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Personalized Advisory and Climate Information Service for Smallholders of South Central India

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ABSTRACT: The remarkable penetration of smart phones and enhanced rural internet base/IT infrastructure can be mainly attributed to the devices user-friendly interface and low data cost/free government-sponsored internet. ICT appliances in agriculture enables farmers to leverage digital technology as a potential tool by providing access to location based, personalized, and various factor specific advisory services. In this context, an initiative, "GreenPHABLET™ powered by the GreenSIM," is implemented in India to benefit small farm holders wherein farmers can access their farm-specific information through Green Phablet. It is an appliance which is a combination of rugged tablet with robust hardware, specially designed to suit challenging agricultural field situations powered by Green SIM Card, so as to utilize the core functions of a SIM card, for delivering free Voice calls along with app-based information. The advisory is transmitted based on the cloud-powered intelligent information database built by annotating the data collected from various scientific personnel involved in the agriculture domain. The database has been built to facilitate the provision of a wide range of information services. Personalized advisories services were provided on fertilizer application, market intelligence, demand and supply patterns, weather forecast, traditional and modern crop production techniques, disease and pest management practices, etc. Another set of voice based participatory advisory also provided to the farmers to create interest and improve the listening patterns. In this context, an impact study was conducted to analyze the effect of ICT-mediated technology intervention in delivering personalized information services, including climate-related information on Pigeon pea varieties throughout the crop season in the Adakkal region Mahabubnagar, Telangana. The focus group for the study was 300 active users across 21 revenue villages. The results showcased that personalized advisories are practical and relevant as they provide customized information services to individual farmers. The average pick-up percentage and listening duration of voice messages among the farmers increased when messages were broadcasted using their fellow farmers' voices as compared to the Voice of artists.

Keywords: Green SIM, GreenPHABLET, ICT mediated personalized advisory services, Information database

Introduction

In a developing country like India, the agriculture sector has always been and remains crucial in transforming the economy, as it is evident from its significant contribution of 16.5% in 2019-20 to the national GDP (Economic survey 2019-20) and employment provision to around 70% of the rural households, of which 82% are small and marginal farmers (FAO, 2021). The agricultural sector constantly absorbs and still demands a lot more innovativeness because the country requires to be developed in agricultural practice management on multiple facets. This insight marked the importance of interlinking technological advancements in the field of agriculture. Ever since the relentless efforts of the technical experts involved in National Agricultural Research and Education Systems (NARES) led to the successful initiation of integrated IT-powered communication services (ICT) for the diffusion of agricultural innovations.

The Sustainable Development Goals (SDG's) have once again underlined the importance of agricultural development to achieve global food & nutrition security. Food demand is predicted to rise due to population increase. There is a need to produce 70% more food by 2050 to feed an additional 2.3 billion people (FAO) with limited resources topped by the vagaries of climate change. The current yields in the smallholder farmers' fields are well below their potential and there is a lot of gap between current yield potential and the yield that they can achieve. Among other critical factors, lack of awareness of the latest agricultural research and development and access to quality inputs such as seed, pesticides, and fertilizers cannot be ignored as the main reason behind this. As per the National Sample Survey Organization (NSSO, 2005), sixty per cent of farmers have little access to advanced agricultural technology knowledge, resulting in a substantial adoption gap.

Furthermore, the gap between the public extension personnel to the farmer is expected to be 1:2000 (Kumar, 2012), which means there is only one public extension officer per 2000 farmers. With that ratio meeting, the farmer information needs of the smallholder farmers become even more challenging. In this scenario, smallholder farmers must be empowered with contemporary ''ICT's which can empower the smallholders to fulfill their information needs. However, it is also equally important to ensure that while implementing any ICT-mediated agricultural project, the use of ICT' 's itself should not be assumed to be the sole solution to the problem. Instead, the '

'ICT's should be integrated with the existing systems/process to amplify the current process and overcome the gaps.

Agricultural practices are hugely knowledge-intensive. Lack of knowledge nearly accounts for up to a quarter of the 'yield gap' between what farmers achieve and what they could achieve (Hengsdijk and Lageveld, 2009). The guiding principle that underlies the diffusion of any innovation is that its reception is majorly dependent on the right channel, right time and to the right person keeping social context in mind. Hence, using a flexible and decentralized participatory extension approach relaxes the constraints to be faced to a greater extent. Like how providing fork is not a solution to solve one's hunger, the mere provision of hardware and software services does not help farmers confront the challenges before them. Agricultural Extension personnel has always played a phenomenal role in providing real-time, comprehensive, and contextual information services to farmers, ensuring effective management practices. They are supposed to be trained to use technology effectively, which the extension personnel can only perform.

The portability and tech-enhanced features have credited ICT mediated mobile phone extension approach outpace the conventional radio and TV mediated transmissions having relatively limited farmer outreach. Many studies have also found that climatic data and agro-advisory services based on ICT can help farmers make better crop management decisions, technology selections and marketing strategies (Ospina and Heeks 2012; Kumar and Singh 2012; Mittal *et al.* 2010). ICT has enormous potential to increase agricultural productivity in developing nations, where timely access to agricultural information is constrained by various variables, like information availability through trusted channels (World Bank 2017).

Nearly 13 crore farmers live in India, with three crore owning smartphones and having an essential awareness of digitization. (Suparna 2018). India, home to one-fifth of the world's smallholder farmers, is on the cusp of a global intelligent farming market that is expected to develop at a compound annual growth rate of 13.27 per cent to $12 billion in 2021 (Suparna 2018). At present, only 10 to 15 per cent of the farmers benefit from mobile phone services, and about 24 perfect farmers are aware of it (CGIAR, 2012). Reliance Jio free calls and affordable data services have brought a data revolution in rural areas. Also, the Govt of India initiated " Bharatnet," the ' 'world's largest rural broadband project by Bharat Broadband Network Limited (BBNL), committed to providing high-speed 100 Mbps broadband connectivity to all the 2.5 lakh gram panchayats in India. The BBNL network is expected to provide a connection to all Gram panchayats in due course. With this kind of rural ICT Infrastructure, the methodology of extension services will address a total change. It is very timely to start huge ICT initiatives for the benefit of all the farmers in India. In India, where agriculture employs 52 per cent of the population but contributes just 13.9 per cent of GDP, customised and personalised advice is extremely vital. The number of independent farmers has climbed to 88 million, despite near-stagnant production, due to fragmented landholdings. The only customized advisory can help farmers to accelerate growth (Jhunjhuwala *et al.,* 2013).

GreenPHABLET powered by GreenSIM

The GreenPHABLET appliance is a farmer centric digital intervention which is designed using the hybrid technology that combines elements of Rugged hardware, mobile app and web portal with a single underlying database. This ICT enabled intervention facilitates bi-directional information exchange between farmers and all the scientific and administrative stakeholders involved in the agriculture domain. This facilitates easy exchange and retrieval of prompt information at both the ends. The mobile application is specifically designed to be accessed by farmers. They are registered in the application and are provided with unique username and password so that they can right away access the information developed pertaining to their own field that simplifies the tedious task of searching for information if dumped altogether, otherwise.

"GreenPHABLET™ powered by GreenSIM" for personalised agriculture advisory services: In order to overcome the challenges of the 21st century fostering the capacity of million individuals involved in the agriculture domain, ICRISAT, upon a strategic partnership with IFFCO, came up with ICT integrated Green SIM initiative and later paired it with a specially designed hardware device named GreenPHABLET and the entire process is being implemented under the pilot project named "Krishi Vani". GreenPHABLET is a unique appliance that is a combination of hardware and software. Hardware is highly rugged to suit the agricultural field conditions. The software is a database-driven software with two parts: (i) Android app which can be accessed via an Android-based tablet/GreenPHABLET; and (ii) Web app, which can be accessed on a desktop/laptop. The android app, which can be accessed on a tablet, is designed as a mobile data collection tool and an information dissemination tool. Farmer facilitators use this app to register farmers and collect farm-level data using the application. They also provide targeted information to farmers, such as soil test-based crop-specific fertilizer recommendations and crop-specific improved practices in the local language. This information is tailored for a particular farm based on the specific farm details available in the database. Availability of information is restricted based on the jurisdiction of the logged-in user.

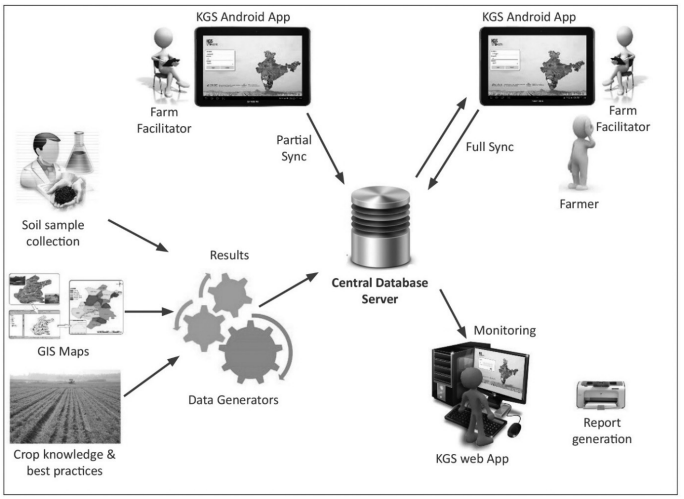

Fig. 1: Architecture of GreenPHABLET Software

Green SIM has been designed to leverage the core functions of a sim card where it is possible to send free personalized audio and video calls as an improved alternative over the usual standard extension approach of delivering complimentary messages. Additionally, it is enabled to deliver personalized messages in regional language.

Motivated by the success of GreenSIM, International Crops Research Institute for Semi-Arid Tropics (ICRISAT) developed GreenPHABLET. This is a GreenSIM- powered Tablet and is a robust and intelligent hardware device specially designed to suit the farmers exposed to field conditions. In other words, it can be used in any weather conditions and has a special resolution that can be accessed quickly, even under the sun. It was designed to develop an alternative equivalent to traditional village information KIOSKs. The advisory services are now brought to farmers' doorstep to facilitate easy access to scientific knowledge.

Fig. 2: Screenshot of the farmer registration module

Given the above, the researcher has attempted to study the customized climate information service to benefit smallholders of the Adakkal region of Mahabubnagar, Telangana, India, one of the significant drought-prone regions of South Central India. There was a need to understand the integrated approach by combining the better varieties, inputs coupled with contemporary ''ICT's to empower the farmers to have better access to information services to have better yield, thereby better income and high socio-economic status. In this context, the study's objective is to analyze the effect of participatory and personalized agricultural advisory services through GreenPHABLET or mobile services.

Materials and Methods

Study area

Adakkal in Mahabubnagar is a significant drought-prone region of South Central India situated at around 100 km from Hyderabad, the state capital of Telangana, India. This area features many unemployed persons, and the majority of the households here are classified as poor. Drought has generated a significant level of seasonal out migration in this area, marked by extreme seasonal variations in markets and income. There are regions of the country where there is a continuous and severe lack of water, causing misery among rural households and animals. Over 75% of the rural population is engaged in agricultural, dairy farming, and allied activity, making agriculture the main occupation of the local people. Due to the lack of an extensive irrigation system, agriculture relies on sporadic rainfall. Most tube wells, open wells, and tanks in this area frequently go dry due to low and variable rainfall, causing the area to become very drought-prone. With an average rainfall of 391 mm to 542.6 mm per year, the region has been classified as one of the poorest and most drought-prone in south-central India. ICRISAT has its experimental hub at Adakkal, a cluster of 21 revenue villages spread in an area of 19,397 ha. The coverage is available in all communities, and the federation has over 8000 members, all of whom are women. The active participation of the AMS members and the rural families encouraged us to select this as the study area.

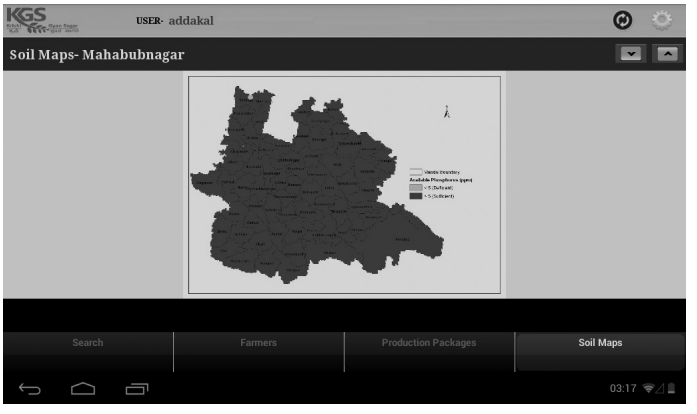

Fig. 3: Soil fertility map of Mahabubnagar displayed in the KGS app

Description of the study group

This impact study was conducted with 300 farmers across 21 revenue villages from Adakkal Mandal of Mahbubnagar

district, Telangana, India. Attributed to the pro-activeness of the smallholder's farmers of the region in using the ICT tools and services, it has been serving as an experimental hub of ICRISAT. The farmers of this region were supplied with improved and drought-tolerant pigeon pea varieties coupled with ICT-enabled GreenPHABLET powered by GreenSIM. ICRISAT, upon a partnership with IFFCO Kisan Sanchar Limited (IKSL) and Agro Forestry Ecology centre developed "Krishi Vani Information service", a successful information dissemination platform through which ICRISAT communicates the farmer community under its operational area.

Data collection and analysis

This is a field-based descriptive and exploratory study. The data were collected by using a pre-structured interview schedule and the Focused Group Discussions (FGD) method. Focused Group Discussions were conducted with farmers from 21 revenue villages from the Adakkal Mandal of Mahabubnagar district, to whom improved varieties of the pigeonpea seeds were distributed. They were also provided support in terms of scientifically supported information needs across the crop life cycle. The data were analyzed with the help of Microsoft Excel and SPSS 20.

Results and Discussion

Personalized Advisory Services

For around two months, voice messages were sent to the farmers via Krishi Vani Information System in Telugu, the regional language spoken in the study area. The personalized voice messages pertained to pigeonpea crop and corresponded to different pests/agronomic practices relevant to particular climatic conditions and the location of the particular farmer's farm. Weather-based forecasting of disease and pest attack patterns and timely and suitable agronomic practices are much needed than advice measures for prevention.

This needed collated information from different stakeholders of high expertise who experimented on the pigeon pea crop. The data recorded by the IKSL server gave positive results that can be inferred from the improved listening pattern and call pickup rate by the focused farmers' group, from the comparative study of the voice messages recorded in artist's voice to that of farmer's voice from the same community. Ganesan *et al.* (2015) on the basis of a study carried out in the Indian state of Tamil Nadu concluded that majority of the farmers considered the information received on their mobile phone as a trusted. Almost all the farmers were very satisfied with audio quality, simplicity of language and contents of voice messages. Majority of the farmers have indicated that the mobile voice messages were better suited to them as compared to other sources of information that they were accessing.

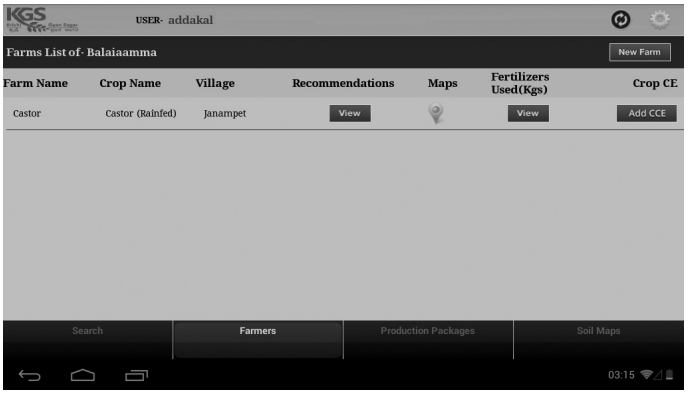

Fig. 4: App indicating the farms owned by a farmer

During FGD, farmers indicated that they need customized/ personal advisory for each one of them. On further discussions, we need to provide personal advisory to each farmer based on 1). Crop-Variety 2). Location 3). DAS (Days after Sowing). Farmers must provide these three things to the system to roll out customized advisory based on various static and dynamic parameters.

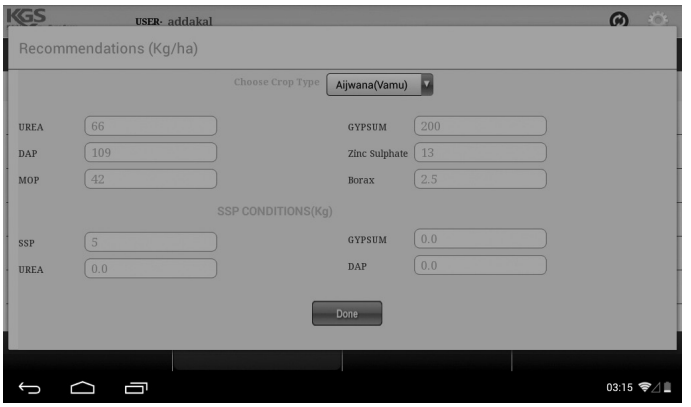

Fig. 5: Crop and location-specific fertilizer recommendation for each farmer

Mr. Mohammed Nasirudin, a resident of Mahbubnagar, Addakal district, has been engaged in farming and rendering agricultural extension support to other smallholder farmers for the past six years. He was engaged in growing crops like rice, groundnut, pigeonpea on the leased farms for the past six years with the help of the ICRISAT. When asked about his interest in agriculture and the role of ICRISAT in strengthening the agricultural practices at Addakal district, Mr. Nasirudin states,

"I was working as an auto driver before becoming a farmer. Six years ago, when ICRISAT came to our village, they provided us with immense support in terms of agricultural and technological knowledge on farming and also provided us with seeds, fertilizers, and ICT tools like mobile phones, tablets, etc." Since then, the scientists and extension workers have frequently visited us, helped us form a Self-Help Group (SHG) and set up an online conferencing studio to have face-to-face chat with

scientists. This helps us to clarify our doubts and problems related to our crops. This way, the scientists have educated us in terms of technology through their projects, Krishi Gyan Sagar and Krishi Vani, which have been very helpful for all of us in the village.

Every day, the farmers receive five-voice messages on their mobile phones, as part of the ICRISAT's ICT for Agriculture Development project named "Krishi Vani", where farmers receive voice messages related to agriculture and health hygiene, and several other topics. According to Mr. Nasirudin- These voice messages are very beneficial as they have helped many of our crops from destruction by untimely rains. All thanks to ICRISAT, we are able to use tablet to get appropriate information about soil, what quantity of fertilizers to be used for a particular crop, etc. and how to enter the data into the tablet to be able to use it in future. Many more farmers like Mr. Mohammed Nasirudin have benefitted from the ICT initiatives implemented in agricultural practices. ICRISAT will continue to help these smallholder farmers to improve their crop production and achieve monetary benefits from them.

Participatory Advisory Services

It is being observed from figure 6 that the average pickup percentage of farmers in one year is more in the case of farmer's voice as compared to the voice-over artist. There was an increase in farmers' call pickup rate when messages were recorded in farmers' voices from their community. It can be because farmers trust more on their fellow farmers as compared to some outsider or artist. They prefer to listen to more messages in the farmers' voice in comparison to some artists.

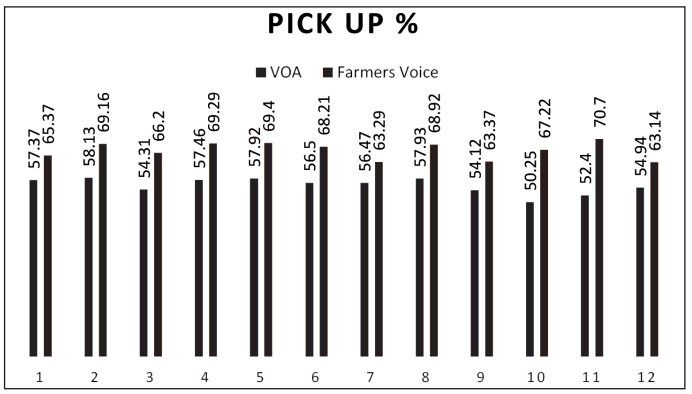

Fig. 6: Average call pickup rate by farmers when they hear fellow farmers' voice to that with voice over artists voice

From the figure 7, it was observed that the average listening duration of farmers has also been increased when messages were broadcasted in their fellow farmer's voice as compared to voice over artists.

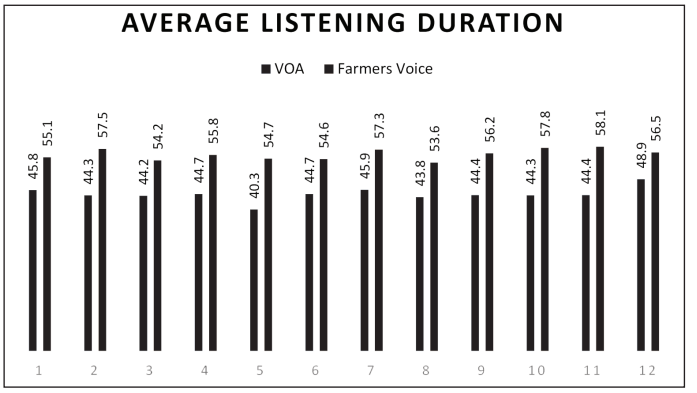

Fig. 7: Average listening duration (in seconds) of voice messages in farmer's voice to that of the voice over artists voice

The impact study is only limited to the small target group of farmers, the comparative results and data suggest that developing the information has shown an increase of around 11.3 per cent both in the phone pickup rate and average listening duration. The results and outcome suggest that farmers farmer's mode of knowledge transfer is still very effective and plays a crucial role in information sharing from one farmer to another. It can also be noted that human intervention still proves to be an effective enabler and enhances the chance of increased adoption of advisory services by smallholder farmers. This approach of using farmers for farmers welfare is called farmer – to –farmer (F2F) approach. Simpson *et al.* (2015) states the benefits of F2F approach, that the organisations using it were able to cover a large number of farmers and extensive areas thus complementing the extension efforts and their sustainability. We find that inclusion of farmers/local expertise in extension and communication endeavours increases efficiency and leads to better adoption of improved technologies.

Conclusion

In the current scenario wherein any mobile interventions offering weather-based agricultural advisory services have been increasingly recognized and used by the farmers, 'ICRISAT's Green PHABLET-Green SIM initiative did not take long to be adopted. This ICT-enabled "participatory based individual farm approach" and more reliable scientific, comprehensive climate-based advisory services have potentially offered early management strategies. These strategies have proactively mitigated the risk faced by the small farmers of South Central India, who are often subjected to vagaries of climate change. Also, the positive results witnessed in the present study in terms of increased call pick up rate and listening duration denoting the 'farmers' willingness to adopt the innovation when implemented using a participatory approach itself is a big motivation. It is high time that more efforts be put by Technocrats and Government in developing and communicating the ICT interventions, which in turn would greatly serve in improving the commercial viability of the farming community.

The growth of Agri tech startups and an increasing number of mobile applications designed to offer personalized advisory services to farmers indicate the growing demand for ICT-enabled solutions to help the farmers confront the challenges before them. ICT integration helps the stakeholders to substitute the traditional solutions. The ICT integration has brought in much scope in agriculture to offer solutions ranging from Financing, advisories related to insurance payouts linked to weather/field data, and data-backed credit risk assessment. Also, inputs regarding awareness-raising and access to information regarding online marketing for inputs and Precision farming and Predictive pest and disease management practices using remote sensing data. Fields of Supply chain management, e-marketing, and price discovery can also be brought under the purview of ICT-enabled personalized advisory services. This demands for the creation of "agristack" for common agricultural data standards and sharing mechanisms; creation of annotated datasets and for use in the agriculture domain, and creation of API layer for access to relevant scientific information which can realize the personalized advisory and information services to all 13 Crore plus farmers of India.

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