INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,

BENGALURU

EVALUATION OF RKVY PROJECTS

OF

UNIVERSITY OF AGRICULTURAL SCIENCES,

RAICHUR

"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS THROUGH e-SAP"

INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,

#15, QUEENS ROAD, BENGALURU 560 052

"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS THROUGH e-SAP"

EXECUTIVE SUMMARY

Given the changing climatic conditions, and unreliable and erratic rainfall pattern that require adoption of new types of crops and farming skills. Farmers are mostly in desperate need of information on modern farming methods and practices that can increase the yields of their farms. The highly variable rainfall of 400 -6000 mm distributed across 40-100 rainy days besides the extreme weather events cause significant variability of crop yields. The low productivity of crops is also due to imbalanced input uses, gap in access to modern technologies and absence of technological break throughs post green revolution. In meeting the need and to improve agricultural productivity, mobile-based phone technology can be leveraged to provide farmers with timely, relevant and accurate agricultural technological information ranging from farm preparation to pre-harvest and post-harvest crop and farm produce management. Indeed, access to mobile-phone connectivity has empowered the consumers and is significantly driving economic growth as users can now access most essential services including market financial services and credit facilities, health and education services, and utilities through their mobile phones to ensure food security and to improve agricultural productivity, mobile-based phone technology has been exploited and leveraged to provide farmers with relevant, accurate, timely and consumable agricultural information ranging from farm preparation to pre-harvest and post-harvest crop and farm produce management.

This includes information on pest and disease control, precision farming and irrigation, market availability and produce pricing, access to credit facilities and extension services among others including livestock management.

Crop yield losses due to insect-pests, diseases, weeds, nematodes and rodents range from 15-25% in India, amounting to 0.9 to 1.4 lakh crore rupees annually. Although pesticide use per hectare (0.57 kg/ha) is lower in India and Maharashtra ranks third (0.73 kg/ha) after Andhra Pradesh and Punjab, pesticide residues in produce have been high mainly due to the indiscriminate use of chemical pesticides (Vennila et al, 2016). In addition, lack of awareness on the label claims and waiting periods before harvest aggravates the problems. Farmers are also unaware of the environment friendly bio-pesticides that constitute 4.2% of the India's total pesticide market. Surveillance of crops to detect early signs of buildup of pests and diseases is crucial for the success of IPM. For timely and effective intervention in the face of an emerging pest/ diseases situation, it is necessary for the surveillance data to be interpreted by technical experts and advisories

issued in real time. Delay in issuing an advisory could lead to a breach of the economic threshold level of the pest leading to loss in production and quality. Rashtriya Krishi Vikas Yojana (RKVY) launched by Government of India during XI Plan provided flexibility to choose innovative and pervasive use of Information and Communication Technology for reaching out to the farmers to assess the pest scenario in their fields, and for issue of real time pest management advisories through short message service (SMS).

A web-based decision support system called e-pest surveillance system (CROPSAP) was developed and implemented for effective and regular pest monitoring in soybean [*Glycine max* (L.) Merrill] and cotton (*Gossypium spp*) crops in Maharashtra. These systems are being implemented in different states like Odisha, Punjab, Madhya Pradesh and Haryana.

The success of CROPSAP in Maharashtra in field crops motivated the officials of Department of Horticulture of the Maharashtra State to adopt ICT-based pest surveillance for horticultural crops. ICAR-NCIPM with its expertise in ICT-based pest management solutions in collaboration with multiple institutions of Indian Council of Agricultural Research with State department officials of horticulture and farmers of target fruit crops are involved in programme implementation. Horticulture pest surveillance and advisory project (HortSAP) – Maharashtra, was initiated from 2011-12 initially for Mango, Pomegranate and Banana followed by the expansion to other fruit crops *viz.,* Sapota, Orange (Nagpur Mandarin) and Sweet Orange (Mosambi) since 2014-15.

"E-National Pest Reporting and Alert System" in pulse crops is a unique ICT based decision support system, which is very effective and easy to operate through a centralized server system at National Centre for Integrated Pest Management (NCIPM), New Delhi, connected with internet and mobile phones. This system has developed to cater to the needs of rural farmers of India, who grow pulse crops.

Keeping the above in view, the project, **"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS THROUGH e-SAP"** was sanctioned under Rashtriya Krishi Vikas Yojane (RKVY) during 2014-15 and was taken up by University of Agricultural Sciences, Raichur. Dr. A. Prabhuraj, Professor of Entomolgy, College of Agriculture, Raichur was the Principal Investigator. Originally e-surveillance in Rice, Cotton and Soybean was taken up in Raichur, Bidar, Koppal, Yadagir and Ballari. The details of the project are as under:

1.	**Title of Project**	**:**	**"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS THROUGH e-SAP"**
2.	**Nodal officer and Principal Investigator**	**:**	**Dr. A. Prabhuraj,** Professor of Entomology and Project Leader, College of Agriculture, University of Agricultural Sciences, Raichur
3.	**Implementing Institution (S) and other collaborating Institution (s)**	**:**	College of Agriculture, Raichur, ARS Bidar, Gangavathi, Koppal, Ballari and Yadgir
4.	**Date of commencement of Project**	**:**	2014-15
5.	**Approved date of completion**	**:**	2014-15
6.	**Actual date of completion**	**:**	2014-15
7.	**Project cost**	**:**	Rs. 81 lakhs

OBJECTIVES

The objectives of the project were as under:

1. To provide pest identification and latest pest management strategies to the farmers of the region for major crops
2. To generate pestilence data in the selected districts based on regular sampling.
3. To develop additional features that significantly enhance the functionalities of e-SAP.
4. To empower field staff of e-SAP of the selected districts of the region.

The focus of Evaluation is:

1. to understand the effectiveness of the e-SAP tool in identification, quantification and intensity based recommendation for management of pests.
2. To assess whether e-SAP tool is effective in sending advisories to farmers for management of all pests.
3. To examine whether farmers are in a position to understand the severity of pest problem and are able to take up management efforts for better control of pests and higher farm returns.
4. To examine whether e-SAP tool can be standardized to extend the services to farmers in management of pests in different crops.

5. To examine whether information generated by e-SAP tool can be effectively used to lay down policy guidelines in management of pests.

The intention of the project is

a. To evaluate the effectiveness of e-SAP in issuing advisories to farmers for management of pests.
b. To examine whether the tool can be further improved to cover more crops and
c. To evaluate whether e-SAP tool can be used to generate and analyse data on pest intensity overlaid with climatic variations so that effective prophylactic measures can be initiated for effective management of the pests.

FINDINGS AND DISCUSSION

Use of the tool of Information and Communication Technology (ICT) in survey of incidence of pests and diseases is a systematic and rigorous approach to pest surveillance and management. It speeds up the pace of IPM implementation on a wider area through adoption of pre-emptive actions of pest management which could mitigate the impending pest outbreaks, and could showcase the minimization of yield losses due to crop pests *vis a vis* success of IPM. e-pest surveillance using Electronic Solutions against Agricultural Pests (e-SAP) is a path-breaking ICT system dedicated for crop health management. The scientists at the University of Agricultural Sciences, Raichur have successfully developed the application. The application which was initially confined to few crops and districts has been extended to a total of 40 crops including horticultural crops and to the entire state.

The e-pest surveillance was initially confined to soybean crop in Bidar, paddy in Koppal and Ballari and cotton in Raichur and Yadgir districts. Encouraged by the positive response received from farmers and field functionaries, the surveillance was extended to a total of 40 crops including horticultural crops and was extended to the entire state. The application now acts as a connecting link among all stake holders (Farmer – Field Officer – Scientist – Administrator – Policy maker) in agriculture and horticulture on a single platform in real time in the field of crop health management.

Scientific survey protocol has been developed for identification, quantification of pests and for management solutions. Totally 17 experts in Agriculture and 17 experts in Horticulture have been enrolled for validation of the management strategies as advisories to cover over 40 crops and for content management.

Device management is being done by experts in the field. The software is upgraded to the latest Android version (6.1 and above) and made device independent.

More than 1,000 extension officers in the Departments of Agriculture and Horticulture have been trained is using the application. An important feature of e-SAP is

the ability to capture farmer-specific data in the field and build database of the activities of each farmer. All relevant details of each farmer and the crop raised, including acreage, images, etc., are captured on the field device and a database is created in the cloud, which is accessed through the web application. Every farmer is identified by a unique number with which a log of all his activities across time is created and made available for further use. Also, opportunities to capture any information on farm activity are made available.

Fields belonging to more than 32,000 farmers have been surveyed under e-pest surveillance and more than 1,00,000 advisories have been given. The application has been found to identify pest incidence with 90 to 95% accuracy.

While selling ineffective (and sometimes, spurious) substances has drastically come down and the quantity of pesticides applied has also been according to the prescription, which has reduced indiscriminate usage of pesticides, quantification of savings on use of pesticides is yet to be done.

Impact

A study on "*perception analysis of e-SAP by farmers in the districts of implementation of e-SAP*" conducted by the Extension Department has revealed highly positive response from the farmers (70% of the sample farmers gave positive response) regarding the power of the technology in all aspects of crop protection. e-SAP has helped farmers overcome a major difficulty - reliable identification of their crop pest problems. Further, e-SAP has effectively driven the concept of quantification of the pest problem and has introduced the concept of pest-intensity based management system. Today, many farmers are receiving printed prescriptions to carry to the retailers and demand the same chemicals to be given to them.

Scientists have discovered many new pest problems in their areas of operation through e-SAP. More important has been the fact that identification of the new problems and their pest management strategies can be disseminated to the field devices in just minutes, such that the field users can henceforth manage these problems by themselves. Certain area-wide decisions have been taken by managers on the basis of data made available in real-time through e-SAP system.

Use of “e-pest surveillance system” as a tool in pest management, benefited the farmers in terms of lesser pest incidence vis-à-vis conservation of beneficial insects by timely action with appropriate plant protection measures and popularisation of eco-friendly management practices. The programme also benefited in terms of employment generation, knowledge sharing among technocrats and efficient extension of pest management technologies. This technology applied 1st time for the purpose of pest management in India resulted in encouraging response from all the stakeholders.

Electronic Solutions against Agricultural Pests (e-SAP), a novel ICT application developed by Dr. Prabhuraj. A and his team of University of Agricultural Sciences, Raichur bagged the "**e- agriculture ICT initiative of the year 2014**" award at national level. This award was instituted by Associated Chambers of Commerce and Industries of India (ASSOCHAM). The award was conferred in the "*National Conference on Information Communication Technologies and awards*" held at Hotel Le Meridian, New Delhi on 4th March 2014. Dr. Prabhuraj A, Project Leader and Mr. Y. B. Srinivasa, Associated Leader of e-SAP received the award from Dr. R. Chandrashekhar, President, NASSCOM. The award was conferred to e-SAP in recognition to the innovative approach adopted for integrating all the stake holders in agriculture on a single platform.

Research paper on "e-SAP: a complete ICT Solutions for Agricultural Extension" was conferred with "Best paper award" at National Conference on VIIth National Extension Education Congress held during 8-11 Nov. 2014 at ICAR RC for NEHR, Umiam, Meghalaya. The award was conferred to e-SAP in recognition to the innovative approach to strengthen the Indian Agricultural Extension system.

REFLECTIONS AND CONCLUSIONS

1. Use of the tools of Information and Communication Technology (ICT) in survey of incidence of pests and diseases is a systematic and rigorous approach to pest surveillance and management and is a multi-disciplinary approach.
2. It speeds up the pace of IPM implementation on a wider area through adoption of pre-emptive actions of pest management which could mitigate the impending pest outbreaks, and could showcase the minimization of yield losses due to crop pests vis a vis success of IPM.
3. e-pest surveillance using Electronic Solutions against Agricultural Pests (e-SAP) is a path-breaking ICT system dedicated for crop health management. The scientists in the University of Agricultural Sciences, Raichur have successfully developed the application. The application which was initially confined to few crops and districts has been extended to a total of 40 crops including horticultural crops and to the entire state.
4. Scientific survey protocol has been developed for identification, quantification of pests and for management solutions. Totally 17 experts in Agriculture and 17 experts in Horticulture have been enrolled for validation of the management strategies as advisories to cover over 40 crops and for content management.
5. Device management is being done by experts in the field. The software is upgraded to the latest Android version (6.1 and above) and made device independent.
6. More than 1,000 extension officers in the Departments of Agriculture and Horticulture have been trained in use of the application.

7. Fields belonging to more than 32,000 farmers have been surveyed under e-pest surveillance and more than 1,00,000 advisories have been given. The application has been found to identify pest incidence with 90 to 95% accuracy.
8. Scientists have discovered many new pest problems in their areas of operation through e-SAP. Notable has been the white-tip disease of paddy and banana skipper. e-SAP has a provision for flagging difficult to identify problems in the field, which has resulted in these discoveries. More important has been the fact that identification of the new problems and their pest management strategies can be disseminated to the field devices in just minutes.
9. Procurement of ineffective (and sometimes, spurious) substances has drastically come down and the quantity of pesticides applied has also been according to the prescription/ package of practices, which has reduced the indiscriminate usage of pesticides. However, quantification of savings on use of pesticides is yet to be done.
10. Use of "e-pest surveillance system" as a tool in pest management, benefited the farmers in terms of lesser pest incidence vis-à-vis conservation of beneficial insects by timely action with appropriate plant protection measures and popularisation of eco-friendly management practices. The programme also benefited in terms of employment generation, knowledge sharing among technocrats and efficient extension of pest management technologies. This technology applied 1st time for the purpose of pest management in India has yielded encouraging response from all the stakeholders.
11. The application now acts as a connecting link among all stake holders (Farmer – Field Officer – Scientist – Administrator – Policy maker) in agriculture and horticulture on a single platform on real time basis in the field of crop health management and harvest.

ACTION POINTS

1. While the University of Agricultural Sciences, Raichur has made commendable efforts in developing the ICT based e-SAP for pest surveillance in over 40 crops and more than 1,00,000 advisories have been sent to the farmers, the impact of these advisories on pest management needs to be studied in detail. Procurement of ineffective (and sometimes, spurious) substances has been reported to have drastically come down and the quantity of pesticides applied has also been according to the prescription/ Package of practices, which has reduced indiscriminate usage of pesticides. However, quantification of savings on use of pesticides is yet to be done.
2. The application now has a data base of more than 1,00,000 farmers. This data base and the information generated through e-pest surveillance can be effectively analysed and converted into policy initiatives for integrated pest management measures.

3. Pest distribution map of some insects overlaid with climate data has been developed using the application. However, this has not been effectively used for contingent planning for pest management as also for future prediction of pest incidence. This should be urgently developed to enable the farmers to take up preventive measures. Besides, integration and convergence of disciplines is needed.
4. There is need to analyse the data generated in e-pest surveillance to assess:

i. Whether the e-pest surveillance device developed is being optimally used by field functionaries and management solutions to pest incidence given to farmers?

ii. Information on effective use of advisories can be obtained through "Follow Up" feature integrated in e-Sap app. Whether such analyses have been made to evaluate whether the farmers are making effective use of the advisories in management of pests in their farm?

iii. Whether e-solutions provided are complete in all respects or there are areas which need to be developed further? This is reflected by the number of UDMs generated and resolved. It is understood that only a few UDMs have been generated showing the usefulness of the e-solutions provided. However, there is need to analyse the same.

iv. The impact of use of e-pest surveillance device in management of pests and resultant impact of crop production.

v. The nature of recommendations given as the indicators of level of understanding of the pests to be managed and corresponding research lacunae identified.

vi. The impact of e-SAP use on the economics of crop production needs to be worked out.

vii. Whether any policy initiatives are required in management of pests based on e-pest surveillance data generated?

5. The process of ICT protocol developed by scientists may be patented.
6. There is need for capacity building on e-SAP both at implementation level as well as farmers level in addition to the line departments. It is understood that four state level workshops were conducted in all Agril. Universities involving scientists, department officials, public and private sector agri entrepreneurs, progressive farmers, NGOs, FPOs and SHGs. And several department level master's trainees trainings were conducted at different places of Karnataka in a capacity building programme. The details are, however, not available.
7. There is need for ground truthing of data base on its reliability and acceptability and impact.
8. The operational details and economics of dissemination of the technology needs to be worked out and it should be user friendly.
9. Strategies for sustaining the e-SAP technology for its maintenance needs to be worked out.

10. The impact of e-SAP technology needs to be worked on pests and diseases and IPM activities besides economics.
11. The evaluation methodology and sampling size and techniques need to be standardized.
12. A mechanism to include every farmer and every crop grown in the state may be developed, so that a systematic registry of all farmers and the crops grown by them can be generated, such that the same can be used by the government agencies to develop policy decisions, for disbursement of subsidy, compensation, *etc.*
13. Listing of critical criteria for each technological intervention needs to be documented for dissemination of technology.
14. Integration of indigenous technology knowledges (ITKs) needs to be relooked into.

RESEARCHABLE ISSUES

1. Development/ standardization of protocols for surveillance of pests and diseases, constant watch on the population/ spread dynamics of pests and diseases, their incidence and damage on each crop at fixed intervals to forewarn the farmers to take up timely crop protection measures.
2. There is need for documentation of level of incidence of pests species, loss caused by the incidence and the economic benefits their control will provide.
3. Convergence of remote sensing with special reference to satellite and air borne remote sensing data compiled with geographic information systems are potentially powerful tools for monitoring pest incidence.
4. There is need to develop Standard Operation Procedures (SOPs) for IPM, IPDM and INM for successful implementation of e-pest surveillance in addition to capacity building of farmers and workers on the above subject.
5. Formation of Steering Committee for all stake holders for convergence and co-ordination in decision support system.
6. Formation of University level Pests and Diseases Monitoring Unit.
7. Strengthening of research on e-pest surveillance and digital delivery of Pests and Diseases Management Advisories.
8. Development of future prediction models of pests and diseases outbreak in relation to climate change.