M-Velanmai Menu Page

Services offered through *"M-Velanmai"* in paddy crop:

1. Caters the technological, market and weather-based information needs of farmers.
2. Ensures two-way communication between farmers and agricultural experts through an interactive platform to share/ exchange information among the users.
3. AI based **'Crop Care'** advisories against major insects, diseases and nutritional disorders are delivered instantly to farmers bilingually in the form of text/ voice message.
4. Farmers can enter the date of sowing under **'Crop Monitor'** section to receive the weekly technical advisories to be adopted for seven days and can be progressively obtained till date of harvest.
5. **Crop Guide'** page enables the farmers to get complete information on different cultivation practices based on different types of ecosystem.
6. **Weather++'** section provides weather based information and agro advisories from different sources.
7. **Market Info'** provides the price details of various agriculture commodities including market forecast for major crops.
8. The queries raised by the farmers and advisories received from the scientists are archived under **'History'** Section.
9. Farmers can offer their feedback about the utility of the app and effectiveness of the advisories received through AI or scientists through **'Feedback'** section.

Perceived Benefits of M-Velanmai

Assessment of the perceived benefits of M-Velanmai app. by the paddy farmers in Tamil Nadu reveals that an overwhelming majority of the Paddy growers (95 %) perceived that the technical advisories to solve the pest problems were received instantly at appropriate time and hence they were able to solve the problem and protect the crop. About 90 per cent of the farmers felt that they were able to accept the technical advice as it is delivered from TNAU which is perceived as a trustworthy source. More than three-fourth of the users (82 %) of M-Velanmai app perceived that the advisories received were adopted and found to be effective in managing the pest. Nearly three-fourth of the farmers (71%) felt that receiving advisories through M-Velanmai saves their time to access the advisories at the right moment in the field itself. The other benefits perceived by more than half of the users were user friendly (69 %) and Feedback can be recorded (51%). Weekly advisories can be accessed through Crop monitor (48%) and Technical information about Paddy can be accessed through Crop guide (35%).

Sl. No.	Perceived benefits	Per cent* (n=100)
1.	Advisories are received instantly	95
2.	Information comes from trustworthy source	90
3.	Advisories are effective to manage pest	82
4.	Saves time to access advisories	71
5.	User friendly	69
6.	Feedback can be recorded	51
7.	Weekly advisories can be accessed through Crop monitor	48
8.	Technical information about Paddy can be accessed through Crop guide	35

Perceived benefits of M-Velanmai by farmers

*Multiple responses recorded

"M-Velanmai" an Artificial Intelligence based extension advisory system was released as a technology by the University Variety and Technology Release Screening Committee (UVTRSC) in 2024. It is recommended for use by paddy farmers of Tamil Nadu.

Way forward

The M-Velanmai app. facilitates farmers with scientific knowledge on crop cultivation practices and empower them to make rational choices in producing crops of better market value through offering information-based services. AI based pest detection using smartphone applications can support farmers in monitoring the crop's health by identifying the pests in the field. More pragmatic farming can take place with the support of AI which helps in improving agricultural yield and reduce potential risks. Hence, the AI powered M-Velanmai application would serve as a technology provider to the farmers besides an eye opener for agricultural scientists to contribute towards more systematic research on AI in agriculture.

M-Velanmai model of extension advisory system has been proved to be effective for technology transfer in Tamil Nadu. It can be developed in other major crops of Tamil Nadu to facilitate technology transfer and decision support to the farmers effectively.

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Policy BRIEF

CARDS, TNAU AG. EXTENSION POLICY BRIEF No. : 1

M-Velanmai: Artificial Intelligence based Extension Advisory System

The existing extension system in India with inadequate staff strength may not be able to provide the required decision support to the farmers. The NABARD's All India Rural Financial Inclusion Survey of 2016-17 estimated the country's "agricultural households" at 100.7 million. But the actual extension worker to farmer ratio is relatively low at 1:1162 against the recommended extension worker to farmer ratio of 1: 750 (Nandi and Swamikannu, 2019). This scenario emphasizes the need to seek the support of more advanced technologies like AI to guide farmers to improve the outcomes from agriculture.

India's digital transformation is happening at an accelerated rate. Number of Smartphone subscriptions is expected to touch more than 8.06 billion by 2029 which was 6.97 billion in 2023 (Source: Ericson Mobility Report, 2023). As on November 2023, 130 million 5G users were in India, Nepal and Bhutan. As per the Telecom Regulatory Authority of India, 78 million wireless subscriptions are from Tamil Nadu as on 30th March, 2024 (TRAI, 2024). It is clear that digital technology, specifically connectivity, will increasingly support agricultural extension service providers to reach out to the farming community. This has opened up the opportunity for agricultural extension system to drive innovation in digital extension services and introduce new means of technology transfer to the farmers.

With this background, the 'M-Velanmai' (Mobile Agriculture) study addressed the following research objectives:

1. To design and develop an artificial intelligence based Agricultural Extension Advisory System named 'M-Velanmai' which can facilitate farmers to access the needed decision support in Paddy.
2. To pilot test, validate, and upscale M-Velanmai: Agricultural Extension Advisory System in Tamil Nadu.
3. To assess the perceived benefits of M-Velanmai by the farmers.

Design and Development Process Involves 3 steps:

I. Collection of Data base for App. creation

- High quality images of the crop damage symptoms with varied resolutions under diverse backgrounds were captured using Digital camera and Smartphones from various districts of Tamil Nadu viz., Villupuram, Cuddalore, Tindivanam, Kanchipuram, Tiruvannamalai, Kanyakumari, Tirur, Thoothukudi, Tirunelveli Aduthurai, Madurai, Erode and Paddy Breeding Station, Coimbatore.
- The images were collected from real field situations with and without background under different lighting conditions and crop growth stages and diverse scenarios such as different resolutions, in different times of the day i.e. morning, afternoon and evening hours and from different geographic locations, climatic condition, varieties and environmental conditions.
- A total of 29,500, 11,500, 19,000 and 27,000 photographs of damage symptoms from Paddy were collected in 2019, 2020, 2021 and 2022 respectively.
- Among the 87,000 photographs collected good quality images covering all major damage symptoms in paddy crop were gathered for machine learning.
- The photographs were sorted, validated with concerned scientists (CoPIs) and labelled crop-wise and symptom-wise for the purpose of image classification under machine learning.
- These photographs were stored in the cloud server to access, recognise and deliver the appropriate solutions based on target query received from the users of the android application.

II.Content development for M-Velanmai app.

- Advisories limited to 250 characters for the management of crop damage symptoms of Paddy were prepared in English and Tamil and validated with the concerned Co-PIs. Technical advisories were gathered from crop production guide 2020 (Agriculture & Horticulture), TNAU Agritech portal and a crop-based repository of approved use of registered insecticides.

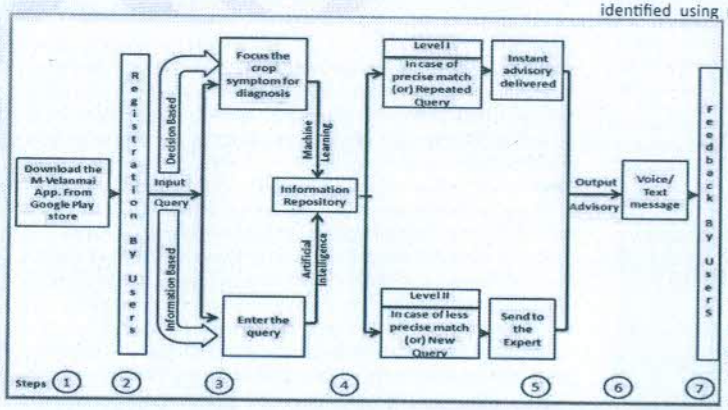
- Database on advisories for the management of crop damage symptoms (pest / disease / nutritional deficiencies / weeds) of paddy was prepared in bilingual form.
- Content for the weekly push notifications on the weather-based package of cultivation practices was prepared for paddy crop.

III. Development of android app on M-Velanmai

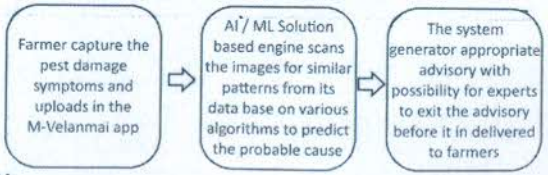
- After many trails, it was found that Flutter with Dart programming, Python programming and Firebase platform were suitable for building an AI based android mobile app. "M-Velanmai".
- The 1st version of the M-Velanmai mobile applications with 45 user interface pages separately for three groups of users namely Farmer, Scientist & Admins and its architecture till database level has been designed and developed.
- The M-Velanmai app. was developed with user interface features such as bilingual mode of query registration, reciprocal interaction between the experts and users, crop cultivation guidance based on weather forecast through weekly push notifications, market info, enquiry list for farmers etc.

The development of artificial intelligence based Agricultural Extension Advisory System named 'M-Velanmai' involves the following framework.

Framework of M-Velanmai



The work flow of the technology outreach process involved in M-Velanmai – Extension model



M-Velanmai application was pilot tested in the Paddy cultivating villages pertaining to five different sub basins namely Aliyar, Nandhiyar, Upper Bhavani, Varahanadhi and Lower Vellar with 25 farmers in each sub basin. Based on the user's feedback, the validation of the M-Velanmai application was done to make it more useful and relevant. Upscaling of M-Velanmai was done in the Paddy cultivating villages pertaining to the following 10 sub basins namely, Cauvery delta, Lower Bhavani, Lower Palar, Lower Vaigai, Lower Thamiraparani, Pachayar, Pambar, Thirumanimuthar, Lower Vellar and Varahanadhi. A survey was undertaken with a random sample of 10 users of M-Velanmai application in these 10 sub basins of Tamil Nadu (Phase I & II) to understand the perceived benefits of M-Velanmai.

Decision Support Service

'M-Velanmai' is an AI based visual diagnostic tool for the farmers to detect pest/disease/ nutritional deficiency problems in paddy. The causal factors for crop damage are identified using machine learning based classification. A digital repository was made with 3000 to 5000 images per pest/disease/nutritional deficiency symptom for paddy along with the appropriate recommendations as solutions for solving.

If a farmer seeks advice for problem based queries, such as pest/disease/nutritional disorder/weeds, he needs to capture the crop damage symptoms through his mobile camera. The captured image will be uploaded in the server. The app through machine learning models will compare the captured image with the images stored in the cloud server. The app will retrieve the most appropriate match for the image captured by the farmer. If the match is valid to an extent of more than 95 per cent precision level, the causal agent along with the suitable management practices as advisories in the form of text will pop up instantly to solve the problem of farmers. When the accuracy of identification is less i.e. less than 95 per cent precision, the farmer will be requested to send the photo of the target symptom to the agricultural experts for advice. The experts will identify the problem and offer personalized advisories in the form of text message in English/Tamil to the farmers as a reply to their queries. The images uploaded by the farmers will be stored in the digital repository and will be used for future problem identifications.

Information Support Service

M-Velanmai app. is designed to serve as single window platform for delivery of information services such as weather forecast, details on crop cultivation practices, fertilizer recommendations etc. to the farmers.

Deep Learning Framework in M-Velanmai

In order to build an AI model using Deep Learning technology the following five major activities were carried out which formed the basis for creating the framework in M-Velanmai application development. They are, (i) Data collection, (ii) Data pre-processing, (iii) Data Augmentation, (iv) Feature extraction and (v) Object Detection

i. Data collection: This forms the first step in building the pest detection model. It is well aware that, the quality of output is deeply influenced by the quality of input, high quality images were collected by DSLR and smartphones under diverse scenarios such as different environmental conditions.

ii. Data Pre-processing: This involves manual labeling and cropping the images to give major focus on the region with symptoms in the photos captured. To work with Convolutional Neural Network (CNN) models (FAInet), large datasets with manually labeled targets are required. Initially when it was started to train the model to classify the infected images from the healthy ones, it has been the issues of misclassifications with a dip in the prediction accuracy was confronted. Then it has been tried with cropped images where we could observe an improvement in the model performance metrics. Hence, data pre-processing work serves as the mandatory prerequisite for preparing the data for training the machine. Here, the symptoms were labeled used Label Img software.

iii. Data Augmentation: It denotes increasing the input which involves rotation of the existing images randomly, zooming in, flipping the images, etc. Random brightness was given to the images to replicate the field level settings as the intensity of sunlight fluctuates throughout the day inducing changes in the colour features. Hence, data augmentation step is considered crucial assuming that the machine will be trained for all the field conditions and is expected to produce reliable prediction in real time situations.

iv. Feature Extraction: Features such as color, texture, shape was extracted. Feature extraction is done to retain the patterns of the damage symptoms without loss of information. Four coordinates namely X, Y axis, height and width were considered to identify (or) recognize the datasets.

v. Object Detection: Lastly, CNN architectures (FAInet architecture) were trained based on the extracted features for classification into pest infested and healthy leaf. The FAInet model performed better compared to other CNN models with the training accuracy of 98 % and Validation accuracy of 95 %. Further to achieve cent per cent accuracy, Object detection model was attempted. Object detection refers to the identification of each object present in the given image. The model identified the presence of symptoms in the image indicated by the boxes. The percentage of symptom present in each box is reflected in the predicted output image. By considering mean of the percentage of symptom in each box, the percentage of damage symptom present in the picture comprising of healthy grains, leaves etc. can be worked out.

"M-Velanmai" app. is an interactive, demand driven and personalized android mobile based extension advisory system for accessing, appropriate and timely technological information / decision support in agriculture by the farmers of Tamil Nadu. M-Velanmai uses the techniques of AI/ML to provide two types of support services viz., decision support and information support for the benefit of farmers.