

AN E-PEST SURVEILLANCE AND ADVISORY SYSTEM TO EMPOWER FARMERS IN MANAGING RICE PESTS AND DISEASES IN SRI LANKA

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ABSTRACT

An e-pest surveillance and advisory system was developed for empowering rice farmers in Sri Lanka to obtain correct identification and recommended solutions for their pest and disease problems of rice on time, forming a national database, monitoring rice pest and disease incidents to identify potential outbreaks and enabling regional authorities for carrying out early intervention and preventive measures. The system is composed of web and mobile applications called “*Govi Vedaduru*”. A user friendly mobile interface was designed in local language (Sinhala) to upload maximum of five images and information about the pest and disease problems. Experts in Rice Research Stations of Department of Agriculture access individual incidents, analyze the problem through the web application and make recommendations allowing farmers to receive full advice through the smart device. The reports generated via web application include classified pest and disease incidents and Google mapping of incidents making identification of pest and disease outbreaks possible. The system was initially piloted in five areas of rice cultivation representing Low Country Wet zone of Galle district in Sri Lanka. A follow up survey of the participant farmers indicated that they received timely, useful and trustworthy advice that helped them with correct remedial measures.

Key words: E-agriculture advisory, Mobile and smart computing, Pest and disease surveillance

INTRODUCTION

In rice farming, 10-20% of the production is lost due to pests and diseases annually, making rice farming unproductive and unprofitable (Nugaliyadda *et al.*, 2000). Pest and disease problems should be identified as early as possible and remedial measures should be taken immediately to make the solution effective. However, most farmers are not competent enough to recognize the pest or disease problem correctly and not aware of the correct recommendations to rectify it. In this context, agriculture extension agents have to play a major role and should intervene to give solutions to the farmer. In Sri Lanka, agriculture extension services are responsible for providing necessary advice to the farmers in solving their field problems. However, lack of officers to meet the demand and difficult to provide solutions on time are considered as serious issues. This hinders the farmers to receive correct information regarding pest and disease identification and remedial measures on time. Further, short length cropping season finishes resulting considerable damage to the field when it is unattended.

The excessive use of agrochemicals due to incorrect identification of pests and excessive chemical application leads to collapse the agricultural ecosystems and increase the cost of production. Majority of Sri Lankan farmers are lack in competence and capabilities in planning a precautionary / preventive method a season ahead in order to minimize pest, disease and field problems in rice; such as selection of resistant varieties, appropriate crop establishment methods, integrated approaches, etc.

There is no established area-wide or island-wide system to monitor pest incidences and forecast the outbreaks to give alarming signals or information to farmers. Further, there is no central database to make forecasting of pest and disease incidences using simulation models considering the prevailing weather conditions to help in decision making of farmers and authorities in Sri Lanka.

To overcome these challenges, a new approach is introduced to developing an e-Agricultural Advisory and surveillance System for rice pest and disease management aimed at bridging the information gaps that exist between farmers, extension officers and scientists at Rice Research Stations (RRS) of Department of Agriculture (DOA). This let the rice farmers send field problems of rice crop directly to the experts at rice research

stations of DOA and receive quick and correct solutions.

Some of the applications designed to address such issues lack the usability and the credibility due to not having local language support and not capturing the expert knowledge in a targeted crop (Perera *et al.*, 2016). Even though the automated image recognition can be applied to scale up pest and disease identification, lack of training data in the targeted crop has been cited as a major issue (Majid *et al.*, 2013). This research project aimed to address such issues by capturing the domain expertise of rice crop and designing a farmer friendly interface.

The permanent Crop Clinic Programme aims to address the resources limitation of Agriculture Instructors (AI) by offering centralized “clinics”, where farmers can bring their problems with crop samples. Even though the approach reduces the AI’s travel times and improves the utilization, it transfers the burden of travelling to the farmer (Jayasundara *et al.*, 2016). “Govi Vedaduru” system on the other hand, empowers farmers to send the pest and disease problems from the farm itself and receive solutions without travelling to central place by creating an accessible direct channel to the scientists in Rice Research System of DOA.

The “Rice Doctor” mobile application developed by International Rice Research Institute (www.knowledgebank.irri.org) provides a menu driven interface to narrow down possible causes. According to the developers of the application, Rice Doctor is aimed at extension workers, students and researchers and not specifically targeted for farmers and it requires substantial knowledge to use.

The broad aims of this study are empowering the rice farmers to obtain correct identification and recommend solutions for their pest and disease problems of rice on time; forming a national database on rice pests and diseases; monitoring rice pest and disease incidents to identify potential outbreaks and enabling regional authorities for carrying out early intervention and preventive measures. Objectives of the present study were formulating integrated solutions of preventive and corrective measures for pests and diseases of rice, developing a work flow for the system, developing a prototype with mobile and web applications and introducing the production ready implementation for rice farmers in Galle district.

MATERIALS AND METHODS

The system is a multidisciplinary effort of the scientists at Plant Protection Division of the Rice Research Station at Labuduwa and the team of software engineers. Scientists formulated integrated solutions, using available information and research findings in the DOA, for common pest and disease problems of rice covering curative actions to be taken in a pest or disease incident including preventive actions for the next season. It was decided to harness the vast adoptability of mobile devices by the public to disseminate these solutions tailored to individual circumstances scalable and cost-effective manner. The proposed solution was captured in the following workflow; 1. Farmer sends the data of the field problem to the shared database using a mobile application. 2. An expert analyses the data and find a tailored solution. 3. The solution is sent back to the farmer account in Sinhala language. 4. Farmer log in to the account and get the solution (Figure 1). To verify the initial concepts, a prototype was developed with a mobile application and a back-end web service supported by a database (Nilakshi, 2013).

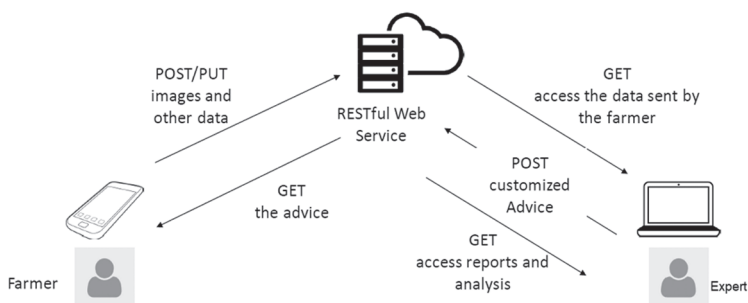


Figure 1. Architecture of e-pest surveillance and advisory

After successfully verifying the proposed workflow through the prototype, a production ready implementation was rolled out. The system is composed of a web application and a mobile application called “*Govi Vedaduru*”, which is compatible with Android 4.0+ version and can be installed to an Android device from the Google play store.

Creation of “*Govi Vedaduru*” account

Once the mobile application is installed to a smart device, the farmer will have to obtain a username and a password from the admin of the web site via relevant Agriculture

Instructor of the area to access and use the application by providing information on personnel details such as name, address, ID number, farm details such as paddy field name, acreage, GPS coordinates and area details such as district, divisional secretariat, agrarian service centre with the format given. “*Govi Vedaduru*” accounts of the farmers are created by the admin of the web site or relevant Agriculture Instructor.

Smart device application

A user-friendly menu system shown in Figure 2 was designed in the mobile application to capture data such as affected part of the crop, age of the crop, percentage of the area affected, establishment method, prevailing weather condition, etc. Further, up to five images captured via smart device with guidance by the menu can be attached. Information captured via the smart device application is sent to the Web service. This data is then stored in a database allowing experts in RRS to access individual incidents, analyze the problem with the information and images and make recommendations. Once the recommendation is sent, farmer can access the full advice through the smart device. Examples for solutions sent to the farmers are shown in Figure 3.

Web application

The experts facing web application can be accessed via multiple logins concurrently. This will ensure the scalability by allowing multiple experts with sufficient privileges to access reported incidents and make recommendations. The web application was designed to analyze pest and disease incidents according to the district level, divisional secretariat level or agrarian service centre level with the selected time period and to give the bar graphs automatically. These reports include classified pest and disease incidents making identifying pest and disease outbreaks possible. Further, pests and diseases incidents are mapped in Google map automatically according to the assigned area (district, divisional secretariat or agrarian centre wise) and time period allowing affected areas to be located.

System implementation

Once the verification of the e-pest surveillance and advisory system was completed, the system was introduced to five areas (*yaya*); *Keradevala*, *Kurunda*, *Indurannevila*, *Uhanowita*, and *Yakkalamulla*, of rice cultivation representing two agro-ecological zones

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; WL1a and WL2a in Galle district as a pilot scale project during the *yala* season of 2017. A training session was held to give awareness on the “Govi Vedaduru” mobile and web applications and the overall objective of the e-pest surveillance and advisory system for selected farmers covering 5 areas and extension officers in the Galle district. During this session, farmers were registered to the system and a mobile app demonstration was done.



Figure 2. The Graphical User Interface of the mobile application

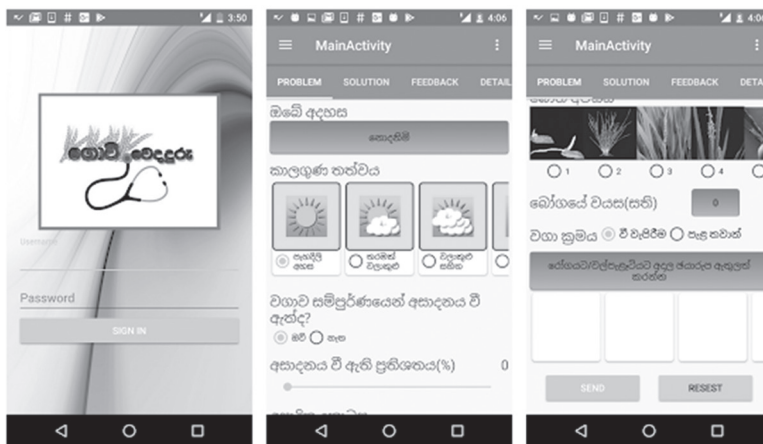


Figure 3. Screen shot of “Govi Vedaduru” mobile application published in google play



Figure 4. Screen shot of solution for the Brown spot disease

Survey with the farmers who send the problems was planned to evaluate the mobile application. Binary type questions were used instead of Likert scale to make it simple for participants. Investigations of the field problems of rice cultivation were done to assess the pest and disease incidents in the season at these five areas.

RESULTS AND DISCUSSION

During the *Yala* season of 2017, five villages were selected in Galle district; *Keradevala*, *Kurunda*, *Indurannewila* which belongs to WL2a and *Uhanowita*, *Yakkalamulla*, which belong to WL1a. From these selected areas 60 farmers were registered to the system. During the period of June to October 2017, 19 inquiries were received and correctly identified by the scientists at the RRS, Labuduwa and solutions were sent back to the farmer accounts. Solutions sent to the farmers contained instructions on curative actions to manage pest, disease and field problems, and preventive methods for the next season. Mostly farmers do not give attention to take actions for prevention of pest and disease problems rather than curative actions, since they are not aware about the preventive methods. A case study results of Siyambalanduwa cyber extension, Ruwanpitiya and Dissanayeke (2017) reported that 71 % of farmers were interested in receiving information related to crop protection techniques, hence the solutions on crop protection techniques sent through the e-pest surveillance and advisory system are customized to the need of information seek farmers in time.

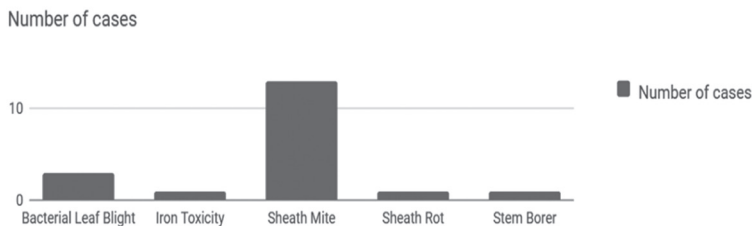


Figure 5. Screen shot of web application showing Bar graph of classified pests and diseases incidence during *yala* 2017

Out of received pest and disease incidence to the system during *Yala* 2017 in selected five *Yaya*, sheath mite were the highest occurring problem that was 13 in number (Figure 4). Bacterial Leaf Blight, Iron toxicity, sheath rot and stem borer were also recorded in lesser numbers in the area. This reveals that rice sheath mite was the

major pest or disease problem of rice during the *Yala* season of 2017 in WL1a and WL2a of Galle district. This information was confirmed by seasonal report, 2017. According to the report, farmer field investigation survey on pests and diseases of rice conducted in *Yala* 2017 in the five areas of Galle district recorded rice sheath mite was the highest occurring problem. Surveillance on pests and diseases through this e-system would be much stronger when the users of the mobile application are increased in the country.

Google mapping of pest and disease problems received through the “*Govi Vedaduru*” system during *Yala* 2017 located the incidences (Figure 5) and zooming the map further showed the exact area (*Yaya*) of incidences with potential outbreaks. Regional extension authorities are enabled to carry out early intervention programmes with this information and further, research priorities in the region can be identified.



Figure 6. Screenshot of Google mapping of pest and disease incidence during *Yala* 2017

Follow up survey was conducted with 10 farmers who reported incidents using the “*Govi Vedaduru*” mobile application at the end of the season. All participants said that the instructions received were useful, informative, understood and reliable. Four farmers used their family members’ phones and thought that having their own would be more useful. Seven followed provided instructions.

The “*Govi Vedaduru*” mobile and web applications were designed to the 25 districts, all the divisional secretariats and all the agrarian service center areas and hence, this application is ready to implement island-wide. However, language of “*Govi Vedaduru*” mobile application should be translated to Tamil language to extent it to Tamil speaking areas. Chat facility and news facility are to be included for further improvement of the system to reduce the gap between farmer and agriculture authorities.

The same generic architecture and the workflow can be applied to other agricultural crops with the minor changes. Machine learning techniques can be used to automate some recommendations by the accumulation of good quality structured data and images about pest and disease incidents, with a high degree of confidence, further increasing the cost effectiveness and scalability.

CONCLUSION

The pest and disease surveillance and advisory system developed using the mobile and web technologies piloted in selected areas in the Galle district found to provide information-poor farmers a reliable solution to manage their pest or disease problems. Farmers are able to receive customized information in time. System is capable of identifying the potential outbreaks providing valuable information to Agriculture Extension Authorities for monitoring and planning purposes and Research Institutes for identification of research needs.

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REFERENCES

- Jayasundara, M.U.P., Y.M.C.K. Herath, A.N. Abeykoon and K. Cameron. 2016. The “Permanent Crop Clinic Programme” in Sri Lanka: making use of data to resolve crop health problems. Poster · October 2016. <https://www.researchgate.net/publication/315798562>
- Majid, K., Y. Herdiyeni and A. Rauf. 2013. I-PEDIA: Mobile application for paddy disease identification using fuzzy entropy and probabilistic neural network. International Conference on Advanced Computer Science and Information Systems. 403-406.
- Nilakshi, S.V. 2013. Rice plant protection system. A report submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Management and Information Technology (B.Sc. MIT), University of Kelaniya, Kelaniya, Sri Lanka.

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Nugaliyadde, L., D.M.N. Dissanayaka and A.S.K. Abesekara. 2003. Towards new dimensions in pest management in rice. Rice Congress 2000. Department of Agriculture, Peradeniya, Sri Lanka. 109-124.

Perera, G.G.E., P.I. Sampath and C.V. Vithanage. 2016. An android based disease identification system for farmers in Sri Lanka. Proceedings of 3rd Ruhuna International Science and Technology Conference. 64.

Rice Doctor. IRRI Rice Knowledge Bank. www.knowledgebank.irri.org

Ruwanpitiya, C.P. and U.I. Dissanayake., 2017. Cyber extension services in fulfilling information needs of a farmer community: A case study of Siyambalanduwa cyber extension unit. Annals of Sri Lanka Department of Agriculture. 19: 243 - 257