

Leveraging Information and Communication Technologies for Strengthening Plant Health Extension Services in South Asia

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Abstract

The plant health management (PHM) is an integrated system that entirely relies on communicating accurate and timely information by key actors in the plant health system. Information and communication technologies (ICT's) are playing a significant role in connecting all the stakeholders in PHM systems. Various ICT approaches have been exploited to bring down the relevant information to the farmers. These innovative technologies have been found to transform and expand the reach of the extension services. Plantwise is a CABI led global programme that supports national extension systems through its network of plant clinics in developing countries to provide smallholder farmers with better access to plant health information and improve their livelihoods by minimizing crop losses. The plant clinics are supported by a global knowledge bank, a central repository for plant health diagnosis and management information. Plant clinics are run by trained 'plant doctors', normally extension officers with a knowledge of agronomy/crop protection, who are trained in different CABI modules in which they are taught field diagnosis and IPM approaches to give pragmatic advice. In this programme, various ICT approaches and solutions have been introduced in an attempt to improve and strengthen its on-going plant clinic activities. The use of ICTs involves the use of mobile technology (tablets) for collecting data and accessing and sharing plant health information via apps. These ICT approaches have been helpful in delivering accurate and timely information to farmers, collecting and making available real time data for informing better decision making as well as building better knowledge networks among extension workers and researchers

Introduction

The incidence of pests and diseases through both pre and post-harvest losses poses a major threat to the food production and availability, one of the important pillars of food security. Pests and diseases cause yield losses of 30-40% (Oerke, 2006). The management of plant health entirely depends on the timely delivery of right information to farmers. Various ICT approaches have been tested so far in agricultural extension to provide accurate and timely advice to the farmers. The ICT interventions in agricultural extension can be capitalised in many ways to catalyse the collection, processing and transmission of information and data, resulting in faster transmission of quality information to more number of farmers in a bottom-up with an interactive channel of communication. ICTs also offer ways by which farmers can access a variety of information sources that are accessible, affordable, relevant and reliable. Also, increasing the use of ICTs in agricultural extension narrows the gender disparities in terms of access to agricultural information.

Smallholder farmers rely on agricultural extension services for advice on how to prevent and manage the pests and diseases posing problems to their crops. However, many agricultural extension services in developing countries are weak (Haug, 1999) and are often under-resourced (Anderson & Feder, 2004). Due to which farmers often turn to their peers or seek advice from pesticide dealers on managing their crop problems. The help they find here can be useful, but if it is inaccurate they run the risk of losing their crops and potentially jeopardizing their livelihood. Therefore to mitigate this problem, the concept of plant clinics has been developed by CABI (Romney *et al.*, 2013). In order to harness the new technological interventions and to provide best advice to the farmers, CABI under its global programme, Plantwise has piloted various ICT approaches to strengthen and improve its extension approach of plant clinics and data management. This paper briefs various interventions led by CABI leveraging the ICTs under the umbrella of flagship Plantwise programme. This programme is operational since 2010 and is currently in its eighth year of implementation. It partners with 33 countries globally out of which eleven are in Asia. The countries implementing Plantwise under South Asia are India, Bangladesh, Nepal and Sri Lanka.

Plant Clinics Concept

Plant clinics concept is similar to the human health concept. A plant clinic is a facility where farmers take samples of their infested/infected plants to extension agents named as “plant doctors” who are agri-professionals also trained on CABI modules to diagnose and advise judiciously. They diagnose and recommend pest management measures specifically based on IPM practices and guided by national and international best-practice standards to the farmers. Plant health clinics are the building blocks of a public plant health service, which in turn seeks to bring together extension and research, regulation and crop management under the one heading of 'plant healthcare system'. Clinics and services here are 'designed by demand' and not 'driven by capacity'. Consultations take place once a month in public places, such as markets or the village place (central meeting area). The farmers bring samples of their diseased plants for plant doctors to diagnose and prescribe safe, affordable and locally available pest management solutions. Plant clinics are reinforced by a plant health repository, Plantwise Knowledge Bank, a gateway to online and offline actionable plant health information, including diagnostic resources, pest management advice and front-line pest data for effective global vigilance (Leach and Hobbs, 2013). During the clinic the plant doctors also record their interaction with the farmer through a standardised ‘prescription form’ collecting information such as farmer name, location of farm, crop grown, plant health problem diagnosed, and treatment advice given. A copy of the form is given to the farmer for reference and then the data from these forms is collated, digitised and analysed by in-country partners through tools available on a central database, Plantwise Online Management System (POMS) (Finegold *et al.*, 2014). At the global level, the POMS database also enables program managers and national coordinators of implementing countries to analyze which types of pests are most often brought to the clinics for advice

and compare this to the topics of the published extension materials (factsheets and pest management decision guides 9PMDGs)) (Katherine *et al.*, 2016).

E- Plant Clinic Model - In order to exploit the potential of ICTs especially the digital technologies, Plantwise piloted a new model of e-plant clinics, first roll out in South Asia was in 2015 in India. In the e-plant clinics the paper prescription forms are replaced by the tablets and data collection app is used for recording data. The SMS invites are sent to advertise the date and venue for plant clinics. Farmers visiting the e-Plant clinics with their infested crop samples are provided recommendations in form of SMS directly on their mobile phones. (Thakur *et al.*, 2016). After learning lessons from the various pilots of e plant clinics in different countries, this model has been successfully scaled up in South Asian countries like Nepal and Sri Lanka in collaboration with national partners.

ICT TOOLS USED IN PLANT CLINICS

USB computer microscope -The plant doctors in the plant clinics are using USB computer microscope which is also known as a computer microscope or a computer connected microscope. This hand-held microscope can be plugged into a USB port on a computer or television. Instead of looking through an eyepiece, the viewer then examines the specimen via the computer's monitor or the television screen. It's essentially a webcam with a macro lens. The USB computer microscope's lens can touch an object to see it magnified or can be used to view objects at a short distance. The images can easily be saved as pictures files or video films, printed and sent to experts. Plant doctors are seen to utilize the technology when they are unable to diagnose the problem they click the pictures and videos and share among the other plant doctors and experts. These microscopes although are very helpful for plant doctors but were also found to attract more farmers and increase the plant clinics attendance The plant doctors click images and videos of unidentified samples and share them with experts. These microscopes have increased the diagnostic ability of plant doctors.

Offline Knowledge Bank- Plantwise Knowledge Bank is adding to plant doctor's knowledge as an offline tool in form of USB devices. The region specific technical and farmers' factsheets can be viewed by plant doctors in the plant clinics to update their knowledge on pests/diseases. This offline application is that it is portable and used without any internet connection. Each stick contains more than 900 factsheets for farmers aimed at the non-technical users; 3259 Plantwise technical factsheets that contain more of an 'Encyclopedia' of scientific information about pests and hosts.

Plantwise Factsheets Library App-Factsheet Library app has enabled plant doctors to take open access data with them to the plant clinics and field with low cost tablets. This application can be downloaded in any mobile application for free from the or Google play store and any country out of 33 countries can be chosen for viewing the plant protection content in the form of factsheets and pest management decision guides. The content is also

available in local languages for the countries. After installing, the app will periodically check the servers for any new updates to factsheets for the selected country packs. During the plant clinics plant doctors can access the factsheets available for checking the recommendations and these recommendations can be copied and pasted from the app to the recommendation field in the app and then messaged to the farmer.

Plant Doctor Simulation games- Many serious games have been launched and tested as a part of plantwise strategy to train the in-country partner staff in identification and diagnosis of pests and pathogens and complement the conventional training through the different modules. The games are android based and ensures a continuous engagement of the players and providing them a simulation of the real working environment in the plant clinics. These were successfully tested to improve the learning capacity of the players. The simulator contains realistic 3D models and scenarios so that plant doctors and extension workers can learn diagnostic skills. The data recorded and analysed by these serious games aims to improve and refine Plantwise training modules, while also measuring plant doctor skills and competencies. The **Plant Doctor Simulator** is a tablet-based plant observation and diagnosis app that complements the plant doctor training modules of the Plantwise program. Users are provided with over 20 simulated plant pest and disease observation and diagnosis scenarios in four common crops: tomato, cassava, maize and cabbage. Each simulation scenario allows users to visually inspect and describe realistic plant parts and symptoms, with highly detailed 3D models constructed from real plants. Users can also demonstrate how they have diagnosed a likely cause. Real-time and contextualised feedback ensures that users learn from their simulation experiences, while also being encouraged to play repeatedly. Training administrators can use online analytic tools to probe users' simulation performance to identify skills and knowledge gaps of individuals or cohorts. Early stage testing suggests the Plant Doctor Simulator is a valid measure of plant doctor diagnostic competency and enhances plant doctor learning.

Case study 1.

Farmer's story- E-Plant Clinic in the rescue of a Woman Farmer Managing Paddy Crop in India

Ms Muthulakshmi is a women farmer from Thirumalairayasamuthiram village in Pudukkottai District of Tamil Nadu in India belongs to a traditional farming family owning three acres of cultivable land and classified as medium farmer as per the government norms. She has an irrigation source from a borewell which irrigates crops such as Paddy during June –September and October – January and Pulses during the season February-April. Considering the better market price for the fine variety of BPT5204 Paddy she has been raising the crop during the Kharif and Rabi seasons every year for the past four years. In the year, 2014 the crop raised by her during the Rabi season witnessed endemic problem of pest menace. She approached the local farm input dealer in her village and adopted the measures recommended by them. The results were far below satisfactory as she reaped 20 bags each weighing 60 kgs with the market price of Rs16 per

kg which was much below than the actual potential. During the Kharif season of 2015 i.e., June – September for the same BPT 5204 variety raised in her 2 acres of irrigated land she observed initial symptoms of shoot borer and located the larva bored into the shoots during the first weeding i.e., after 20 days of transplanting. As a part of regular field visit, the trained plant doctors in Pudukkottai Village Resource Centre (VRC), MSSRF visited the field and apprised her of the scheduled e-plant clinic programme at a nearby village, on July 11, 2015 and suggested to participate in the clinic session along with the infested plant sample while reminding to bring the mobile phone for receiving the advisory through SMS. Having heard of the benefits of e-plant clinics operated regularly, she visited the Clinic along with the affected sample crop. Visiting the plant clinic she felt that the plant doctors patiently listened to the woes and analyzed the plant samples using specialised e-microscope, diagnosed the problem by shoot borer and explained her causes, symptoms, extent of yield loss, mode of spread, conducive atmosphere conditions and the possible control measures. They also showed her the photographs on the tablets and explained the preparation of recommended inputs. Plant Doctors sent all the control and remedial measures as advisory to her mobile in Short Text Message and ensured that the message reached her mobile phone. She was completely convinced with the control measures suggested by the Plant Doctors as they explained the habitat of pest, its different stages of development, damages caused and the control measures. She shared her experience in the e-Plant Clinic with the family members and showed recommendations made in the SMS where everyone felt happy about this modern method of dissemination of agro-advisory to the farmers. The next day without making much delay she showed the SMS on her phone to the Agro-input dealer and purchased the inputs as recommended by the Plant Doctor in the clinic session Following the recommendations of Plant Doctors, she removed the affected shoots from the field and sprayed input as per the recommendations. To her surprise, she visibly observed the larva stopped feeding on the leaves within hours after spraying and after a week, active tillering observed in the paddy crop. The appreciable growth and yield traits finally showed its increased yield by 26 bags of paddy (60 kg each) per acre and fetched Rs.18 per kg in the market compared to only 20 bags in the last season due to the same pest infestation. With an increased yield of 360 kg per acre and with a premium price of Rs 18 kg per kg fetched Rs 6480 additional return. This was possible by the scientific intervention and regular advice of e-Plant Clinic Doctors. The expenses included the cost of inputs and spraying cost of Rs.1000 per acre. Hence the recommendation made by the e-plant clinic helped to reach a cost-benefit ratio of 1: 6.5. She is now a regular visitor of plant clinic and spread the word with her fellow farmers.

In the voice of Ms Muthulakshmi

“The timely intervention of e-plant clinic and the recommendations of the Plant Doctors helped me to recover Paddy crop from the pest problem. I have experienced a different feeling in this novel approach since I am also using the modern ICTs on par with the younger generations. I felt proud in showing the digital SMS recommendations to my family members as also to my neighborhood farmers. I have learnt that the recommendations can be kept permanent in my mobile phone. I am now fully aware of the

shoot borer pest problem with the help of the fact sheet issued in the plant clinic. From my earlier experience, I was under the mercy of the local Agro-input retailer were masters of my farm field. Now, I feel proud of real master of my field as I know the complete history of the field problems and the use of technology in my mobile phone.”

Case study 2 -Response to a new pest in Sri Lanka

A good case in point is the story of “Banana Skipper” (*Erionota* sp.) in the year, 2015. In comparison to manual entry and transmission, use of tablets along with the “Telegram” messaging app accelerated the information spread to extension about the Banana Skipper at galloping speed. (Figure1). Banana skipper (*Erionota* sp.), new pest in Sri Lanka that can damage banana crops. For new pests like this, comprehensive monitoring and rapid communication are key to an effective government response. The tablets helped in this battle against banana skipper in a number of ways:

Daminda Kumara, a plant doctor, used the chat group to report that a farmer had brought a new pest to his clinic 1 October, and requested diagnostic support to identify it based on photos. A diagnostic expert responded the same day with a suggested identification based on the photos. General management advice was shared with plant doctors the same day via the chat group. A local diagnostic expert arranged to take samples and national pest reporting protocols were activated. 20 days later, the Department of Agriculture awareness raising factsheet was shared with plant doctors via the chat group, including specific management advice. 22 days after that first record from Daminda, records of banana skipper start appearing in the POMS data. 52 reports of banana skipper have now appeared in POMS, allowing the government to monitor the spread of the pest and respond to the threat more quickly. This clearly demonstrated the validity of the e-crop clinic concept and its transmission efficiency in Sri Lanka. “After Daminda's report, DOA entomologists observed the same pest in several locations and then the awareness programme has been launched. Daminda's report encouraged all of us to put more attention on the pest.” (KP Somachandra, Regional Agricultural Research and Development Centre, Bandarawela)

Case study 3 -E plant clinics providing platform for extension workers/researchers for sharing experiences for management of a new pest (Nepal) Plant doctors in Nepal shared their experiences of best ways found to manage *Tuta absoluta* and advising farmers the best recommendation which had proved effective in other areas. Telegram, a social networking app has been introduced to the plant doctors during e plant clinic trainings in which they are linked with each other as well as experts in their region. This platform has been actively used by the plant doctors to enhance their knowledge and to seek timely help on diagnosis. This is used as a platform to share management advice released by extension department about *Tuta absoluta*, reaching all plant doctors in the whole Nepal. This channel of communication did not exist earlier in Nepal. (Figure 2) The implementing partners in Nepal are Plant Protection Department (PPD), Nepal

Challenges and lessons learned

Although the implementation pilots of e-plant clinics were initially found to be more expensive than paper based plant clinics but it's been seen to be self –sustainable approach over time. The e -plant clinics had eliminated print and transport costs and reduced data processing times of the staff. Introducing tablets had also streamlined the data processing model in the following key ways: removing data transfer manually and entry of data into excel; reducing step of manual translation and harmonisation and facilitating information distribution.

Training the plant doctors in using the tablets and the apps was key for the testing and rollout of these technologies. For many of the plant doctors using tablets had been completely a new skill and some struggled initially. Giving the plant doctors the space to explore the tablets together without the supervision of trainers was helpful. The language of data collection and fixing our systems to support the language was major time consuming process. Meeting the expectations of the partners at every stage was important. Feedback from plant doctors was critical input at every stage which helped to improve the app. Regular technical backstopping of the plant doctors helped to achieve seamless working of e plant clinics.

Next steps

The programme is also keen to test other services bundled with other extension services and other stakeholders for reaching and benefitting more farmers. The next steps involve collaborations with private sector for the scale up of the approach and technologies. The e plant clinic approach has been extended to the Farmer producer organisations (FPO's) in India. The national NGO's are adopting the approach to meet their mandate of helping more farmers in India. The service providers are identified as the key stakeholders to test a collaborative work to complement the e crop clinic approach in Sri Lanka and reaching out to more number of farmers. The plant protection extension services are using this approach to collect and manage data and inform decision making in Nepal.

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