INSTITUTION OF AGRICULTURAL TECHNOLOGISTS,

BENGALURU

EVALUATION OF RKVY PROJECTS

OF

UNIVERSITY OF AGRICULTURAL SCIENCES,

RAICHUR

"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS"

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"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS"

EXECUTIVE SUMMARY

Given the changing climatic conditions, and unreliable and erratic raining patterns that require adoption of new types of crops and new farming skills, farmers are mostly in desperate need of information on modern farming methods and practices that can sustain or 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 breakthroughs post green revolution. In meeting the need and to improve agricultural productivity. Mobile-based phone technology is amenable for exploitation and can be leveraged to provide farmers with timely, relevant and accurate agricultural information ranging from farm preparation to pre-harvest and post harvest crop and farm produce management. Access to mobile-phone connectivity has empowered the consumers and is significantly driving economic growth as users can now access most essential services including financial and credit facilities, health and education services and other utilities through their mobile phones to ensure food security and to improve agricultural productivity. Mobile-based phone technology is amenable for exploitation and can be 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 services 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. 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 at 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 along 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, New Delhi, connected with internet and mobile phones. This system was 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"** was sanctioned under Rashtriya Krishi Vikas Yojane (RKVY) during 2011-12 and was taken up by University of Agricultural Sciences, Raichur. Dr. A. Prabhuraj, Professor of Entomology, College of Agriculture, Raichur was the Principal Investigator. Originally e-surveillance in Rice, Cotton and Soybean was taken up in Raichur, Bidar, Koppal, Yadgiri and Ballari. The details of the project are as under:

1.	**Title of Project**	**:**	**"e-PEST SURVEILLANCE IN SELECTED CROP ECOSYSTEMS"**
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**	**:**	2011-12
5.	**Approved date of completion**	**:**	2011-12
6.	**Actual date of completion**	**:**	2011-12
7.	**Project cost**	**:**	Rs. 100 lakhs

OBJECTIVES

The objectives of the project were as under:

1. To adopt the National Co-ordinated Integrated Pest Management (NCIPM) e-surveillance module on a pilot basis for three crops namely Rice, Cotton and Soybean in five districts of UAS, Raichur to issue early warning and advisory for pest management.

Sub-Objectives:

a. To generate scouting data for three major crops *viz*., Rice, cotton and soybean in Bidar, Yadgir, Raichur, Bellary and Koppal districts under UAS, Raichur.
b. To conduct training programmes for scouts and other stake-holders in IPM for selected crops.
c. Issuing advisories to all the officials of the line departments from NCIPM servers and also to send the alerts by bulk SMS to registered farmers.

2. Development of Technological hardware and software on R & D mode for seven crops for pest identification, instant crop advisory and GIS based report generation on real time (e-SAP).

Sub-Objectives

a. Developing a high tech, user friendly pest advisory-cum-surveillance device.
b. Developing an application system software for automated solutions and real time map based pest/ disease monitoring.
c. Developing real time decision support and forewarning system.

The focus of Evaluation is:

1. To assess the effectiveness of scouting data in identification, quantification and management of pests in selected crops.
2. to develop an e-SAP tool for identification and quantification of pests and intensity based recommendation for management of pests.
3. To assess whether e-SAP tool is effective in sending advisories to farmers for management of all pests.
4. 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.
5. To examine whether e-SAP tool can be standardized to extend the services to farmers in management of pests in different crops.
6. To examine whether information generated by e-SAP tool can be effectively used to lay down policy guidelines in management of pests.

FINDINGS

In each of the five districts, five field staff were recruited to scout for pests and disease incidences and to record data in the three major crops. For each crop 1000 ha was covered for scouting based on the sampling methodology developed by NCIPM. In addition to scouting, quick snap-shot roving surveys were carried out during critical stages of the crops. The weekly reports were critically analysed by Senor Research Fellows for trends in the incidence of pests and diseases and advisories were issued in consultation with the experts. Since, NCIPM, New Delhi could not make provision for the online survey data entry in their website, crop advisories were issued to the concerned farmers through Agropedia website in the form of bulk SMS and voice messages. In total 75 voice messages were issued during crop growth period from KVK, Bidar, 105 from KVK, Kalaburgi, 45 from KVK, Raichur and 40 from KVK, Gangavathi.

eSAP (Electronic Solutions against Agricultural Pests) is a path-breaking ICT system dedicated for crop health management. Insect pests, microbial diseases, nutritional deficiencies and weed problems are covered in the current version of eSAP. The potential of eSAP is such that any new agricultural technology can be communicated in an extremely effective manner, in real-time to the field; and, field situations across space and time are instantaneously made known to the managers/ policymakers/researchers. For instance, if a new pest management strategy has to be disseminated to many field workers spread across a vast geography, a press of a button in some remote location would ensure instantaneous delivery to all of them. The platform can disseminate information built in various forms like videos, animations, images, text and audio. On the other hand, if a pest attack is noted in a cotton field in Raichur district, the managers/ researchers will know it,

and will be able to view the field in real-time in their respective offices/ laboratories anywhere in the world. Further, spatial coordinates of the field are instantaneously reflected on a GIS map along with the extent of severity of the problem. Additionally, such data are presented in automatically updated graphs and tables that enable real-time monitoring of field situations. Inbuilt intelligence aids the process of decision-making, so that biases are minimised and decisions are based on authentic, verifiable field data. Concurrently, this system will ensure seamless integration of different players in the agricultural ecosystem – field users, subject experts, managers, policymakers, and so on. This application has been successfully tested and put to practice for the first time in India by the University of Agricultural Sciences (UAS), Raichur. The features can be briefly summarised as follows. e-SAP is an application built on a platform that opens a gateway for two-way dissemination of information in real time. Central to the platform is a handheld medium that:

i) provides field users with all the relevant information in their hands;
ii) information can be accessed offline;
iii) information is intelligently metamorphosed into a form that can be easily understood and put to use by illiterate users transcending language barriers;
iv) it has substantial in-built intelligence for on-field decision support;
v) it has protocols for intelligent surveys and data collection;
vi) specific information on any/all devices can be updated remotely that makes real time dissemination possible;
vii) there is real time expert connect to handle emergencies and unknown field situations; and,
viii) all forms of data, including multimedia, can be disseminated in both directions in real time. The platform enables policy makers, researchers and users at the other end of the spectrum to obtain field information in real time. Field data that streams-in is viewed over GIS platform. There are automatically updated graphs and tables along with decision support intelligence. It is multidirectional, flexible and scalable.

One of the objectives of the project was to scout data on major pests in three crops in the five districts covered by the University and issue advisories to officials of line departments and registered farmers. The scouting data was generated for 1000 ha in each of the three crops in these districts. The surveys done were able to identify incidence of only aphids, mealy bugs and dusky bugs in cotton in Raichur district, aphids and jassids in cotton in Yadgir district, no significant incidence in paddy in Ballari district, gall midge in paddy in Koppal district and no incidence in soybean in Bidar district.

Since, NCIPM, New Delhi could not make provision for the online survey data entry in their website, crop advisories were issued to the concerned farmers through Agropedia website in the form of bulk SMS and voice messages. In total 75 voice messages were issued

from KVK, Bidar, 105 from KVK, Kalaburgi, 45 from KVK, Raichur and 40 from KVK, Gangavathi. The impact of these advisories on management of the pests during the crop season has not been recorded.

The total area to be surveyed for each crop in each district had been spelt out at 1,000 ha. However, considering the area under these crops in the selected districts, the scouting data generated does not appear to be indicative of the level of incidence of pests. A larger representative area could have resulted in better assessment of the incidence of the pests and suitable management practices could have been assessed and recommended.

The task of development of e-solutions for agricultural pests was initiated in right earnest. The development of simple navigation system through a set of user-friendly menus to reach the details of pest in question and recommended management schedules has been done meticulously. The opportunity provided to the user to interact with experts and also for finding management solution for undiagnosed maladies has been well thought out.

In developing pest management schedules, focus has mostly been on control measures through spray of chemicals. In the light of many pests developing resistance to spray of chemicals and cost of pest management becoming prohibitive in recent years, the Experts Panel may look into biological solutions in management of pests. There is hardly any mention of use of biopesticides in the recommended management schedules.

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. What is the extent of adoption of the advisories provided to the farmers?
iii. Whether the farmers are making effective use of the advisories in management of pests in their farms in terms of A) the relative extent of farm advisory provided and B) the availability (accessibility) of the recommended inputs for implementing the advisory to the farmers within a reasonable distance?
iv. 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.
v. The impact of use of e-pest surveillance device in management of pests and resultant impact of crop production.
vi. What are the ways in which the data collected through e-surveillance can be compiled and processed to draw conclusions on the state of pest management in the selected crops in the area surveyed?
vii. What policy initiatives can be taken to improve overall crop productivity based on e-pest surveillance data generated? Based on the e-pest surveillance data

generated, what policy initiatives can be taken to improve the overall crop productivity?

These studies are understood to have been taken up in the subsequent years when pilot scale studies were started in Raichur and other districts under UASR jurisdiction and the results were presented in an International Conference held in Japan during 2014.

REFLECTIONS AND CONCLUSIONS

1. The scouting for survey of pests is an age old and important method to identify and manage pests.
2. The total area to be surveyed for each crop in each district had been spelt out at 1,000 ha. However, considering the area under these crops in the selected districts, the scouting data generated does not appear to be indicative of the level of incidence of pests. A larger representative area could have resulted in better assessment of the incidence of the pests and suitable management practices could have been assessed and recommended.
3. Since, NCIPM, New Delhi could not make provision for the online survey data entry in their website, crop advisories were issued to the concerned farmers through Agropedia website in the form of bulk SMS and voice messages. The impact of these advices on management of pests is not known in terms of how many of these were actually accessed by the farmers and how many were followed and to what extent. However, qualitative analysis of the data was undertaken by taking the feedback from farmers over phone.
4. The surveys done were able to identify incidence of only aphids, mealy bugs and dusky bugs in cotton in Raichur district, aphids and jassids in cotton in Yadgir district, no significant incidence in paddy in Ballari district, gall midge in paddy in Koppal district and no incidence in soybean in Bidar district. Although, these pests are economically very important causing significant reduction in yield, these pests did not appear to have caused much problem during the project period and are not known to be significant in reducing crop production. In this context, the nature of the advisories given and the suggestions to avoid pest management practices in respect of economically less important pests is important and to what extent such suggestions are provided needs to be appreciated.
5. The initiatives taken for development of e-pest surveillance device are exemplary. The e-SAP (Electronic Solutions against Agricultural Pests) is a novel ICT application developed at University of Agricultural Sciences, Raichur. However, it needs to be upscaled to cover more crops and made user friendly for which convergence of line/ user departments and farmers integration needs to be strategized. It should be on Private Public Participation (PPP) mode by involving researchers, corporates, retailers, manufacturers and buyers etc.

6. The process of ICT developed by scientists may be patented.
7. The Cost Benefit Ratio of use of e-SAP device needs to be worked out for individual farmers.
8. There is need for techniques to upscale the adoptability of the technology.
9. There is need for convergence of the line departments and multi-disciplines of the scientists across the universities of the state as well as Central ICAR institutions working on the above crops prevailing in the area.

ACTION POINTS

A. There is a need to evaluate the recommendations given for each of the pests and then to check whether the recommendations can be improved in terms of ease of management.

B. Proportional representation of non-chemical recommendations (biopesticides) be increased to move towards reducing chemical load for pest management.

C. Geographic data collated on a state-wide basis may be evaluated for widespread pests to check whether climatic data can be used to make predictions on the pest outbreaks. In order to achieve this, abundance maps may be overlaid with weather data to check how the weather factors are influencing the pest situations.

D. Once a recommendation is given, it was observed that 70 % of the farmers are happy with the results. The question of why the other 30 % are not positive needs to be appreciated. This would help to understand the limitations on the part of the farmer to implement the given recommendations. This would help develop more easily adoptable recommendations or alternatively mechanisms of implementation of the given recommendations such that the overall adoption rates are improved.

E. Voluminous data generated may be made available in public domain for interested researchers to explore the data. This will help in the long run in many different ways in understanding the pest biology, population dynamics, development of alternative management options, etc.

F. Extension of the eSAP system to all farmers and all fields cultivated right across the state would in many different ways help manage socio-economic and policy issues. That would also help in employment generation apart from bringing the entire farming lot of the state into an accessible and meaningful documentation of the farming activity.

G. Standard protocols for identification of insects/ diseases/ deficiency symptoms needs to be strengthened through research.

H. A systematic practical tool is needed for the assessment of the technological interventions.

I. Focussed attention on non-cash inputs and indigenous technology knowledges (ITKs) needs to be researched.