, fisheries, animal husbandry, healthcare etc. Indigenous manufacturing of such devices will make them affordable for deployment in rural areas.
12. Smart City platforms should be able to manage the emergency health services to the public of city as well as rural areas by analysing data from the connected healthcare devices as well as respond to the calls of the public, especially in a pandemic situation.

Connecting villages on high speed network in India- case study

- Government of India created a special purpose vehicle, named Bharat Broadband Network Limited (BBNL) in 2011 for accelerating the National optical fibre network project (NOFN) for providing 100 Mbps connectivity to 0.25 million gram panchayats (GPs)/ village Panchayat (cluster of 2-3 villages). It is presently known as Bharatnet.
- Around 0.18 million gram panchayats have already been connected on OFC.
- Internet facility is being extended through Wi-Fi hotspots.
- Telecom service providers / LPWAN providers are using the OFC connectivity to further extending the services.,
- To proliferate Broadband access through Public Wi-Fi networks, Department of Telecom (DoT) released a Framework and Guidelines for Wi-Fi Access Network Interface named as PM-WANI.

Connecting villages on high speed network in India



- The aim is to improve the backbone network for telecom & ICT services in the rural area, by providing services such as voice, video and data.
- Applications such as e-Agriculture, e-Commerce, e-Banking, e-Governance, e-Education and Tele-medicine etc. which require high speed Internet connectivity may be provided.

Source: USOF

Pics of Rural India using Internet services



Community service center in a village



Farmers using internet facility

Other important Smart services for rural communities

Healthcare

Smart devices like Thermometer, SPO2 meter, portable ECG machines with Bluetooth connectivity may be used to monitor the patients remotely by the doctors as there may be shortage of beds in the hospitals, in particular during pandemics.

Fisheries

IoT technology may be used to monitor the water quality as well as vital parameters (temperature, pH, turbidity, carbonates and bi-carbonates, ammonia, etc.) related to health and development of fishes in aquaculture.

Tele-education

- Smart classrooms may be created in villages having connectivity with other educational institutions around the world
- Student's drop-out rate may be reduced
- Distance and adaptive learning is possible, thus reducing the need to move to towns or cities to achieve better quality of education
- Various applications and remote participation platforms assist in organizing virtual classes

Some relevant standards

- Recommendation ITU-T L.1700 (2016), *“Requirements and framework for low-cost sustainable telecommunications infrastructure for rural communications in developing countries.”*

- Related supplements for developing low-cost sustainable telecommunications infrastructure for rural communications in developing countries:
 - ITU-T L Suppl. 22 using optical fiber cable,
 - ITU-T L Suppl. 23 using radio links,
 - ITU-T L Suppl. 29 using cellular technologies,
 - ITU-T L Suppl. 30 using cellular network with capacity transfer,
 - ITU-T L Suppl. 31 using satellite systems

Related work item in progress

- Y.SRC “Requirements for deployment of smart services in rural communities” work item in progress in Q2/20 is expected to:
 - provide technical guidelines to bridge the digital divide by establishing the requirements for deployment of smart services (such as e-governance, tele-health, tele-education, precision agriculture etc.) in rural communities.
 - help in increasing the income of rural households.
 - help in reducing frequent migration in search of better education, health care and jobs.
 - improve the quality of life of rural community.

Some IoT use cases in Agriculture in India

- Live soil nutrient monitoring: IoT device can measure the soil nutrients and transmit to server / smart phone and recommendation of fertilizer.
- Smart irrigation System: Remotely monitoring the water pump (on/ off) using mobile phone/ Smart phone named as Nano Ganesh.
- Drone for farming.
- Connected machines/ Agriculture appliances
- Smart Green house

THANKS