UNIVERSITY OF AGRICULTURAL SCIENCES
RAICHUR – 584 104

Success Stories of
Rashtriya Krishi Vikasa Yojana Projects
Implemented by
University of Agricultural Sciences, Raichur

Submitted to

The Commissioner for Agriculture
Commissionerate of Agriculture
Sheshadri Road, Bangalore – 560 001

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e-Pest surveillance in selected cropping ecosystems through eSAP

Title : e-Pest surveillance in selected cropping ecosystems through eSAP

Category: Pest surveillance and IPM

Challenge

Crop health management is a complex subject. It majorly encompasses problems caused by and solutions for various pestiferous species of insects, viruses, fungi, bacteria, nematodes and weeds, and nutritional deficiencies that decrease crop production and impact farmers' welfare. There are numerous species of pests that affect each crop, and not all impact in equal propensities at any given space and time. Pests have always plagued agriculture; the numbers of challenges having multiplied following green revolution. After water, they are perhaps the most worrisome to a farmer in India, and, post sowing, take a major chunk of his finances. Total crop losses, even suicides by farmers, have been attributed to pests. Modern agriculture has witnessed the rise of many locally unknown pests, or those that once had a 'minor pest' tag on them. Invasive pests, pest resurgence and pest resistance have complicated the issues.

On the other hand, pest management options are equally complex. There are many microbial, botanical, chemical, cultural, mechanical and biological methods, and there are many techniques and tools for administering these methods to affect pest populations. Some of them are ecologically sensitive, while some others are part of the humble natural world; some are economical, while some others are expensive; some methods suit intensively managed agriculture, while some others suit extensive farming systems, and a mismatch could have dire consequences on the society, like large-scale ecosystem poisoning. Selection of pest management strategies depends on the intensity of the pest problem at a given space/time. However, assessment strategies to decide on pest intensity vary with crops, pests and physiographical features; taking it to the ground level is a difficult task. At most times, one method of management, or one strategy, would not suffice to lower a pest population; it is a combination of strategies that has been proven to be effective in most cases. This can be complicated because some methods are compatible with some others and incompatible with certain others; some methods are applicable only at a particular time of the day and some others at particular positions above/below the ground. Further, it is often observed that farmer preferences play a significant role in selection of management strategies.

Some look for organic methods, some for inorganic, some prefer cultural and biological, while some others are open to any effective management action. All such variations should be taken into consideration while suggesting remedial actions. Moreover, there is a constant influx of new pest management tools and molecules into the market. These too need to be used appropriately so that farmers and the Nation obtain the maximum benefit. Therefore, pest management is an extremely challenging and complicated section of agriculture.

Adding to the challenges posed by the diversities of pests and their management strategies is the delivery mechanism of pest management solutions to farmers. The social fabric of our farming community, the economic position of our farmers, their level of education, the infrastructure at their disposal and their sheer numbers have erected tall hurdles along the routes of the delivery channels. Of course! This is additional to the complexities of pests themselves and their management strategies. Therefore, there has been little notable success obtained in the field of crop health management, unlike other subjects of agriculture, where there has been measurable amounts of achievements made since the 1970s. Success stories in the field of crop health management are sporadic at most; a national revolution has been a distant dream. Pest dynamics, and the number of variables that influence them, easily surpass market dynamics. And, when it has been difficult to regulate market dynamics surrounding agriculture, it is undoubtedly a bigger challenge to manage pest dynamics.

4. Initiative

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. Further, it enables enumeration of different species of natural enemies, which has gained importance during recent times. There is also provision to capture the history of plant protection measures that have previously been adopted by the farmer while raising the current crop. 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 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.

e-SAP Features that assist field workers

Pest identification:

This is one of the most highlighted features of e-SAP. The architecture for pest identification follows a unique image-based branching model. High-quality images that characterize pests and their symptoms are adopted to intuitively guide users in identifying the pest. Audio assistance in local language is provided at every step; the user need not be literate. The user merely needs to touch a relevant image at each of the steps to identify the problem-causing organism. The content aims at covering all known pests, so that users are able to identify all pest-related problems in the field itself; dependency on external help is minimal. As the content can be accessed offline, it can be used anywhere, anytime.

Pest surveillance:

Pest identification alone is not sufficient to take up remedial measures; it is essential to determine the extent of the pest problem prevalent in each farm. For this purpose, there are intuitively built pest-specific survey forms to quantify damage caused by various pests. Data are automatically analysed based on the survey and the pre-determined economic threshold values for each pest. Results and respective suggestions are instantaneously visible on the field device. Depending on this, the user can decide on adopting management strategies or might simply watch for further buildup of the pest. Survey can be conducted offline too and results can be obtained straight away.

As surveillance entails multiple image capture by the field device, a set of close-ups and field images along with data on crop, crop age, pest damage and geo-coordinates of the field are transmitted to the cloud for further use by researchers/policymakers. Data transfer occurs instantly on the availability of telecommunication signals.

Pest management:

A schedule of recommended management strategies are made available against each pest after determining the extent of damage. The strategy takes into account the crop, crop age and crop part affected. The user may adopt strategies depending on the automated suggestion made on the basis of the survey conducted. Management strategies are also available offline. Any new strategy, or pest management technology, can be remotely made available on the availability of telecommunication signals.

Pest information:

To supplement the knowledge of users, details of each pest are made available on the field device, which is available offline and updated online. Expert connect Under extraordinary cases, when the available content in the field device is insufficient or the user faces difficulty in using it correctly, expert connect is made available on the device. Here, the application not only enables capture of multiple images of the crop, but also makes it possible for the user to record his opinion as he speaks. These images and audio files along with other relevant details like geo-coordinates, crop and farmer details are transferred to the cloud in realtime. Designated experts receive an alert regarding the same, and can access information using e-SAP's web application. The application also allows inter-expert exchange of information before posting their suggestions to the field device. Normally, this process takes less than ten minutes when telecommunication networks are available to all the users.

Features that assist policymakers/researchers

Farmer database:

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.

Data analyses:

and reporting Data captured from various field devices are fed into several databases in the cloud, which are then made available for viewing over the GIS across any defined time and any chosen set of parameters. Users can access automated graphs over e-SAP's web application. Points over GIS maps and continuously updated graphs/tables allow real-time monitoring of pest situations across any defined space.

Decision support system:

Micro-level decision support system is provided on the field device for taking decisions on adopting pest management strategies. e-SAP also makes provision for macro-level decision support in the web application. Based on the data generated across space and time, and builtin analyses, alerts for various scenarios can be customised by each web-user, which would warn in several ways – on mobile phones, emails, etc. for taking immediate actions on a larger scale.

Feedbacks As with respect to adoption of technologies and assessment of technologies by field users, provision is made to capture feedbacks in the form of multimedia content, like audio and images, and intuitive grading.

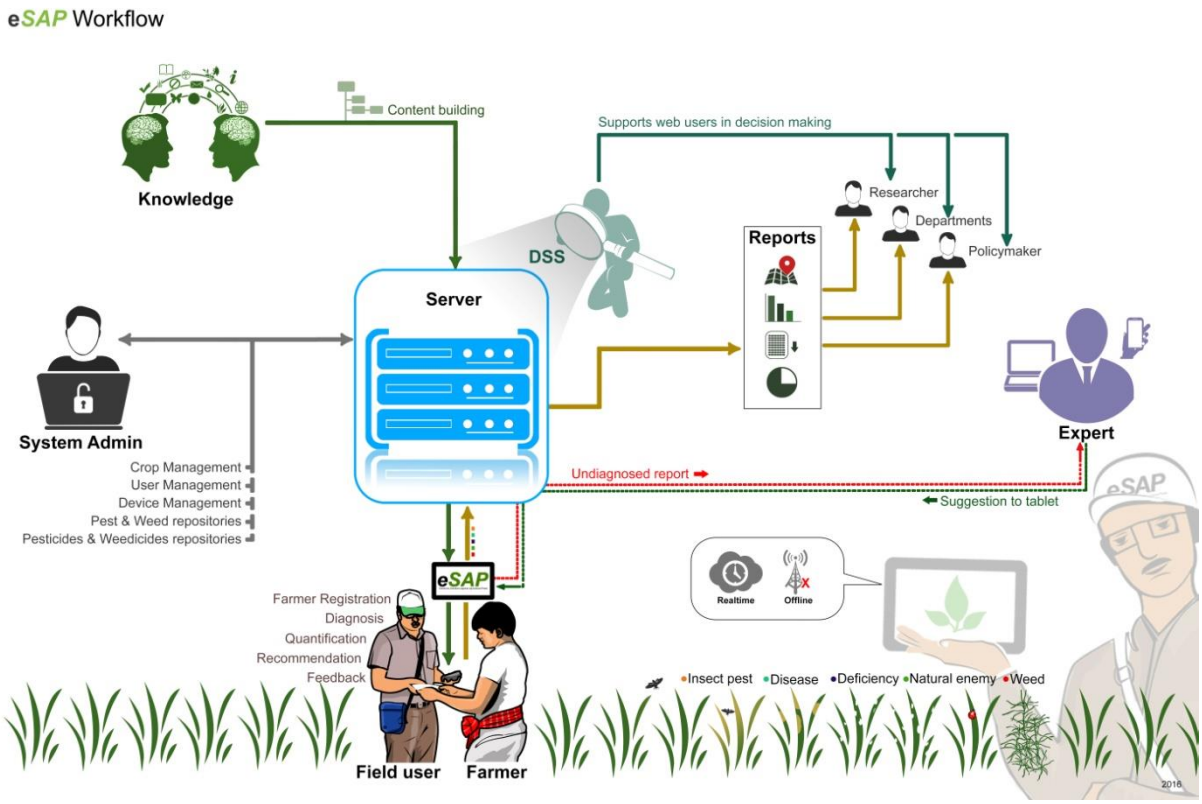
Content management:

e-SAP allows for real-time dissemination of pest management technologies and other information to all/designated field devices. Information on new pests or new information on existing pests, new/modified pest identification routes, additional/new symptoms, new survey plans, and new management strategies can be remotely updated on the field devices over existing telecommunication networks.

Device management:

The device part of the platform exploits emerging technologies with capabilities to generate/ provide data in a format that an illiterate user can generate/use easy-to-understand multimedia content. Today, telecommunication networks reach a wide spectrum of geographies. However, in the absence of such networks, the device utilises offline storage and delivers content on network availability.

Describe what activity or activities under RKVY have done to address the challenge. Showcase the implementation of strategy and timeline of actions. How were different stakeholder or users engaged in or consulted in the implementation process? Specify who benefitted from the activity and how is the activity knowledge that was produced being used now by different beneficiaries (farmer, community, policy maker, private sector, university, etc.) to change their practice, policy, investments, etc. also mention the year of intervention, amount spent etc. **(300-350 words)**



5. Key result/insight/interesting fact

- **Large scale deployment**

e-SAP has reached over 1,00,000 farmers covering 26 crops in all 6 districts of Karnataka.

- **Rural Employment**

More than 50 extension workers recruited under various projects have received employment opportunities.

- **Effective use of pesticides**

The opportunities for selling ineffective (and sometimes, spurious) substances has drastically come down. The quantity of pesticides applied has also been according to the prescription, which has reduced indiscriminate usage of pesticides.

- **Scientific pest management**

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 receiving printed prescriptions carry it to the retailers and demand the same to be given to them. It has had a significant impact on the interactions between the pesticide retailers and farmers. Their confidence levels for tackling pest problems have increased. This is largely because of the fact that they are completely involved in the identification and quantification process by the extension functionary.

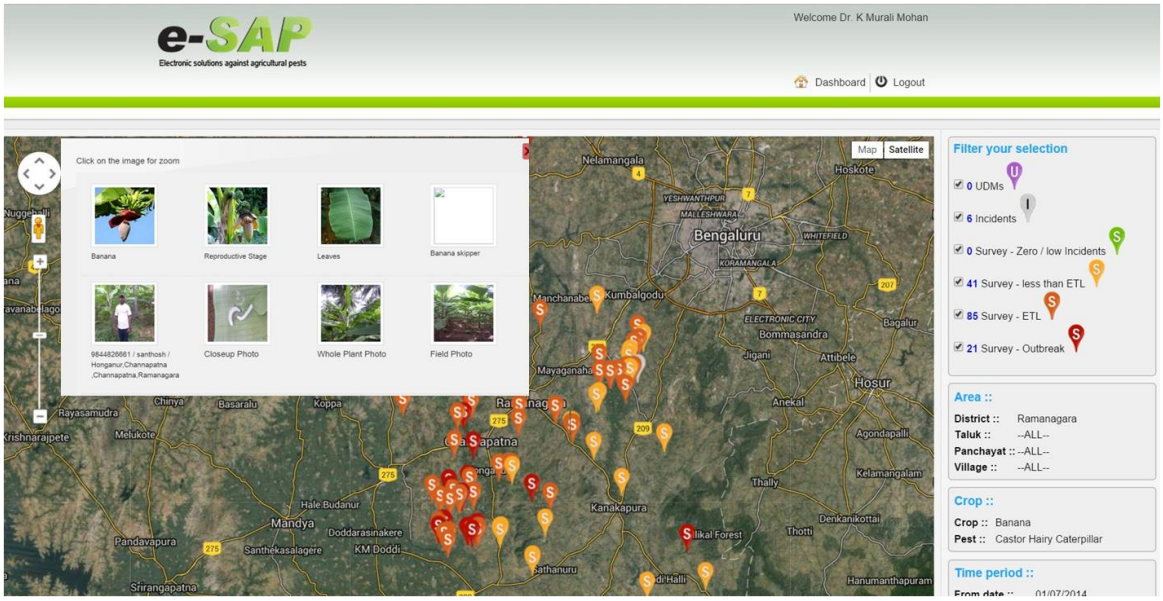
6. Impact

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 receiving printed prescriptions carry it to the retailers and demand the same to be given to them. It has had a significant impact on the interactions between the pesticide retailers and farmers. Their confidence levels for tackling pest problems have increased. This is largely because of the fact that they are completely involved in the identification and quantification process by the extension functionary.

Three more fellow agricultural universities in Karnataka have adopted e-SAP. Together, there are more than 1,00,000 farms in Karnataka who have benefitted from e-SAP till date. More than 100 extension workers recruited under various projects have received employment opportunities. The opportunities for selling ineffective (and sometimes, spurious) substances has drastically come down. The quantity of pesticides applied has also been according to the prescription, which has reduced indiscriminate usage of pesticides.

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, 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. Notable example has been management of cotton leafhopper resistance in Raichur area. Real-time data showed that the pest population was not declining in the area despite adoption of management strategies. Soon, the expert team found that the population had developed resistance to the pesticide. Administrators, with the help of researchers, decided on changing the strategy. The new strategy was made available on the field devices in real-time, which resulted in successfully managing the pest population before it got escalated to serious levels. Such has been the impact of e-SAP.

In the beginning of the paddy crop during 2013, reports in the form of unresolved problems (UDMs) started trickling on e-SAP web applications.

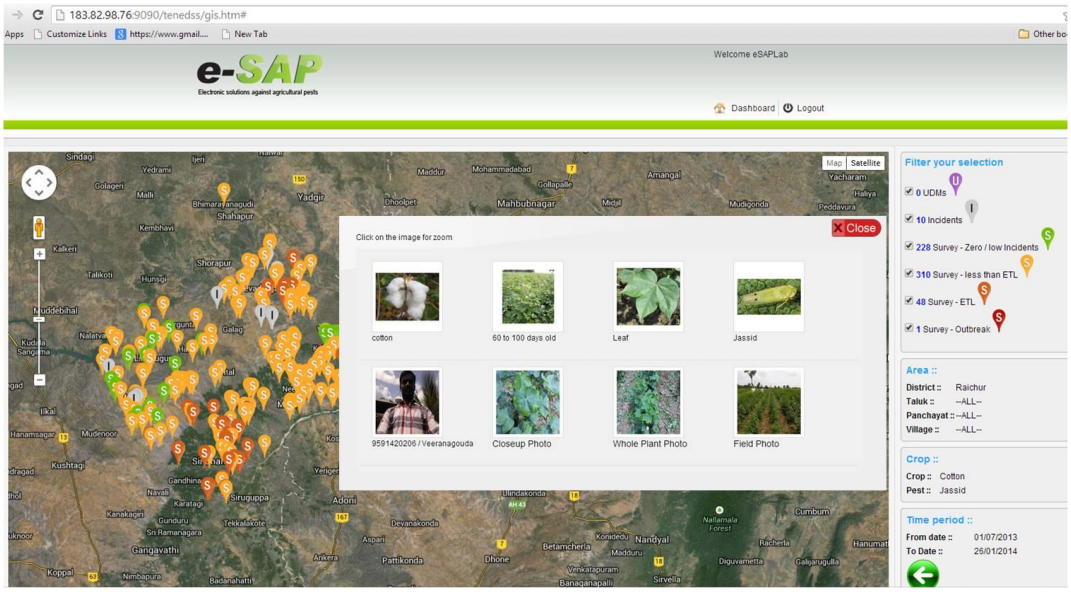


Field captured images of banana skipper from Ramanagara district

Field captured images of paddy crop from TBP command area

Interestingly, experts at UAS, Raichur through high resolution field captured images and audio message of the extension personnel, identified the problem as "*White Tip of nematode*". For further confirmation, they visited the affected field (with help of e-SAP database) and did a detailed diagnosis and arrived to the conclusion. This has opened up a new research on this nematode which was not reported from this region earlier.

Tackling the problem of cotton leaf hopper



Cotton leaf hopper scenario in Raichur district during 2013-14

The present insecticides recommended were not found effective against this pest as they have developed resistance. Hence, with permission of experts and the administrators, an ad-hoc recommendation of new chemical which was performing better against this pest was immediately recommended and thus managed the pest. The success was measured in terms of appreciations from the farmer, extension persons, experts of the University, and administrators of University including Hon'ble Vice-chancellor, policy makers of the administrative and legislative wing.

7. Lessons Learned

1. What did you learn in this process? What was difficult or challenging?

The difficult challenge was developing and identification architecture. This is one of the unique structures developed in the IT platform. The architecture was built in such a manner that even a minimum educated person can follow the instructions which are entirely dependent on images and audio support in identification of the problem right in the farmers' field.

2. How did you overcome the challenges faced?

The architecture for pest identification follows a unique image-based branching model. High-quality images that characterize pests and their symptoms are adopted to intuitively guide users in identifying the pest. Audio assistance in local language is provided at every step; the user need not be literate. The user merely needs to touch a relevant image at each of the steps to identify the problem-causing organism. The content aims at covering all known pests, so that users are able to identify all pest-related problems in the field itself; dependency on external help is minimal. As the content can be accessed offline, it can be used anywhere, anytime

3. If you were to do it all over again, what would you do differently? **(100-150 words)**

e-SAP will continuously expand in terms of its features and capabilities, also in terms of its usage by the agriculture sector. Two major features are on the anvil. The natural enemy module will be a game-changer in terms of increasing the relevance of pest management through biological control, which is an eco-friendly method of pest management; multi-pest intelligence will be the first of its kind in the world where the device can intelligently provide the field user the best management strategy when multiple problems affect a particular crop.

In terms of spatial expansion, e-SAP is now fully prepared for a nation-wide adoption. We look

forward towards both government and corporate institutions to adopt e-SAP for the benefit of the agriculture sector as a whole

8. Supporting Quotes and Images

Very informative and educative towards benefitting farmers. This should spread to other regions of Karnataka and India……..
Padmabhushana Dr. M. Mahadevappa, former VC and Director, ASRR

Excellent initiative! Potential to generate rich data and empower our farmers. Let us take it forward soon!……..

Smt. Uma Mahadevan, Principal Secretary (Agriculture), Govt. Of Karnataka

Agriculture commissioner, Govt. of India Govt. of Karnataka listening to e-SAP reports of UAS, Raichur

Shri Krishna Byregouda, Hon'ble Minister of Agriculture,

A farmer keepnly watching the identification of problem through eSAP

Farm women being benefited by eSAp technology

9. Additional information

Please provide additional relevant information, such as:

1. Collaborators of the project: Our IT partner in this venture has been Tene Agricultural Solutions Pvt Ltd., Bangalore.

2. Links to supporting materials, such as news items, photos on Flicker and presentations on Slide Share

3. Other information you want to add

Awards/Recognitions

e-SAP bagged the "e-agriculture ICT initiative of the year 2014" award

Electronic Solutions against Agricultural Pests (e-SAP), a novel ICT application developed by Dr. Prabhuraj. A and his team of UAS, 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.

e-SAP bagged the "Best paper presentation award at national level Conference"

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.


SOCIETY OF EXTENSION EDUCATION

The Organizing Committee Confers its

Best Paper Presentation Award-2014

Certified that Dr. Prabhuraj. A participated in 7th *National Extension Education Congress-2014* on **" Translational Research-Extension for Sustainable Small Farm Development"** organized by Society of Extension Education, Agra in collaboration with ICAR Research Complex for NEH Region, Umiam, Meghalaya during November 8-11, 2014.

He/~~She~~ has presented a paper (oral/~~poster~~) entitled e-SAP: A complete ICT Solutions for Agricultural Extension

Dr. Jitendra Chauhan
General Secretary

Prof. Ram Pratap Singh
President

eSAP was the runnerup in the 2016 Manthan South Asia Award under

THE MANTHAN AWARD SOUTH ASIA RUNNERS-UP (41)

GOVERNMENT & CITIZEN ENGAGEMENT – 07

- Depot Online System for FCI - INDIA
- VAT Checker - BANGLADESH
- MEMORY (My Exam My Online Re-view Yes) - INDIA
- iRevenue Mobile Application - INDIA
- Core Treasury System(eKosh) - INDIA
- E-Sanchayika - The Knowledge Bank of the ICDS - INDIA
- Land Pooling Scheme - ICT System - INDIA

HEALTH & WELL BEING – 05

- Vision Guard – SRI LANKA
- Q-global - INDIA
- mMitra Voice Call Service - INDIA
- Daily Handwashing for an Ailment-free Life (DHaAL) - INDIA
- Dhaka University Telemedicine Programme - BANGLADESH

LEARNING & EDUCATION – 07

- ExamFear.com - INDIA
- 10 Minute School - BANGLADESH
- Youth Opportunities - BANGLADESH
- REPTO Education Center - BANGLADESH
- CAREER CLINIQ SMART TUTOR - INDIA
- Rani Kajal Community Owned Wireless Mesh (Cowmesh Ranikajal) - INDIA
- MINDLER - INDIA

ENVIRONMENT & GREEN ENERGY - 06

- e-SAP (Electronic Solutions against Agricultural Pests) - INDIA
- Unnati - INDIA
- Farmers Project - INDIA
- Krishoker Janala-Apnar - BANGLADESH
- BARI Application- Krishi Projukti Bhandar - BANGLADESH
- Mrittika - BANGLADESH

CULTURE & TOURISM – 04

- e-Archives: Online Cataloging of Odisha State Archives, Bhubaneswar - INDIA
- Vromon - BANGLADESH
- Sevendiary.com - INDIA
- Badajari Sinhala Online Restaurant Directory – SRI LANKA

Important links:

eSAP: A short video: https://www.youtube.com/watch?v=XRMKqG01o2E&feature=youtu.be

eSAP: A PDF presentation: http://www.mmp.cips.org.in/documents/Workshops/2015/30jul-1aug/eSAP-Dr._A_Prabhuraj.pdf

10. Checklist

No.	Question to consider	Yes	No
1	Is the story interesting to the target audience of the project/activity report?	YES	
2	Does the story explain what new insights the project brings? What is the main lesson learned from this story? Does the story describe a key insight on what works and what doesn't and something that future project could build on	YES	
3	Does the story describe the outcomes the project produced and the people who are benefitting? What changes–in skills, knowledge, attitude, practice, or policy–has the project brought, and who is benefitting from these changes?	YES	
4	Does the story make a compelling point that people will remember? Does the story show how the project makes a difference to improving livelihoods and lessening poverty?	YES	
5	Does the story provide an interesting fact that people will remember? For example, how much yields increased, how many hectares of land could become more productive from this innovation or technology?	YES	
6	Does the story explain what kind of impact this innovation or technology could have if scaled up?	YES	
7	Does the story show which partners contributed and how?	YES	
8	Does the story include quotes from Stackeholders or beneficiaries?	YES	
9	Have I provided links to other media (journal articles, website news, newsletter, blogs, annual reports of other Programme/ project) that also feature this story?	YES	
10	Have I provided the contact details of people who can provide more information?	YES	

1. Contact person for this story (name, position, email address)

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