Cropin

SUSTAINABLE LIVELIHOODS & ADAPTATION TO CLIMATE CHANGE (SLACC)

2017
2020

Project End Report on Cropin Service in SLACC Intervention Project - Bihar

CONTENTS

FOREWORD

With production of agriculture activity of **$375.61 billion,** India is 2nd larger producer of agriculture product. India accounts for **7.39 percent of total global agricultural output.** The agricultural sector represents 35% of India's Gross National Product (GNP) and as such plays a crucial role in the country's development. In recent years there had been tangible change in environment and the climate. In India 67% of net sown area are under rain-fed condition. The effect is enhanced many fold due to fact that most of rural population are under poverty line. Age long traditional farming practice, low income, illiteracy, gender inequality and fragmented lands had contributed to poverty in rural areas. The same factor also makes this segment vulnerable to climate changes that adversely affects crop production, livestock performance and judicious utilization of available resources. In recent years global warming has become a tangible phenomenon which have largely impacted farming at large. Due to the vast size of India and its complex geography, climate in this part of the globe has large spatial and temporal variations. If not countered with adequate, calculated measures the climate change will cause extreme food scarcity and affect multitude of population that directly of indirectly depends on farming.

In order to devise an effective strategy for helping rural masses adopt to climate change that affects on short, mid and long terms, World Bank with SRLMs as implementation bodies has floated the program of Sustainable Livelihood and Adaptation to climate Change for two districts each in states of Bihar and Madhya Pradesh in year 2017. The multidisciplinary and multi-phased project that involved spectrum of agencies ranging from Weather companies, NGOs, agribusiness firms, commercial banks/MFIs to financial service providers and Agritech organizations primarily aimed to deploy the strategy for enhancing farm based livelihood through capacity building, rural enterprise and skills development, access to market and development of entrepreneurship. The project was implemented through mobilization of SHG members in target areas encompassing poorer and economically backward section of society who inherently lack capacity, resources and skill sets to adopt to rapidly changing climatic condition and its impact on farm-based livelihood.In this project, CropIn has played a vital role in bridging the gap in Information asymmetry through its technology intervention. CropIn mobile based platform helped to digitize the farming operation and catered to data driven farming by deploying AI powered application modules that support data capture, real time reporting and recording of field conditions. Computer based interface offered complete visibility and monitoring ease to implementation bodies about the beneficiaries and their farm activities through smart dashboards, reports and charts. CropIn provided complete **MIS solution** that helped in decision-making, coordination, control, analysis, and visualization of information which is an intrinsic requirement to drive such programme.

The challenge to implement such technology based solutions in field also means a robust hand-holding and on-time training to extension teams. Also, constant modification and upgradation in application modules demands that such hand-holding are done on freq uent basis. Beneficiaries also received farm based climate-smart sms advisory modules on crops and livestock from CropIn in order for them to adopt to improved farming practices particularly relevant for climate change agriculture. CropIn had dedicated team planted at the target districts who incessantly carried on the task of training to field- Implementation teams, gathering in-situ feedback and constantly upgrading strategies to make the advisories effective to rapidly changing climatic conditions. Supported by a well groomed and professional team of IT specialists, subject matter experts, management personnel and field coordinators, CropIn has used its technology platform to effectively expand and extend climate smart agriculture knowledge to 4000 target beneficiaries spread across 200+ villages of Mandla and Sheopur districts of Madhya Pradesh, CropIn also helped the state implementing bodies to visualize, monitor and evaluate farm condition data and device implementation methods to tackle the climate change effects.

We do acknowledge our well deserve appreciation to State Rural Livelihood Mission and World Bank team for their immense support and valuable guidance throughout the project tenure.

CropIn envisages to maximize per acre value and make every farmer traceable and SLACC project was indeed a major milestone added to this journey. Each and every such instance of success realized through benefit received by farmers and spread through their smiles makes this conviction grow stronger with each passing day..

2. EXECUTIVE SUMMARY

The SLACC project was launched in 2017 in two districts of Madhya Pradesh- Mandla and Sheopur. The objective of the project was to devise strategies which will help farmer to counter climate change impact on their crop and other farming activities and increase their livelihood. The role of CropIn had been as **Technical Support Agency** who was responsible for disseminating weather based agro advisory to selected farmers of Sheopur and Mandla spread into four blocks, two from each district. The farmers were provided Advisories across three consecutive years 2017, 2018 and 2019 to 4000 + farmer.

4,92,712
Pop & Weather Based Agro-Advisories Triggered

6,545
Alerts Raised & Supervised

4,000+
Farmer Serviced

2
Districts Covered

13,742+
Plots Monitored Across Seasons

10
Subject Matter Experts Across MP

4
Block Co-ordinators

1
Project Managers

CropIn service helped farmers not only to adopt to newer resilient techniques through its world class digital solutions but has also helped digitizing enormous volume of field level data. The effort has caused a shift in mind-frame of beneficiaries from more reactive approach towards more proactive sustainable and resilient agriculture practices. The following report is an effort to capture the on-field experience, learning and status of the project implementation.

3. CROPIN DATA ARCHITECTURE, FRAME WORK & PORTAL SET UP DETAILS

CropIn provides digital platform to monitor and capture farm level data and then accordingly deliver adaptive real time advisories to help farmer get actionable information against changing climatic conditions.

The innovative technology of CropIn has been instrumental improving adaptive capacity of farmers to climate changes. SLACC selected farmers in 25 villages per Block in 2 Blocks each in Sheopur and Mandla districts of Madhya Pradesh over a period of 24 months. The key component of the assignment are as follows:

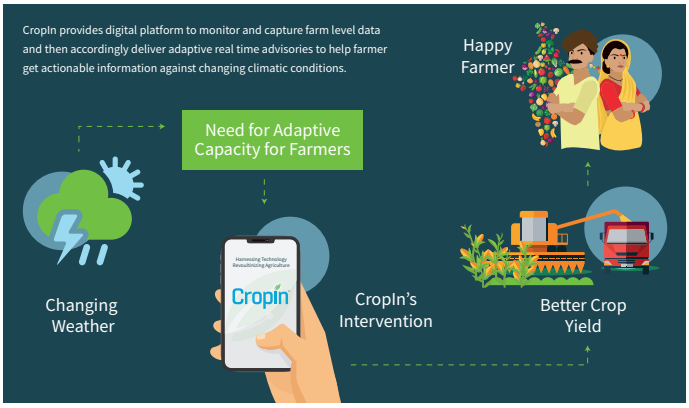
ICTPlatform For Managing Advisory Generation, Transmission Archiving & Data Mining

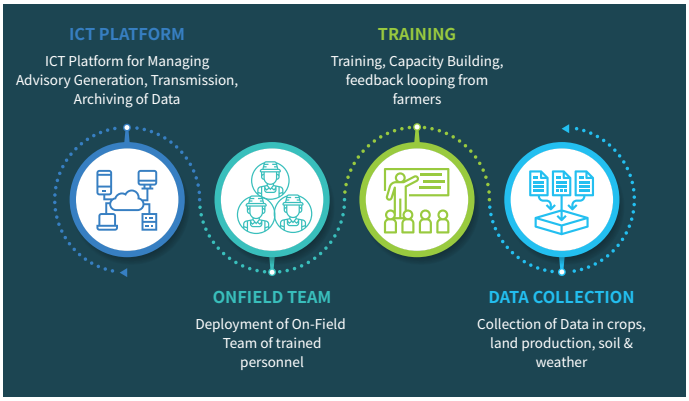
CropIn ICT Platform provides both Web based and mobile platform to transmit WBASS to farmers. The system is capable of electronically receiving and using data generated by third party such as weather forecasts from SkyMet.

Generating And Transmitting Agro Advisories

CropIn adopted the process for collecting data and uploading data on to the ICT Platform, which involves a regular, periodic and pre decided visit schedule for each crop from each selected farm using VRPs. CropIn developed forms and formats for collecting data, crop, pest and disease calendar for selection of critical period for each crop. It also scheduled when the data must be collected, timing and technique of pictorial data (photographs of the crop) collection that shows crop growth, pest and disease attack etc. CropIn provides the following category of messages to farmers:

- Weather Based Advisory and Weather alert
- Crop Management practices (Package of Practices) to be undertaken by the farmer for the stage of the crop.
- Pest and disease forecast and management practices.
- Nutrient management practices for the stage of the crop.
- Soil and water management practices to be undertaken for the stage of the crop
- Animal Husbandry





3. CROPIN DATA ARCHITECTURE, FRAME WORK & PORTAL SET UP DETAILS

Database Management & MIS

The CropIn's platform architecture renders it to store the data collected, the advisories disseminated, action taken by the farmers and results thereof in the form of a database. In addition, the CropIn architecture is able to support querying and providing customized data and reports in various formats such as excel etc. Once the initial platform is setup , the extension network to be leveraged to capture micro level data including details of farmers in the region, land records, crop records, and other components. The data is captured using Android based mobile application. The captured data is visible in an interactive dashboard accessible through a web application giving live updates for each farmer, the activity at the farm. The dashboard also has a reporting & MIS modules.

Alert Raising System

CropIn established a system such that the crop advisories are developed and transmitted within 48 hours of collecting data from the selected farms. While the thrust of the system was to provide proactive (without waiting for a query from the farmer) crop advisories, CropIn made appropriate arrangements to provide solutions within SLA of 48 hours to queries from farmers

The frequency of the crop advisories followed phonological cycle so that advisories adequately cover critical stages of the crop.

Database Management, Data Mining & MIS

The CropIn's platform architecture renders it to store the data collected, the advisories disseminated, action taken by the farmers and results thereof in the form of a database. In addition, the CropIn architecture is able to support querying and providing customized data and reports in various formats such as excel etc.

Technology Specifications &Platform Architecture

CropIn's web platform interface relies on Microsoft technologies, while its mobile app is built on Android. The application instances are hosted on an IIS server and the data is stored on a SQL server database. The web is built on Microsoft .NET MVC framework. The front-end uses combination of Bootstrap theme and AngularJS. Besides Google map is used for visualization of farms. CropIn uses Microsoft SSRS for reports. It also uses Jaspersoft for advanced analytic and dashboard.

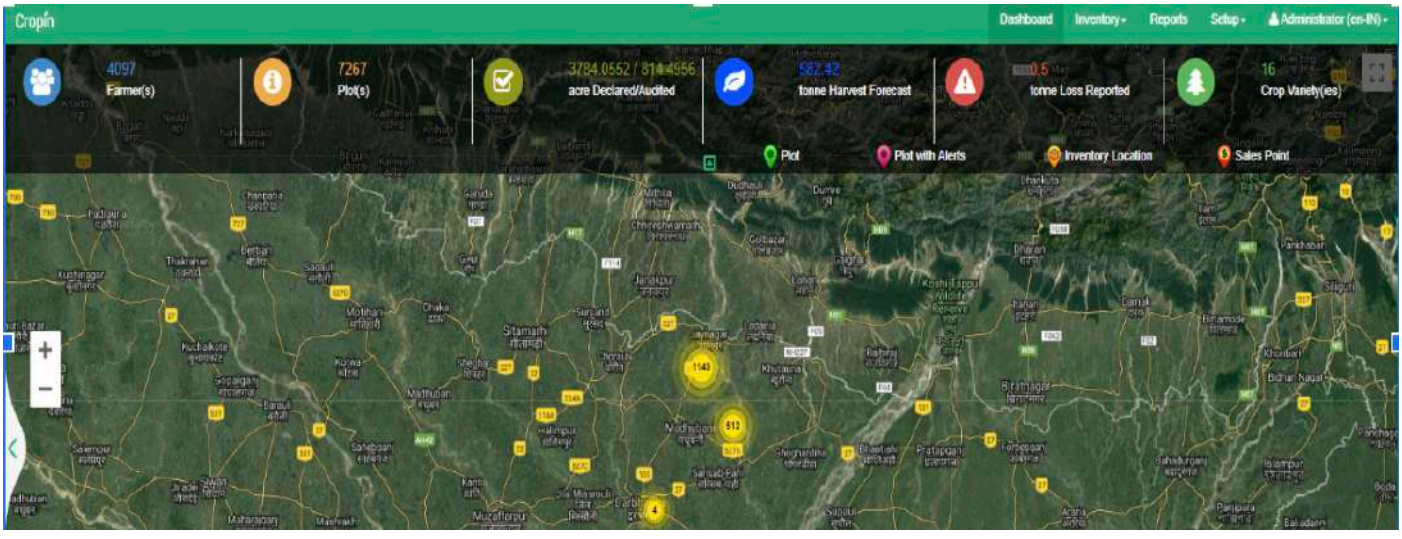


Image 1: Interactive Dashboard

4. CAPACITY BUILDING AND TRAINING

Throughout the Project period of 3 years, CropIn ensured adequate number of staffs who are well qualified and experienced as per ToR. Some of the key staff who have been working in the project:

- Subject matter Specialists (Agronomists) that are familiar with local cropping conditions and local language
- Information Technology Specialists to manage the ICT platform on which the crop advisory system
- Project Manager and Block Supervisors

Community Resource Persons (to be provided by the SLACC project) are responsible for collecting data on crop. Condition, farmer problems, actions taken by farmer on a periodic basis and delivering advisories and explaining it to farmers.

WHO	HOW MANY	RESPONSIBILITY	DEPLOYED BY
Subject Matter Specialist	10	Creation of Content	CropIn Technology Solutions
IT	2	Manage the web & Mobile Platform	CropIn Technology Solutions
Block Co-Ordinator	4	Execute the project in the block	CropIn Technology Solutions
Project Manager	1	Manage Overall CropIn Deliverable	CropIn Technology Solutions
Village Resource Person	97	Extension Work	Ajeevika

4.1. Type Of Training & Content

Training were provided to field level VRPs, YPs and BPMs and also to district level officials about use of application, data management, navigating through reports and analyzing dashboards:

TYPE OF TRAINING	TARGET GROUP	CONTENT	PURPOSE
Awareness Training	Farmers	How application helps the farmers through weather advisory, POP advisory, Alert Advisory. Implication of the messages	Awareness about CropIn app features
Awareness Training	Farmers	Discussion on POP, Agro based, weather based, Alert based Advisory	To enhance understanding of messages
Technical Training	VRPs, YPs	Training of Application features and navigation through the app	Enable field staff with technical knowledge to conduct monitoring and evaluation of farm
Technical Training	VRPs, YPs	Filling of Custom forms target for specific Information gathering	Custom form fill-up training
Technical Training	VRPs, YPs	Interpreting images of crop stage, understanding technical glitches etc	Interpreting the app inputs and common technical issues
Operational training	VRPs, YPs	Planning for season, strategies to decide target villages for intensive intervention, Collection of feedback to measure the knowledge gap	Equip field staff with adequate know-hows to device strategies to plan for season, select region and create feedback loop

4.2. Training Methodology

The meetings are regularly conducted in target villages of Sheopur and Mandla. The primary goal of such meetings are:

- Weather Based Advisory and Weather alert
- Crop Management practices (Package of Practices) to be undertaken by the farmer for the stage of the crop.
- Pest and disease forecast and management practices.

Image 3: Training Methodology

5. ADVISORY

Agricultural production is often volatile due to external factors, such as weather, insect/pests, diseases, and input/output prices. Recently, increasing climatic risks in agriculture are causing serious distresses to farming communities across the world. India is home to 16% of the world population, but only 4% of the world water resources.

Agriculture is directly dependent on climate, since temperature, sunlight and water are the main drivers of crop growth. While some aspects of climate change such as longer growing season and warmer temperatures may bring benefits in crop growth and yield, there will also be a range of adverse impacts due to reduced water availability and more frequent extreme weather conditions.
These impacts may put agricultural activities at significant risk.

Climate change has already caused significant damage to our present crop profile and threatens to bring even more serious consequences in the future (WHO, 1992). Wheat yields are predicted to fall by 5-10% with every increase of 1°C and overall crop yields could decrease up to 30% in South Asia by the mid-21st century. From below depicted Table, it is clear that most of the staple food crops in India are going to be adversely affected. For sugarcane, it was observed that for every 1°C rise in temperature, there would be a marked reduction in its yield

CROP	SCENARIO	PROJECTION	REFERENCE
Rice	2°C rise 1°C rise +2mm rain-fall + 460 ppm CO_2	-0.06 -0.075 ton/ hec + 12% in South India	Sinha & Swaninathan (1991) Sassedaran et al (1999)
Wheat	2°C rise + 425 ppm CO_2	-1.5 -5.8% in Sub Tropical India -17 -18% in Tropical India -10% in Punjab, Haryana	Aggarwal & Kalra (1994) Kumar & Parikh (1998)
Maize	2°C rise + 425 ppm CO_2	-7 -12% in North India	Chatterjee (1998)

(Chattopadhayay 2000).
India could experience a 40% decline in agricultural productivity by the 2080s [9]. Rise in temperatures will affect wheat growing regions, placing hundreds of millions of people at the brink of chronic hunger

5. ADVISORY

Impact On Agriculture Productivity

Agricultural productivity can be affected by climate change in two ways: first, directly, due to changes in temperature, precipitation and/or CO2 levels and second, indirectly, through changes in soil, distribution and frequency of infestation by pests, insects, diseases or weeds. Acute water shortage conditions, combined with thermal stress, could adversely affect wheat and, more severely, rice productivity in India even under the positive effects of elevated CO2 in the future. The mean temperature in India is projected to increase by 0.40C to 2.00C in kharif and 1.10C to 4.50C in Rabi by 2070 (IPCC, 1996). Mean rainfall is projected to increase by 10% during Rabi by 2070. At the same time, there is an increased possibility of climate extremes, such as the timing of onset of monsoon and intensities and frequencies of droughts and floods.

Impact On Soil

The potential changes in the soil forming factors. Both the organic matter and carbon to nitrogen ratio (C: N ratio) in soil will diminish in a warmer soil temperature regime. Drier soil conditions will suppress both root growth and decomposition of organic matter and will increase vulnerability to erosion. Increased evaporation from the soil and accelerated transpiration from the plants themselves will cause soil moisture stress.

Impact On Pests, Diseases And Weeds

Incidence of pest and diseases would be most severe in tropical regions due to favorable climate/weather conditions, multiple cropping and availability of alternate pests throughout the year. Climate change is likely to cause a spread of tropical and subtropical weed species into temperate areas and to increase the numbers of many temperate weed species currently limited by the low temperature at high latitudes.

Agriculture is the main occupation of farming community of India. Transfer of technology plays a major role in disseminating the research outcome to the farming community. In recent years, agriculture is facing severe challenge and coupled with limited man power of extension personnel due to which information need of farmers are not met. In this context, arrival of ICTs in agriculture is well time. The use of ICTs is more prevalent now a day in agriculture. ICT has reduced the costs of gathering, processing, and disseminating information that helps farmer mitigate risk. Applications of ICTs to transfer agricultural risk through instruments such as insurance and future contracts are still quite limited. The widespread use of these instruments seems to be hampered by low levels of institutional development, high costs, inability to customize products to meet smallholders' requirements, and poor financial literacy rather than by the information constraints that ICTs can address. Given the impacts of climate change on agriculture, enhancing farmers' capacity to manage climatic risks is an important adaptation strategy in agriculture and allied sector. Climate smart Agriculture(CSA) focuses on developing resilient food production systems that lead to food and income security under progressive climate change and variability.

Change in crop and livestock management practices, use of new farm technologies, and change in land

5. ADVISORY

use patterns help to adapt climatic risks in agriculture. These practices include use of improved climate resilient seeds, crop nutrients and water management practices, changes in tillage practices (such as conventional to minimum tillage), change in sowing time based on climate information, etc. However, farmers often lack access to updated information on several CSA technologies, practices, and services. Weather Based Argo Advisory on weather forecasts, climate information-based input use and crop management practices, empowers farming communities in tackling climate and market risks in agriculture. One major dependency in dissemination and translation of Climate smart agriculture technologies through WBAAS (Weather based Argo Advisory Services) amongst farmers is extent to which a state has its ICT penetrations. A large number of hot-spot districts with high vulnerability and low access to ICT services are located in Madhya Pradesh where the majority of the population depends on agricultural activities for their livelihoods. This service hence becomes all the more relevant to state of Madhya Pradesh in terms of accessibility and propagation of Climate resilient technologies and advisory based intervention. The application instances are hosted on an IIS server and the data is stored on a SQL server database. The web is built on Microsoft .NET MVC framework. The front-end uses combination of Bootstrap theme and AngularJS. Besides Google map is used for visualization of farms. CropIn uses Microsoft SSRS for reports. It also uses Jaspersoft for advanced analytic and dashboard. Training were provided to field level VRPs, YPs and BPMs and also to district level officials about use of application, data management, navigating through reports and analyzing dashboards:data and reports in various formats such as excel etc.

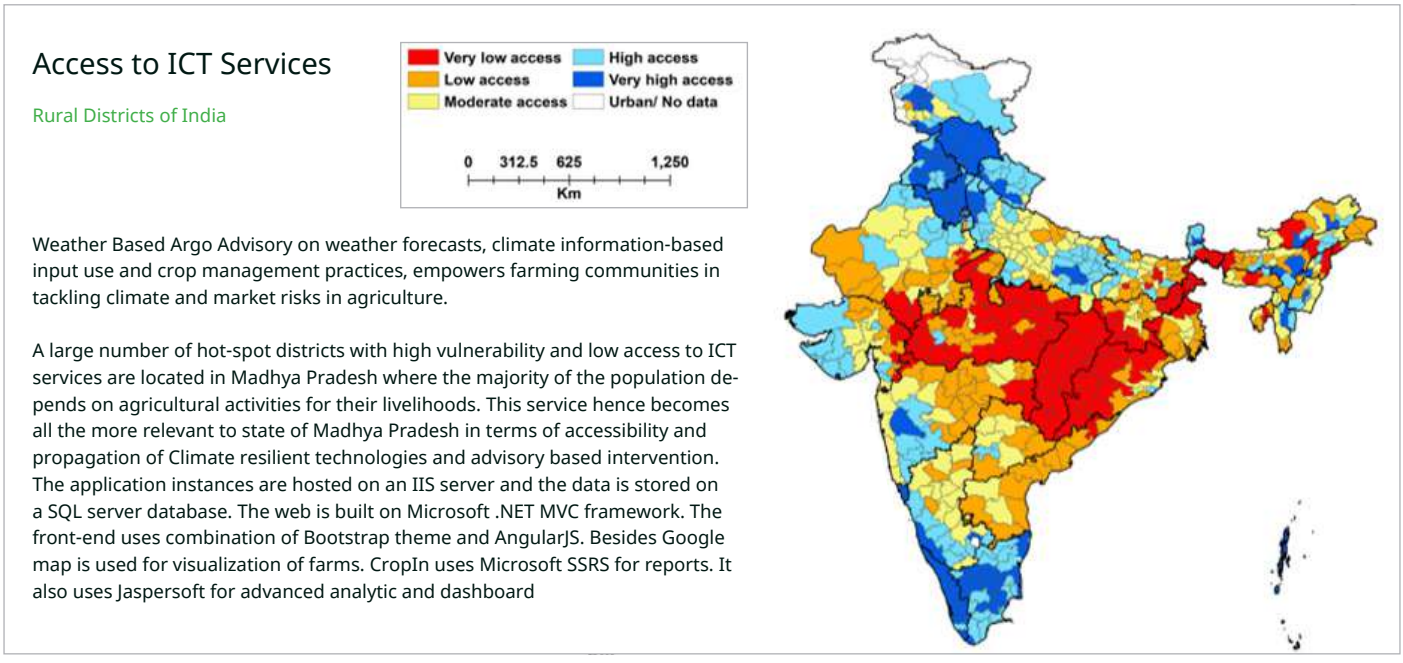


Image 4: Relative ranking of access to ICT services in the rural districts of India

The SLACC project intends to improve the ability of farmers to cope with climate uncertainty. WBAAS component provided by CropIn short-term weather forecasts were intended to help a farming household better schedule farm operation thereby minimizing loss or costs or both. Longer term weather forecasts were intended to help farmers make better varietal or crop choices, make appropriate arrangements to decrease the impact or even put in place adaptation mechanisms. However not every farmer is equipped

5. ADVISORY

with the knowledge (or has access to) in order to make these choices. Therefore, instead of merely providing forecasts, weather forecast-based Agro-advisories that inform the farmer on the likely weather, its impacts on the crop and steps needed to tide over the situation were provided farmers in SLACC. Improved capacity to learn and deal with unexpected, changing and adverse weather conditions is expected to gradually improve farmers' resilience to weather variability and hence prepare them for climate change in the longer-term. The mobile phone-enabled information delivery mechanism has the potential to reduce the knowledge gap between large and small farmers, and also across gender by creating awareness about new technologies and best practices. The information delivered through mobile phones under SLACC pilot project contributed towards reducing information asymmetry among farmers. Participating farmers reported that precise and timely weather-based Agro-advisory messages helped them in taking informed decisions about input use, thus leading to savings on irrigation and reducing the cost of other inputs such as pesticides and fertilizers. Women farmers also said that Agro-advisory messaging helped them make more efficient use of inputs by increasing their knowledge about climate-smart technologies.

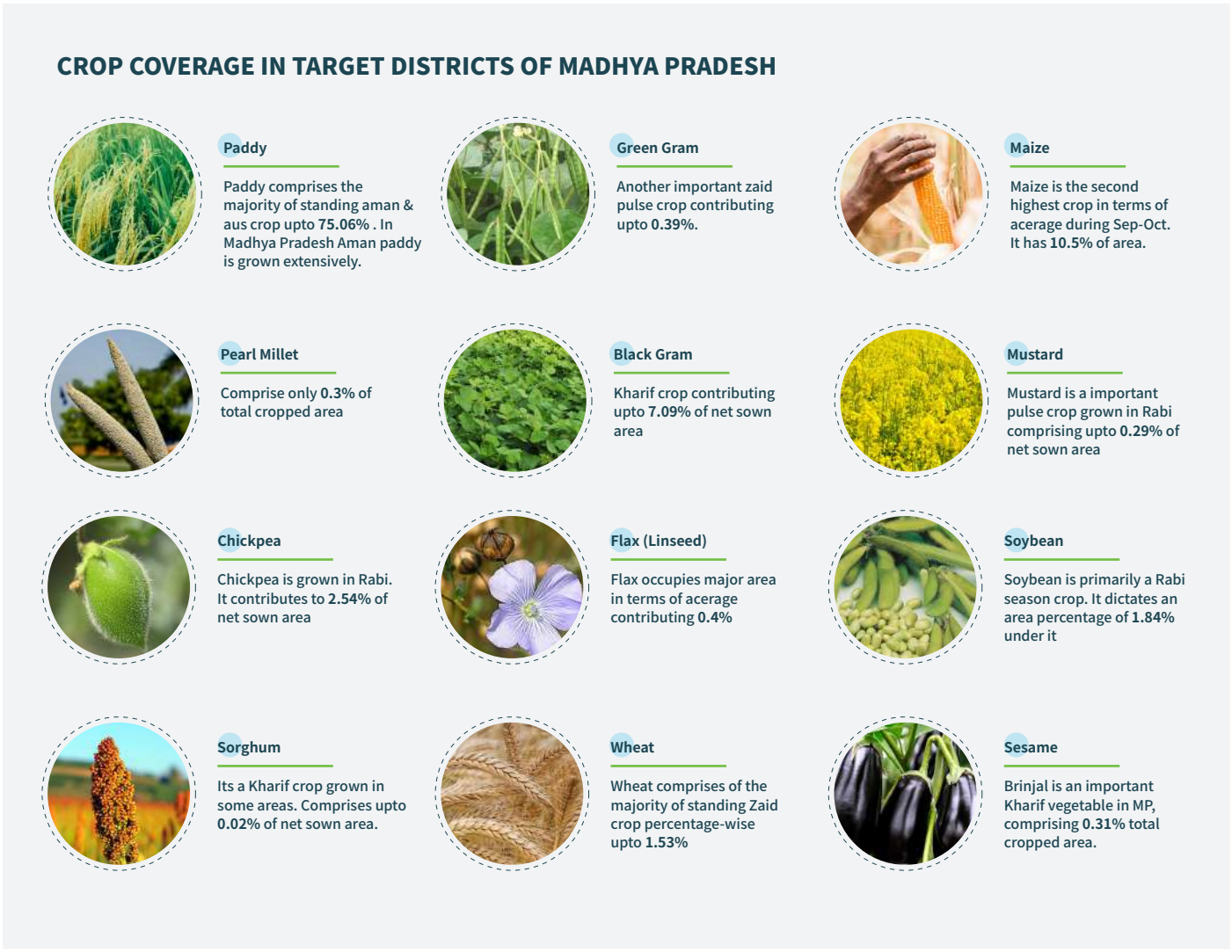


Image 5: Crop Coverage in Target districts of Madhya Pradesh

5. ADVISORY

CROP	MANDLA	SHEOPUR	GRAND TOTAL
Paddy	42573	1300	43873
Maize	5243	631	5873
Black gram	143	4001	4144
Chickpea (Bengal Gram)	795	691	1486
Soybean	2	1073	1075
Wheat	195	697	893
Sesame (Til)	2	437	439
Green gram	5	225	230
Pearlmillet	5	225	229
Mustard	5	167	167
Flax (Linseed)	10	15	25
Sorghum (Jowar)	0	13	13
Kodo Millet	0	4	5
Grand Total	**48975**	**9478**	**58453**

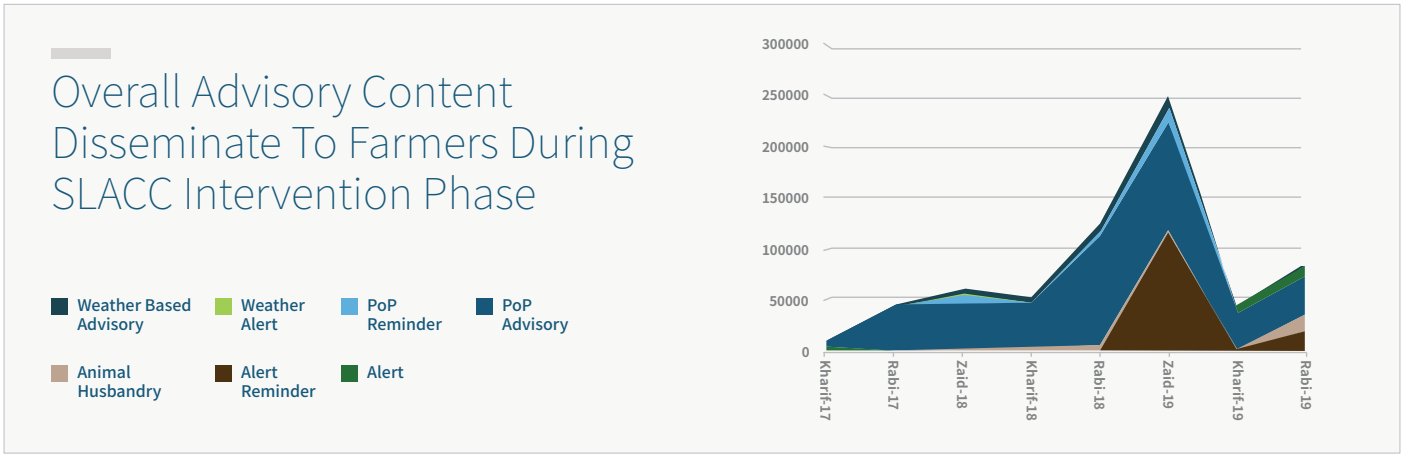
Table 2: Sowing Area of Major Crops Grown in Madhya Pradesh

5.1. Report On Advisory Delivery To 2000 Beneficiaries Until The End Of FY 2019.

The advisory has increased both in quantity and diversity as per the growing farming needs of the farmers. The above chart depicts various category of messages sent to Farmers of Sheopur ad Mandla over years. There has been progressive increase with the peak in year 2019.

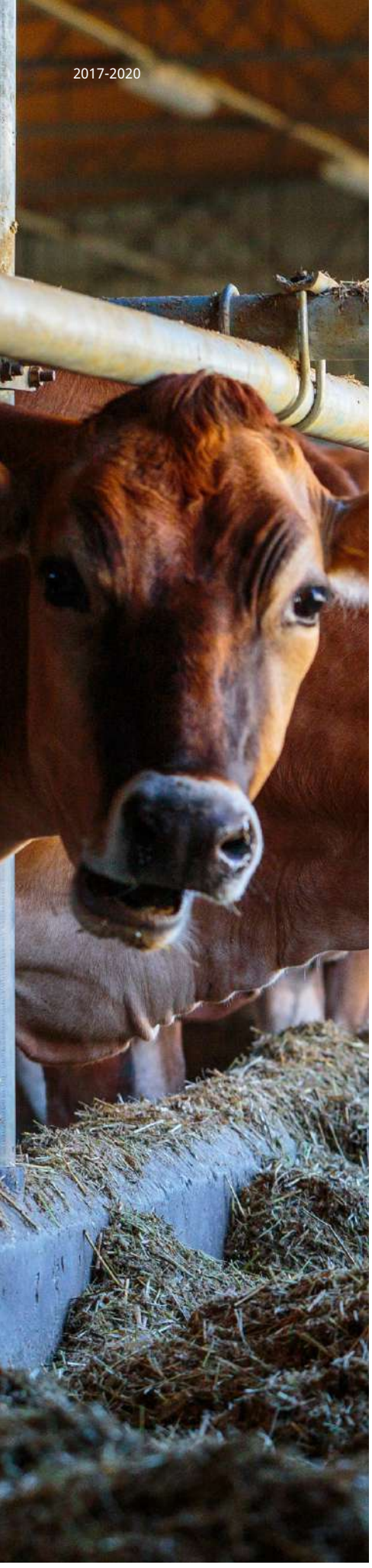
There had been considerable increase in alert reminder messages. This proactive approach ensures that farmers are following the intervention at appropriate time. Alert advisory too had been considerably higher in 2019. This shift from reactive to proactive approach has helped the farmer to judiciously plan their resources right ahead of time and reduce losses at advanced stages of biotic stress life-cycle.

The PoP advisories has been the highest number category of messages being sent to farmers. Alert reminder is the second in category with highest number of messages.Both the trend indicates a proactive and dynamic approach where farmers are encouraged and constantly kept updated with latest climatic conditions and relevant cultural practices. Another significant effort undertake was increase in number of animal husbandry messages.



MESSAGE CATEGORY	2017	2018	2019	GRAND TOTAL
Alert	5756	326	463	6545
Alert Reminder	_	_	136415	136415
Animal Husbandry	_	9840	17721	27561
PoP Advisory	45190	197924	180279	423393
PoP Reminder	2427	6984	15103	24514
Weather Alert	195	1674	522	2196
Weather based advisory	_	19635	21722	41706
Grand Total	**53722**	**236383**	**372225**	**662330**

Table 3: Advisory under various category year-wise breakup



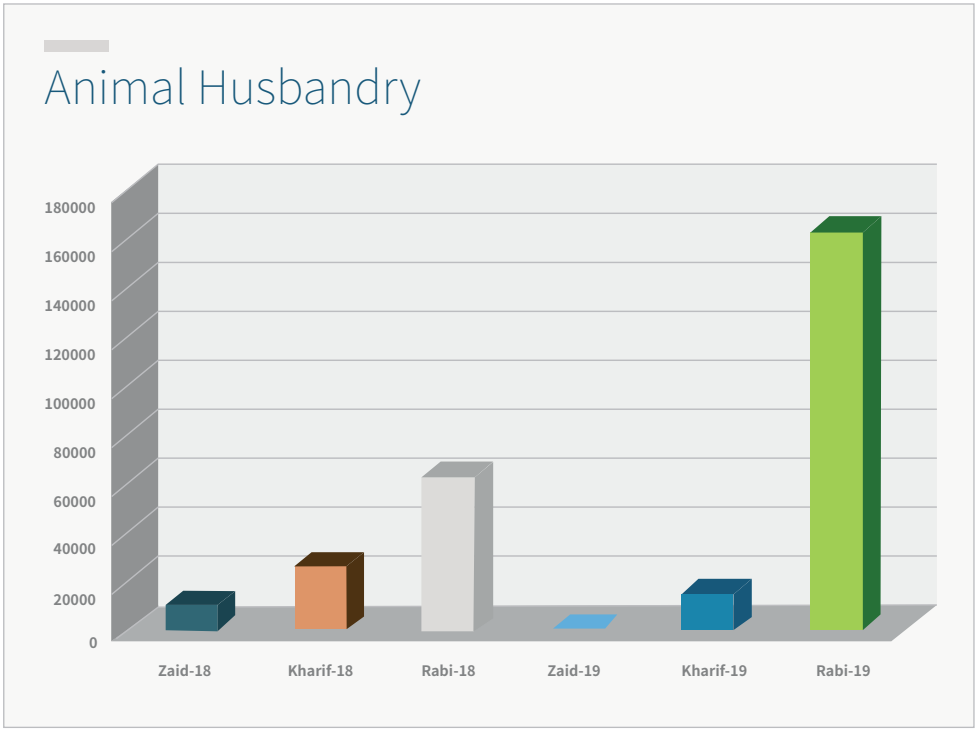
5.2. Status of delivery of animal husbandry messages to farmers in at-least 5 villages in each state.

Objective

Demonstrating a model for delivering livestock (cattle, goats, and poultry, any of these) on a pilot basis in at least 5 villages of each project district. Animal husbandry has been very contributing factor to farmers' livelihoods since olden times and currently a lot to be done to increase the milk availability per person as currently it is 184 gm against the standard requirement of 300 gm (source: http://ahd.bih.nic.in). Awareness to farmers of all standard best practices in this regard which will result in correct breed selection, proper diet management, and timely vaccinations against prominent diseases, treatment of internal parasites, and practices relation to cattle gestation etc.

Content And Spread Of Messages

CropIn technology has provided a robust platform via Smartfarm application to engage such farmers by sending out various set of advisories directly to their mobile phones in order to ensure they are aware of all necessary standard cattle management practices. Timely information of vaccinations, proper diet and information about government initiatives would help farmers sustain and build more assets in terms of incomes from cattle domestication. There is a dedicated Animal Husbandry expert hired who is devotedly working to send advisories and pay attention to raised alerts if any. Following areas are considered vital for by the



5.2. Status of delivery of animal husbandry messages to farmers in at-least 5 villages in each state.

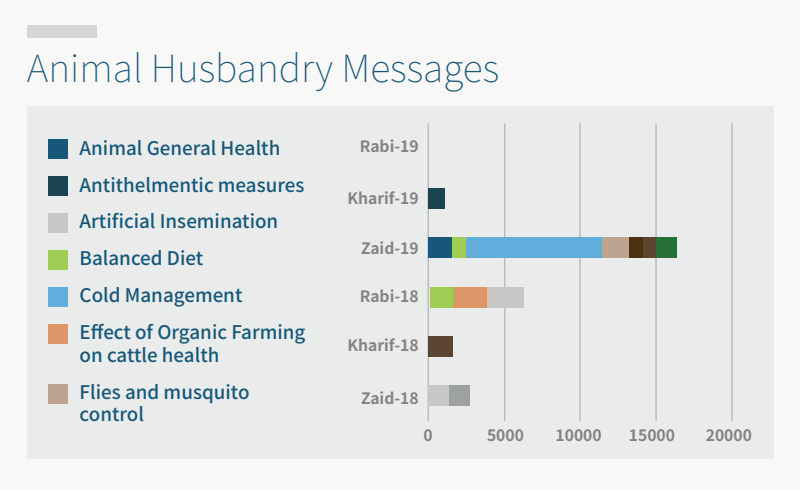
Animal Husbandry experts to advise farmers.With the increased frequency of livestock advisories as well as seasonal disease advisories farmers have been helped immensely. The number of livestock messages being sent to farmers have been increased. Also, it has been ensured that all beneficiaries under SLACC receives the Animal Husbandry messages.The diversity of messages have been increased as well covering all aspects of cattle rearing:

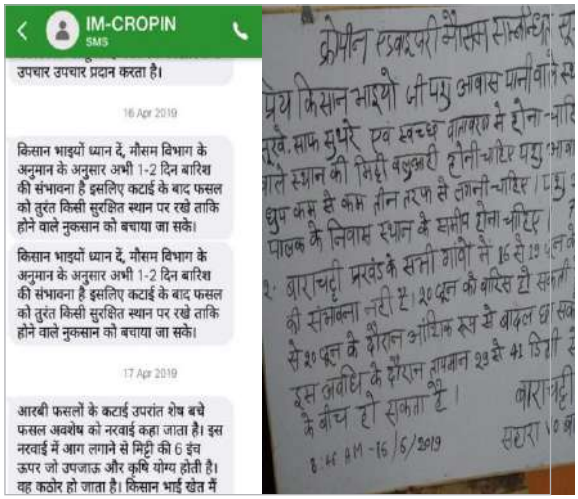
- Variety selection
- Breeding: Gestation, pregnancy, birth
- Feed and nutrition
- Immunization schedule
- De-worming
- Climate based health advisory
- General health and milk production
- Disease and treatment: prophylactic and curative

The advisory topics and number of messages has been drastically enhanced over seasons. The adjacent chart depicts the content types represented by various colour bands being disseminated to farmers under animal husbandry messages.

The advisory sent were relevant to the month and as per the prevailing weather condition of the area. To make the advisory more relevant, feedback from the field were collected on regular interval which acted as feedback-loop mechanism for the content specialists.

Initiating animal Husbandry & soil health & nutrition management message to all active 4000 farmers: Earlier, the animal husbandry messages were sent only to farmers who were registered with having cattle. This now has been extended to all live SLACC farmers. This will ensure that all farmers under project purview are aware of these two important subjects to maintain and enhance diversification and sustainability of their farm. Since milk production is an important aspect of livelihood generation among cattle rearing farmers, milk production and cattle health has been provided a priority to ensure livelihood sustainability and enhancement can be ensured during challenging climatic conditions.





Current Status: 1000+ farmers have been looped in for livestock advisory services and so far around **27561 various message** been sent out to them. This is equivalent to on average **27.5 messages per farmer** which is equivalent to **1 message per month** per farmer.

5.3. The adoption rate of such advisory services among various blocks in each NRLM state.

About 25 crop advisory messages per farmer per month,15 weather-based advisories per season per farmer and 1 weather alert per farmer per season were sent in during last Rabi. There has been customer raised Alerts because of the proactive and high number of plant protection advisories.

About 10 crop advisory messages per farmer per month,17 weather-based advisories per season per farmer and average 2 weather advisory per farmer per month were sent during last Kharif season. There have been very few user alerts so far because of extensive messages on crop protection covered.

ADOPTION RATES INDICATOR	Progress
Launch of Service	Mar-17
Number of CRPs	97
Number of Villages	100
Farmers covered	4000
Number of Advisory messages sent in Kharif 2018	3,30,954
Number of Advisory messages per Season	About 90
Number of Advisory messages sent in Rabi 2018	4,95,536
Number of Advisory messages per Season	About 123

MID-TERM EVALUATION SURVEY (IN APR. 2018)	Progress
Percentage of farmers who received messages	57%
Percentage who adhered to advice at least once	90%
Percentage who will continue to follow advice	90%

MONITORING SURVEY (FEB-JULY 2019	Progress
Percentage of farmers who received messages	99.80%
Percentage who will continue to follow advice	74%

CATEGORY OF MESSAGE	NUMBER OF MESSAGES SENT	NUMBER OF MES-SAGES/FARMER	NUMBER OF MES-SAGES/FARMER/ MONTH
PoP-Crop Management Practices	160586	40	8
PoP-Pest & Disease Forecast	114275	29	6
PoP-Soil and Water Management	50257	13	3
Weather Based advisory	64689	16	3

5.3. The adoption rate of such advisory services among various blocks in each NRLM state.

CATEGORY OF MESSAGE	NUMBER OF MESSAGES SENT	NUMBER OF MESSAGES/FARMER	NUMBER OF MESSAGES/FARMER/MONTH
PoP- Nutrient Management	64223	16	3
Animal Husbandry	32740	8	2
Weather Alert	5180	1	0
PoP Alerts	3536	1	0
Customer Raised Alerts	50	0	0
Grand Total	**217126**	**124**	**25**

About 25 crop advisory messages per farmer per month,16 weather-based advisories per season per farmer and average 1 weather advisory per farmer per month were sent during last Rabi season. There have been very few user alerts so far because of extensive messages on crop protection covered. CropIn conducted a Pilot project of taking the feedback from farmers on adoption and usefulness of various advisories which were triggered by CropIn System from time to time. There were 3 Types of advisories sent.

- Proactive PoP Advisory
- Alert based Advisory
- Organic Farming Advisory based on Weather Forecast

The questionnaire and the results of the survey are attached here. The Forms are in Hindi. But for our understanding, the form has been translated in English. The objective of this survey was to know adoption percentage and its impact on yield.

This Pilot Feedback (Monitoring & Evaluation) were taken from 25 SLACC farmers each in each block in both Bihar and MP. This has been configured in SmartFarm application and data can be captured through VRP's mobile application as any other activity which normally a VRP does as part of SLACC Project.

This Pilot Survey was conducted by CropIn's Block Coordinators in all the Blocks of MP. The Pilot study shows that adoption rate is 72% in Madhya Pradesh. extensive messages on crop protection covered. CropIn conducted a Pilot project of taking the feedback from farmers on adoption and usefulness of various advisories which were triggered by CropIn System from time to time. There were 3 Types of advisories sent.

This Pilot Survey was conducted by CropIn's Block Coordinators in all the Blocks of MP. The Pilot study shows that adoption rate is **72% in Madhya Pradesh.**

5.3. The adoption rate of such advisory services among various blocks in each NRLM state.

This document has Monitoring & Evaluation Form with questions asked and Report for Madhya Pradesh.

MONITORING & EVALUATION FORM		
Frequency	**Once in 15 days-pop up when VRP does her routes**	
	Question	**Options**
1	How many SMS advisory messages did you or your family member receive in the last 15 days?	<number>
2	What were the advisories about?	Multiselect: - Pest and Disease advisory - Sowing advisory - Package of Practices advisory - Chemical and pesticide application advisory - Harvest advisory - Animal husbandry
3	How many advisories did you adopt?	<number>
4	Due to what reason you did not adopt all the advisories	- Could not understand - Lack of money or resources - Didn't find it help - All messages used
5	Did you get benefited from the advisories?	- Yes - No

5.3. The adoption rate of such advisory services among various blocks in each NRLM state.

MONITORING & EVALUATION FORM		
Frequency	**Once in 15 days-pop up when VRP does her routes**	
	Question	**Options**
6	How did you benefit?	- Harvested before rains or strong wind - Avoid irrigation - Prepared for irrigation due to dry spell - Prevented pest or diseas attack - In animal husbandry - Other benefits
7	Were you briefed about the context and purpose of this monitoring and evaluation form data?	- Yes - No

Implications Of The Survey

MONITORING & EVALUATION FORM – MADHYA PRADESH	
Total Number of Farmers Surveyed	116
Number of sample farmers who received 10 or more advisories in last 15 days.	1756
Out of total, how many advisories were adopted and what is the adoption rate?	1272 / 72.44%
How many advisories were un-adopted?	484

MAJORITY OF FARMERS WERE BENEFITED IN THE AREA OF	
Harvested before rains or strong winds	
Prepared for irrigation due to dry spell	
Prevented pest or disease attack	
Animal husbandry	
How many farmers were briefed about the context and purpose of this monitoring and evaluation form data?	95 / 82%

* Minimum 25 farmers per block across two districts were planned as sample size

5.3. The adoption rate of such advisory services among various blocks in each NRLM state.

- The results give us an understanding of the adoption rate of the advisories sent to farmers. 72.5% adopted to the CropIn Messages
- All farmers received 10 or more CropIn advisory messages

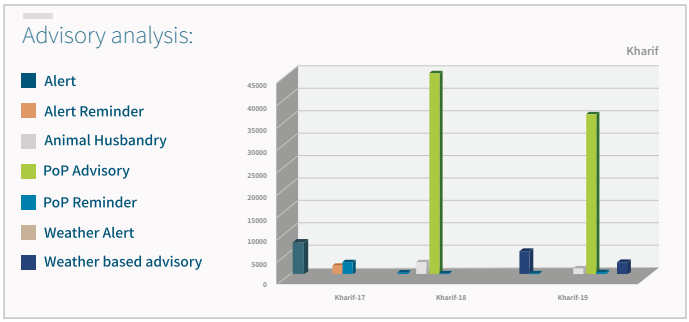
After the successful, pilot study report, this was extended for all the SLACC farmers MP. The form is already configured in the system by CropIn Team. To improve the impact of advisories, To improve the adoption rate and to assess its impact, the survey was conducted during period of February'19 to June'19 among odd 3000 farmers in 6 blocks of Mandla and Sheopur. The farmers feedback was evaluated primarily to determine the rate of adoption of messages, relative usefulness of various category of messages to farmers and major roadblock in adoption of Weather based Agro Advisories.

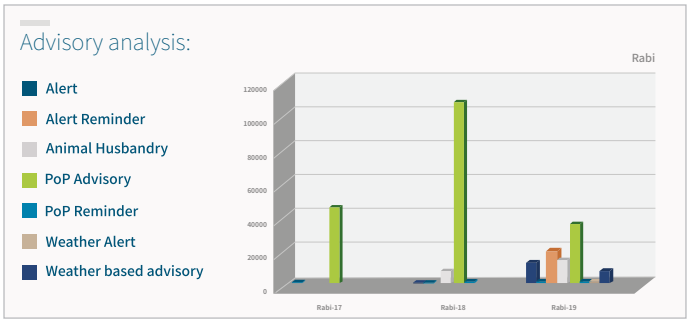
The following Table summarizes the finding of the study:

BLOCKS	UNIQUE FARMERS	AVERAGE MESSAGES/ FARMER	TOTAL MESSAGES	NUMBER OF MESSAGES IM-PLEMENTED	ADOPTION RATE
Anjaneya	9	14	124	107	86%
Badoda	32740	19	3248	2772	85%
Bichhiya	560	21	11796	8383	71%
Karahal	1321	14	18448	14642	79%
Mandla	819	12	10177	3554	35%
Sheopur	363	18	6600	5729	87%
Grand Total	**3244**	**16**	**50393**	**35187**	**74%**

5.4. Advisory Analysis

Figure 1: Season-Wise Advisory Sent Under Various Category





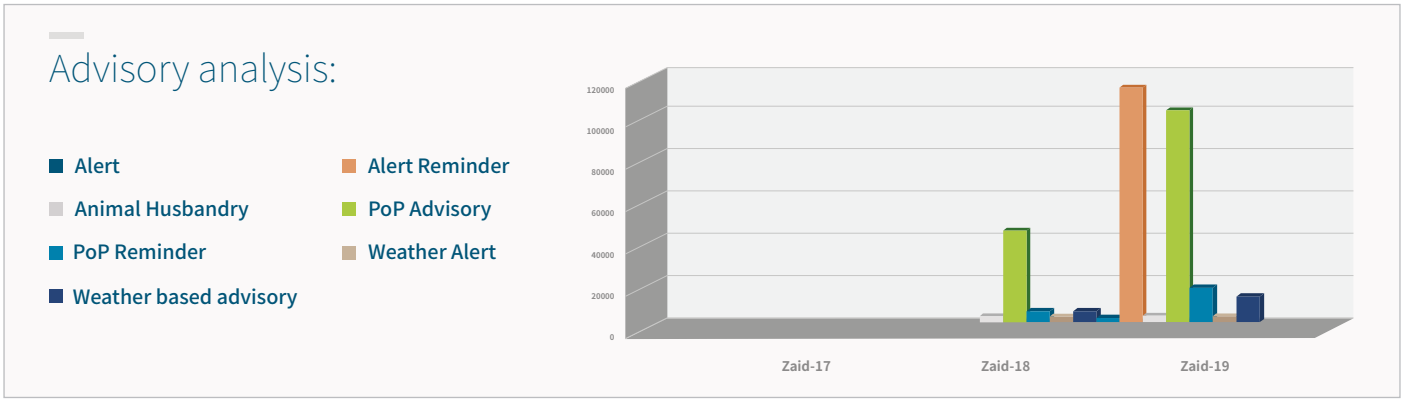
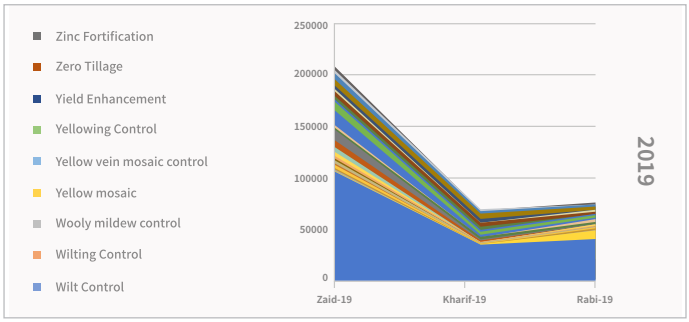
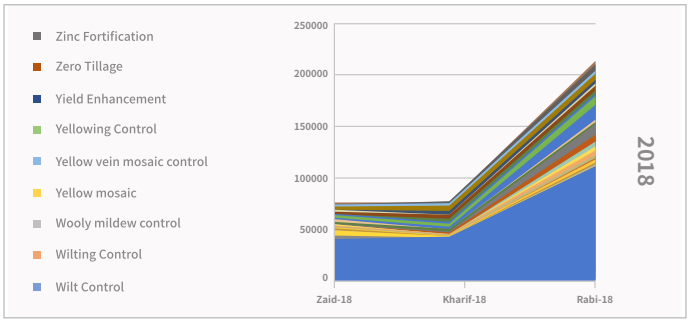
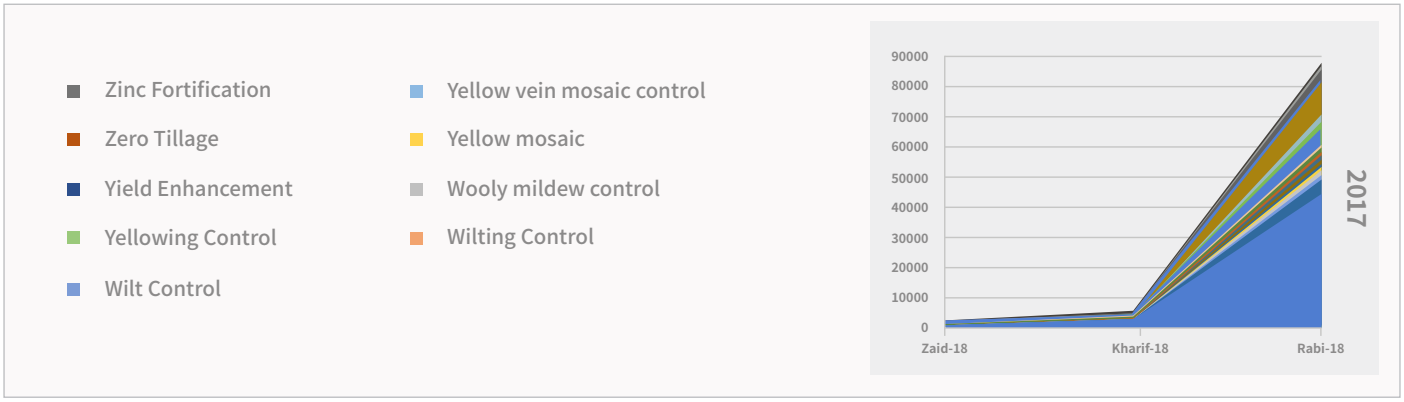


Figure 2: Yearwise Various Messages Set Under Package Of Practice







5.4. Advisory Analysis

The various categories of messages were sent across the year which is pertinent as per the prevailing local weather condition and in context to local cultivation stages.

There had been considerable increase in proactive advisories. Messages that promote proactive approach towards farming are in long run fair better as a measure to mitigate risk. Building on what exists using relevant tools and practices already in place confers better participation from farmers. In the face of climatic uncertainty, risk-averse farmers employ conservative strategies which includes avoidance of improved technology, under-use of fertilizers and shifting from productive to non-productive liquid assets.

The proactive approach uses principles that essentially develops resilience capability by incorporating various techniques which emphasizes on inclusion of practices that prevents or minimizes biotic and abiotic stress. This includes promotion of organic farming, using Integrated farming approaches, organic seed treatment, using improved stress tolerant crop varieties,

Proactive Advisories

The proactive approach uses principles that essentially develops resilience capability which includes promotion of organic farming, using Integrated farming approaches, organic seed treatment, using improved stress, tolerant crop varieties, utilizing alternate source of nutrient management, water conservation techniques, indigenous cultural practices, improved cultivation techniques, timely monitoring and using various visually identifiable indices to early identify crop stage, pest or disease attacks in field.

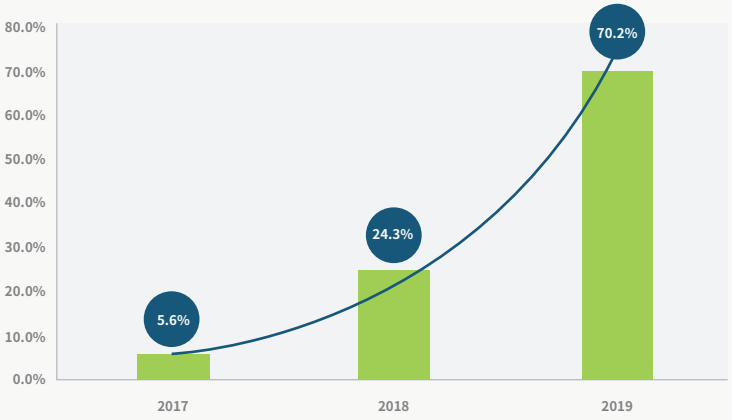
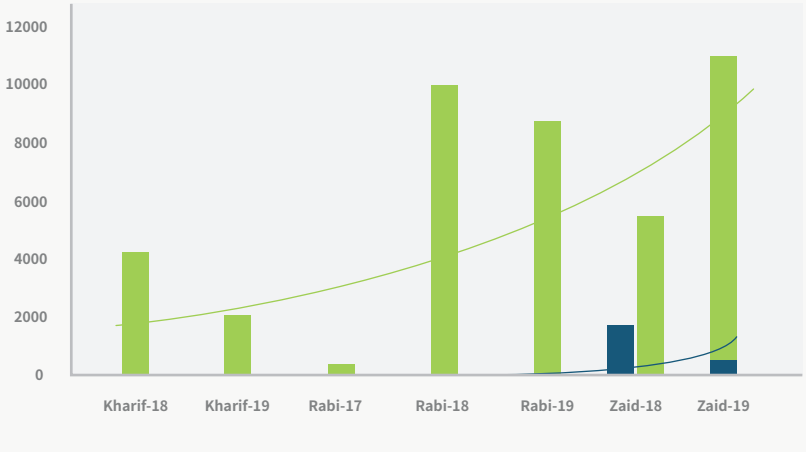


FIGURE 3: PROACTIVE ADVISORY SENT ACROSS YEARS

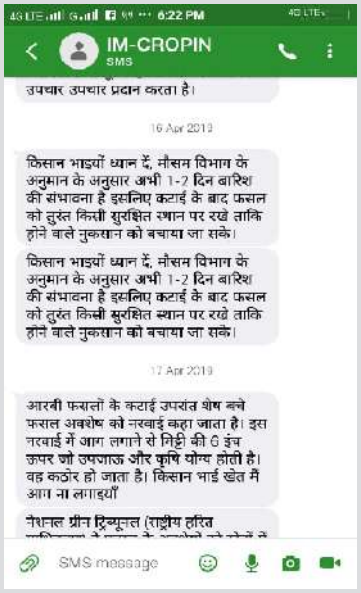
Weather Alert Vs Weather Based Advisories

There had been considerable increase in proactive advisories. Messages that promote proactive approach towards farming are in long run fair better as a measure to mitigate risk. Building on what exists using relevant tools and practices already in place confers better participation from farmers.



5.4. Advisory Analysis

Table 4: Advisory Creation: Roles & Responsibility

TYPE OF ADVISORIES	WHO CREATES THEM?	HOW ADVISORIES ARE CREATED	WHO ARE RECIPIENTS?	EXAMPLE
POP Based Advisories:- • Soil & Water Management • Crop Management Practices • Pest and disease forecast & management • Nutrient Managemen	Sent by Agronomy Specialists during life cycle of selected crops in each specific season. The advisories are of Pre-sowing, Post-sowing, vegetative phase	These advisories are static in nature which are configured on the Cropin Portal, and is broadcasted on set time during different stages of a crop	All the farmers who have registered plots with one crop, all Post-sowing POP advisories related to that crop will be sent to them. All registered farmers will get all Pre-sowing advisories for all the crops	
Weather Based Advisories	Sent by Meteorology Specialists assigned to each District (Sheopur and Mandla). Usually broadcasted weekly and bi-weekly or on any specific weather conditions	The raw data is received from Skymet which can be accessed via Cropin portal by the Meteorology Specialists, and they create relevant message	All the farmers who are registered on the portal	

5.4. Advisory Analysis

Table 4: Advisory Creation: Roles & Responsibility

TYPE OF ADVISORIES	WHO CREATES THEM?	HOW ADVISORIES ARE CREATED	WHO ARE RECIPIENTS?	EXAMPLE
Alert Based Advisories	Remedies are Pre-configured on the Portal. a VRP observe issue with the crop infield, he can select the correct disease from alert section and snap the picture of affected area. As soon as this data is synced, an alert information and its remedy is sent to the mobile of the farmers whose crop is affected. A simultaneous alert is sent to tagged VRP mobile	The raw data is received from Skymet which can be accessed via Cropin portal by the Meteorology Specialists, and they create relevant message	All the farmers who are registered on the portal	
Livestock Advisories	Sent by the Livestock Specialist	Advisories are pre-configured. The specialist sends general livestock advice as well as weather specific advisories .	All the farmers whose livestock are added	

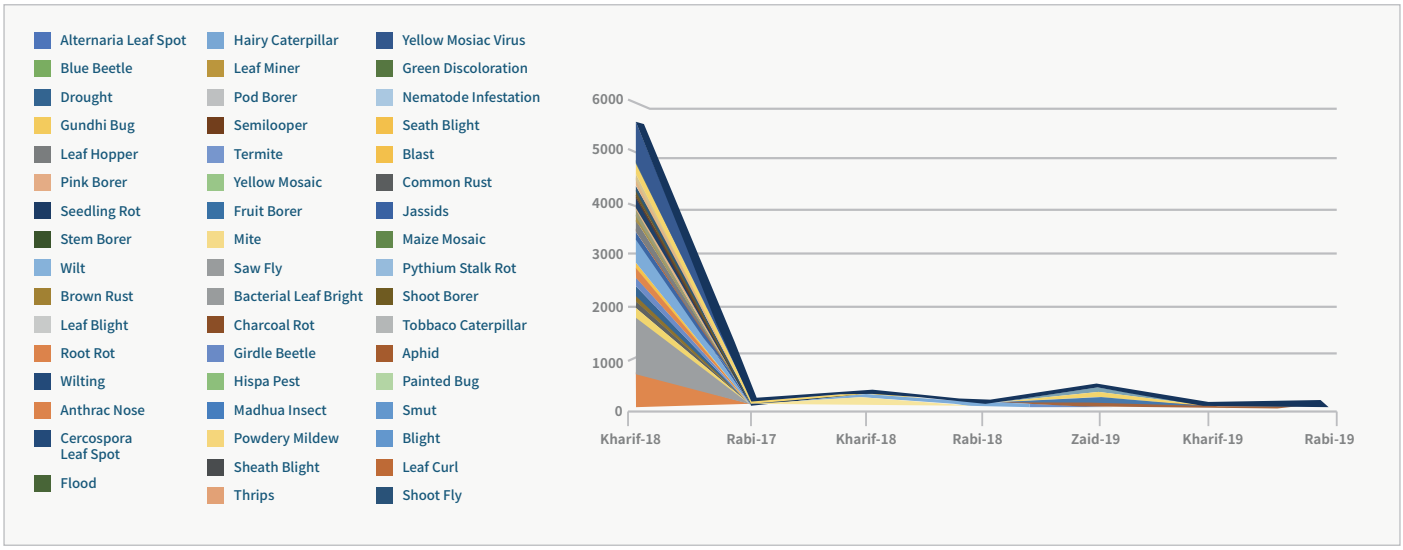
5.4. Advisory Analysis

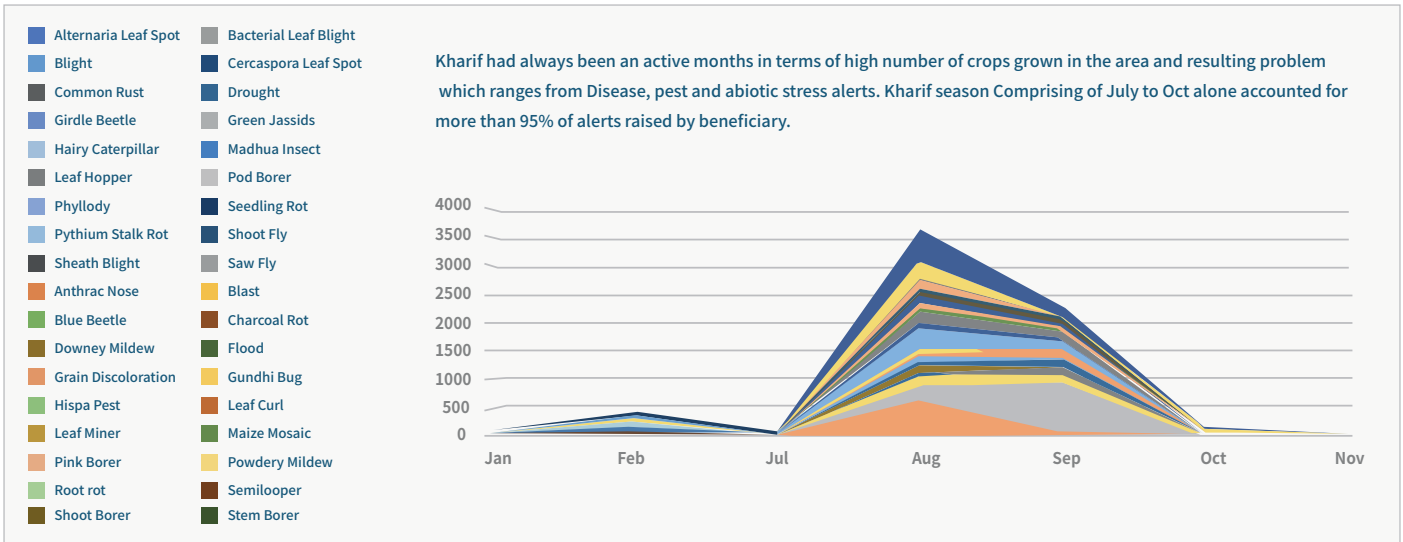
Alerts Raised

Total of 6545 alerts were raise during the entire project period. The year 2017 was highest in number of alert recorded (88%). Followed by 2019 (7.07%) and 2018 (5%). The reducing number of Alerts were results of high number of proactive messages, Alert and PoP reminders which helped in bringing down the number of raised alerts.

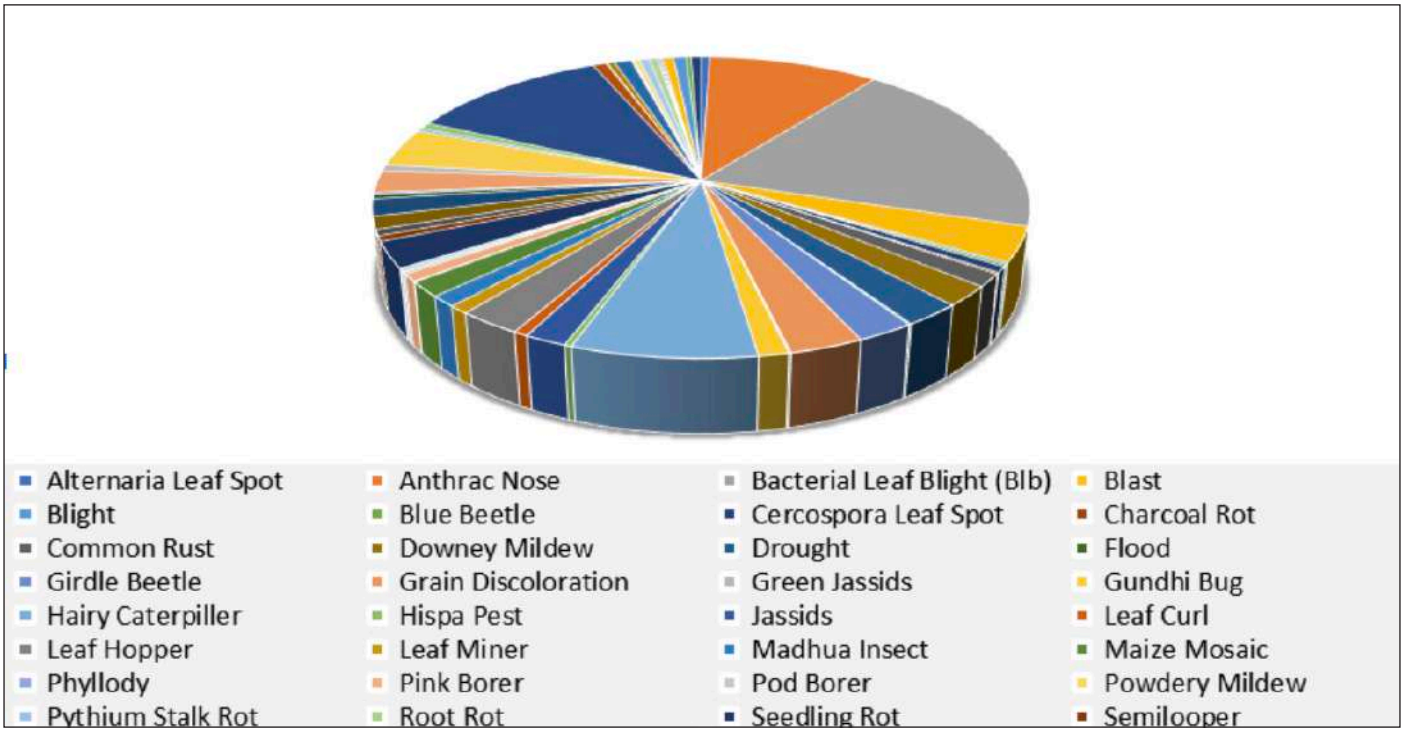
Kharif had always been an active months in terms of high number of crops grown in the area and resulting problems which ranges from Disease, pest and abiotic stress alerts. Kharif season Comprising of July to Oct alone accounted for more than 95% of alerts raised by beneficiary.

Bacterial Leaf Blight (BLB), Yellow mosaic virus, Anthrac nose, Hairy Caterpillar contributed to 49% of total Alerts raised.





5.4. Advisory Analysis

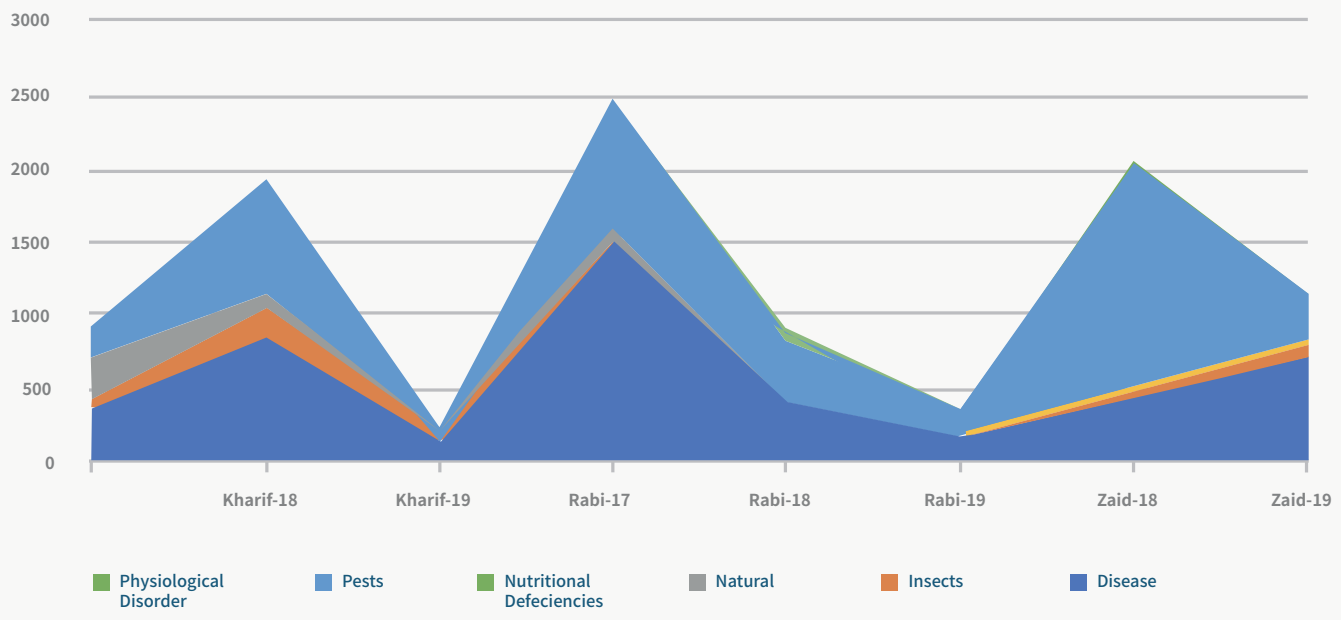


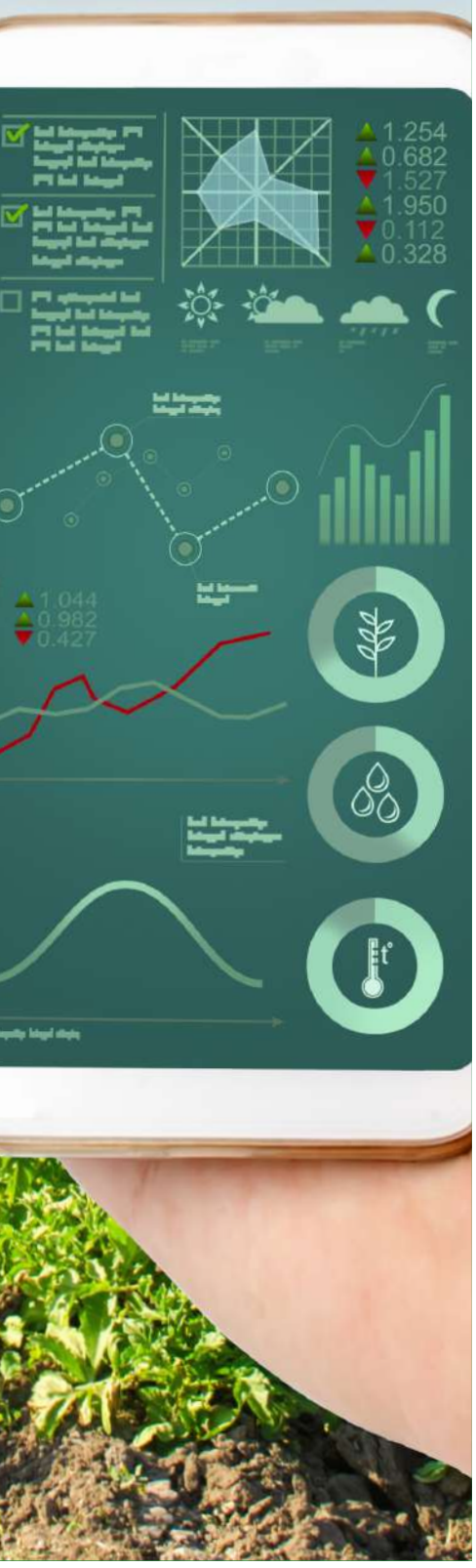
SEASON	MONTH	DISEASE	NATURAL	OTHERS	PESTS	GRAND TOTAL
Kharif-17	Jun	26	-	-	-	26
	Jul	274	5	28	244	551
	Aug	2600	105	234	1336	4275
	Sep	680	51	12	148	891
Kharif 17 Total		**3580**	**161**	**274**	**1728**	**5743**
Rabi-17	Oct	0	0	0	13	13
	Dec	6	0	0	-	6
Rabi 17 Total		**6**	**0**	**0**	**13**	**19**
Kharif 18	Aug	18	0	0	-	18
	Sep	205	6	0	49	260
Kharif 18 Total		**223**	**6**	**0**	**49**	**278**
Rabi 18	Aug	27	0	0	15	42
Rabi 18 Total		**27**	**0**	**0**	**15**	**42**

5.4. Advisory Analysis

SEASON	MONTH	DISEASE	NATURAL	OTHERS	PESTS	GRAND TOTAL
Kharif-19	Jun	12	0	0	0	12
	Aug	0	0	0	1	1
	Sep	14	0	0	5	18
Kharif 19 Total		**26**	**0**	**0**	**5**	**31**
Rabi-19	Jan	64	0	0	0	64
	Feb	358	0	0	0	358
	Oct	8	0	0	2	10
Rabi 19 Total		**430**	**0**	**0**	**2**	**432**
Grand Total		**4292**	**167**	**274**	**1812**	**6545**

Proactive Advisories





6. ADOPTION & FEEDBACK FROM FARMERS

The Average messages received by a farmer during a month was around 16. The adoption rate in Average across the blocks were 74% which is exceptionally good considering the backwardness, economical impairment and major climatic challenge that farmers of target districts faced .

Adoption rate in Mandla being the lowest due to its extensive forest covered terrain, low agriculture land availability (only up to 6% of land available for cultivation) and inhabited by tribal population of Gond who have most backward socioeconomic conditions and low cultural receptivity compared to other districts.

Adoption & Feedback From Farmers

2%
Agricultural Messages were not Useful or not relevant

14%
Farmers did not understand the messages

12%
of farmers wanted to adopt the messages but due to lack of money & resources, they were not able to proceed

77%
Farmers were satisfied with messages sent

- Rain Alerts has helped us to take pre-emptive measures and use irrigation resources judiciously
- Information on weather helped to save or minimize losses from strong wind and rainfall
- Weather based advisories helped us to arrange proper feed, immunization and health management of our cattle
- Organic based advisories helped improving water retentive capacity of soil, water utilization and production enhancement of crops.
- Weather advisories has helped us to arrange for irrigation during drought periods
- Crop management and alert advisories helped to save crop damage from pest and disease and thus improving monetary benefits

6. ADOPTION & FEEDBACK FROM FARMERS

Cost effectiveness

BENEFIT	NUMBER OF FARMERS WHO REALIZED THE USEFULNESS	PERCENTAGE
Enhancement in soil physiology, nutrient value and physical property	2508	77%
Helped to prevent loss due to weather alert & weather-based Advisories	2012	62%
Better management of cattle health due to animal Husbandry advisories	1915	59%
Realized reduced farming cost	1350	42%
Enhanced production	2263	70%
Prevention and Control of disease & Pest	467	14%
Experienced better utilization of water due to water management advisories	1358	42%
Grand Total	**3244**	**100%**

SLACC is a pilot project with 4000 farmers under CropIn service fold getting Agro advisory services. The project cost was 1,10,44,000 which includes all costs excluding service charges. The approximate breakup of cost components will be:

EXPENSE HEAD	AMOUNT(INR)	PERCENTAGE OF TOTAL COST
Operational Expense (OPEX)	9194655	83%
IT cost CAPEX)	1849345	17%
Total	**11044000**	**100%**

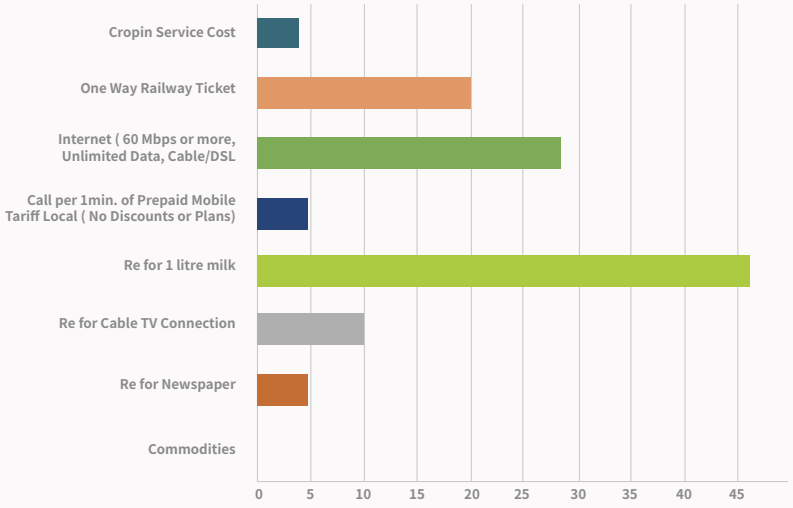
The actual cost per farmer per season is Rs. 630 out of which 13% is for CAPEX (mainly forecasting costs and the CropIn ICT platform) and 87% for OPEX (75% goes towards human resources). The cost per

6. ADOPTION & FEEDBACK FROM FARMERS

farmer months approximately works out to be INR 115 per month per farmer or around INR.4 per day. This expense is minuscule compared to the benefits farmers can reap out of this service.

Comparison of CropIn service cost with some essential service and commodity that rural people use on a daily basis are provided below:

The actual cost per farmer per season is Rs. 630 out of which 13% is for CAPEX (mainly forecasting costs and the CropIn ICT platform and 87% for OPEX (75% goes towards human resources). The cost per farmer months approximately works out to be INR 115 per month per farmer or around INR.4 per day. This expense is minuscule compared to the benefits farmers can reap out of this service.



7. COST-BENEFIT REPORT

The service charge of CropIn will further come down with scale-up. At present the service is already at par with some very cheap service commodities like newspaper and local phone calls which farmers already consume in their day to day life.

The following study shows the impact of Cropin Intervention in2536 paddy growers of Mandla district for Kharif 2017. The results indicate the positive correlation between the number of advisories being sent to farmers and consequent increase in farm yield resulting in an increase in their income.

The study established that paddy yield varies between 1000 - 8000 kg/ha with the advisories ranges between 40- 360 which show normal distribution between both the variables..

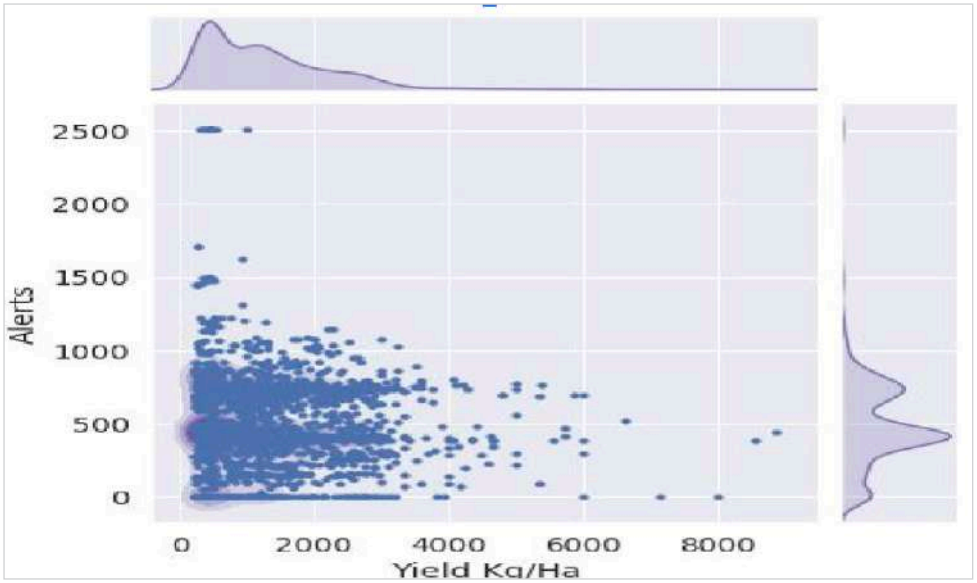


IMAGE 7: SCATTERPLOT OF YIELD(KG/HA) VS ADVISORIES

CLASS	YIELD	ADVISORIES RANGE	AVERAGE ADVISORIES
Cluster 1	less than 1000	44 - 279	137
Cluster 2	1001 - 2000	41 - 312	139
Cluster 3	2001 - 3000	43 - 312	140
Cluster 4	3001 - 4000	43 - 287	146
Cluster 5	more than 4001	44 - 310	146

TABLE. 1 VARIATION OF YIELD WITH NUMBER OF ADVISORIES

7. COST-BENEFIT REPORT

Assumptions:

- The yield of District is considered representative yield of concerned Block
- All the farmers are small or margin
- Uniformity is considered for all varieties of Paddy

Methodology:

The data have been clustered into 4 classes based on the number of advisories that the farmer has received:

- less than 350 advisories
- between 351 to 450 advisories
- between 451 to 650 advisories
- more than 651 advisories

Mean Test:

Mean calculation of each cluster and find the deviation from higher strata which district-level yield value of paddy to cluster average mean

Distribution Analysis:

- Skewness calculation of all clusters

Data:

- District Mean: 900 as per NIC Mandla
- Price of the commodity:Rs.15.5 per Kg from MSP(Minimum Support Price) (source:www.agricoop.nic.in/)

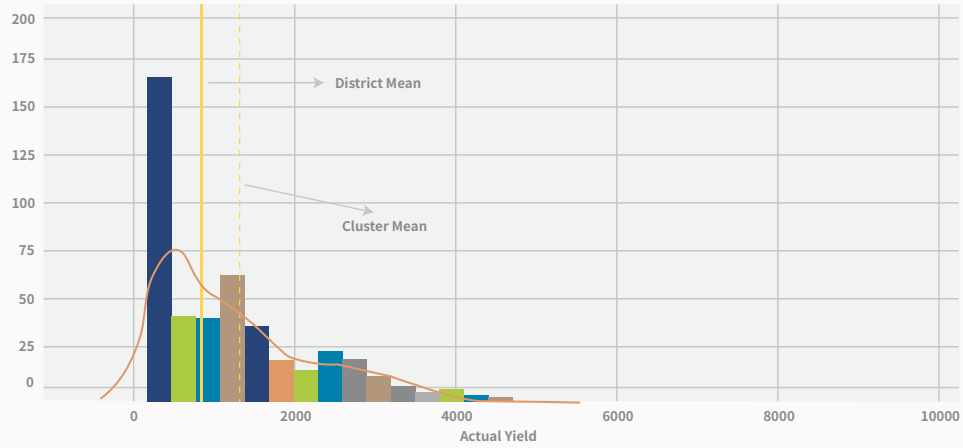
Results:

CLUSTER	NUMBER OF ADVISORIES DISSEMINATED	AVERAGE YIELD VALUE KG/ACRE)	INCREASE % OF CLUSTER AVERAGE YIELD OVER DISTRICT AVERAGE YIELD
1	less than 350 advisories	1302	44 %
2	between 351 to 450 advisories	1397	55 %
3	between 451 to 650 advisories	1045	16 %
4	more than 651 advisories	1247	38 %
Total			**38.5%**

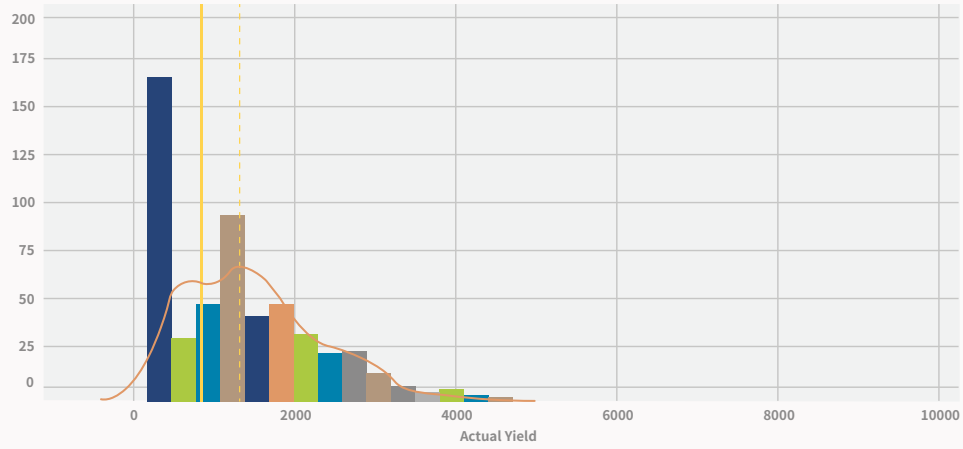
TABLE. 2. CLASSIFICATION OF YIELD POPULATION BY NUMBER OF ADVISORIES AND THERE DEVIATION

7. COST-BENEFIT REPORT

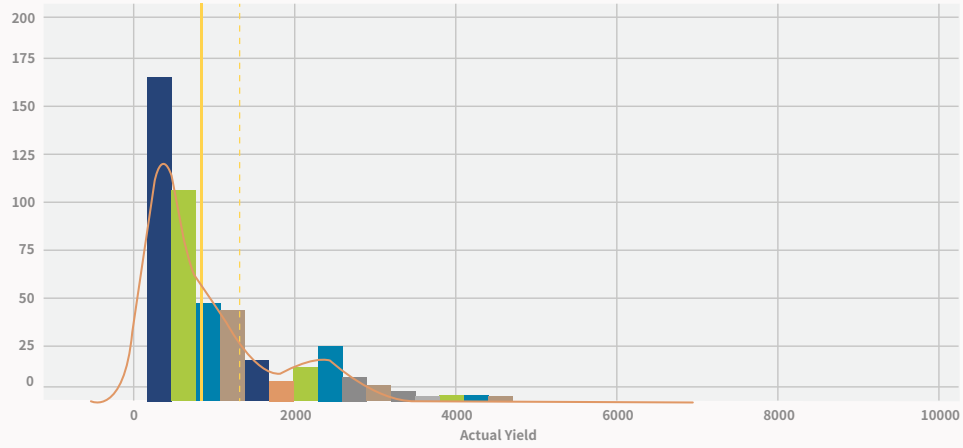
Cluster 1
(Less than 350 Advisories)



Cluster 2
(Between 351 to 450 advisories)

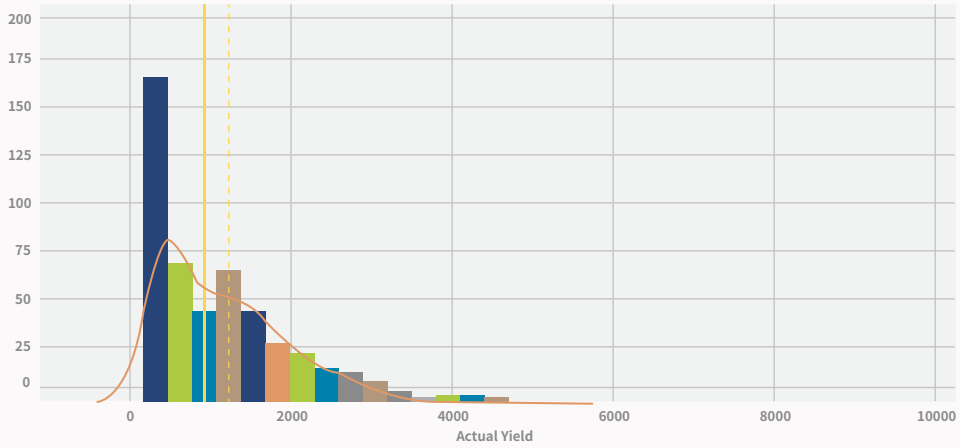


Cluster 3
(Between 451 to 650 advisories)



7. COST-BENEFIT REPORT

Cluster 4
(More than 650 advisories)



CLUSTER	NO. OF FARMERS BELOW DISTRICT MEAN	NO. OF FARMERS ABOVE DISTRICT MEAN	SKEWNESS	INFERENCE
1	389	239	1.8	Highly Skewed
2	408	281	2.16	Highly Skewed
3	267	142	1.94	Highly Skewed
4	471	339	1.41	Highly Skewed

TABLE. 3. CLUSTER WISE FARMERS WITH DISTRICT MEAN AND SKEWNESS

Conclusions & Observations

In the Mean test (Table 2), it is observed that there is an increase in the mean value at the cluster level from district implies SLAAC farmers make use of the advisories to improve their yield.

Based on Mean deviation from district mean tells that SLAAC farmers improve their productivity by around **38 %**.The average price of a commodity (Rice) is **Rs. 15.5 per Kg** (Source: http://fci.gov.in/) For district farmers, income per farmer:
1600 * 15.5 = Rs. 24800

It is observed (Table 2) that when the number of advisories increases there is an increase in the yield value.

The average price of a commodity (Rice) is Rs. 15.5 per Kg (Source:http://fci.gov.in/)

For district: 1300 * 15.5 = Rs, 13,950.
For SLAAC: 1248 * 15.5 = Rs. 19,344

7. COST-BENEFIT REPORT

Conclusions & Observations

Skewness results (Table 3) imply all the clusters are highly skewed and the skewness is at the higher side of yield value which shows that most of the SLAAC farmers make use of the technology to makes uphold their production in terms of yield.

CLUSTER	NUMBER OF ADVISORIES DISSEMINATE	AVERAGE YIELD VALUE KG/ACRE)	PROJECT COST PER FARMER FOR ENTIRE PROJECT TENURE (RS)	TOTAL INCOME PER FARMER UNDER SLACC (RS)	TOTAL INCOME FOR NON-SLACC DISTRICT FARMERS (RS)	BENEFIT PER FARMER UNDER SLACC (RS)	BCR
1	less than 350 advisories	1302	2,761	20181	13950	6231	2.26
2	between 351 to 450 advisories	1397	2,761	21653.5	13950	7703.5	2.79
3	between 451 to 650 advisories	1045	2,761	16197.5	13950	2247.5	2.26
4	more than 651	1247	2,761	19328.5	13950	5378.5	1.95
		Age Ratio Benefit					**2**

The Benefit to Cost Ratio comes out to be 2.0 indicating that the project is economically viable and has benefited the farmers to achieve their productivity against climatic vagaries.

8. SUSTAINABILITY & LESSONS LEARNT

8.1. Operational leanings on training, advisories & adoption

- Organic farming is better then chemical based farming in all aspects. The organic farming has helped the farmers to reduce their operational costs and arrange plant protection measures right at home with existing household resources. Apart from improving soil texture and physical properties organic farming has helped farmers to practice crop diversification as inorganic chemicals tend to be selective in action. However, age-long practice, nexus of inorganic input sellers and low income capacity of farmers deter them from adopting quickly from inorganic to organic farming.
- CropIn intervention has proved that the technological interventions does matter and this can play pivotal role in further scaling of the similar interventions in field. The major use of technology has been in ability to quickly reach multitude of farmers spread across geography, provide ability to remotely monitor the entire span of project activities in almost real time and create digitized information and data that can be analyzed further to devise a data driven decision system.
- Though slow, behavioral changes are possible among farmers, even farmers are adopting to new and innovative methods of farming to ensure better quality and quantity of produce. The challenge of fragmented lands and poor economical conditions were always present in our country. In-spite of this, there are many farmers who are ready to adopt to better farming practices that ensures better and sustainable crop yield. There had been shift to diverse crop varieties and cultural practices that are relatively cheap and effective. Adoption to newer technologies has also been on rise due to SLACC intervention.
- Through Cropin advisories, Farmers has realized ultimately that new method of farming is more beneficial then old pattern. They have adopted to various prophylactic cultural measures and are particularly more vigilant during disease and pest infestation period. The PoP alerts sent to farmers during the cultivation process,Shifting to better crop practices, disease tolerant varieties, seed treatment, on-time plant protection measures has helped them to intervene at the right time thereby reducing crop loss due to pest and disease infestation.
- Farmers were appreciative of weather alerts and weather based advisories. These advisories had not only been disseminated in terms of crops but also used in creating animal husbandry messages. In many instances farmer

8. SUSTAINABILITY & LESSONS LEARNT

8.1. Operational leanings on training, advisories & adoption

had been able to prevent crop loss due to sudden rainfall just after harvest. Rainfall alerts had been particularly helpful during critical crop stages of sowing, harvesting, irrigation and nutrient management schedules.

- Animal Husbandry had been useful part of the advisory module. During climate change, cattle resource provides an alternate source of livelihood generation for farmers.This has been particularly true for Sheopur and Mandla districts which represents extreme of water scarce and flood prone areas. In these areas, Cattle population take the worst hit of weather/climate change resulting into lower milk production, animal deaths, and outbreak of seasonal disease due to lower health standards.

8.2. How to make the service better and how would we do things differently

- The adoption rate to the WBAAS messages were affected by number of reasons, illiteracy being one of the primary reason of them. Literacy rate of females in Sheopur and Mandla districts are 53.34% and 62.39% respectively as against national female literacy rate of 65.46%. Voice messages could be used to disseminate information to farmers along with text advisories.

- Richer content utilizing CropIn platform could be used to train and inform VRPs, YPs, DPs, etc using Short motivational videos. These videos can also be used during SHG meeting which can be effective AV method for farmers to adopt new and innovative practices of agriculture.

- Currently advisories are customized to individual plot level. However certain layer of customization can still be possible to add by including soil test based results during creation of advisory. This will categorically help farmers to practice cultivation as per their niche ecological and soil condition thereby conferring more accurate plant cultivation technique.

8.2. How to make the service better and how would we do things differently

- Toll-free call support & expert advise center (including weather information) would be beneficial to farmers.This will help farmers to participate proactively and also reduce need for physical accessibility of the geolocation by project implementation team. Regular outbound health check calls, survey calls, feedback calls and complaint register lines will help to constantly monitor the on-field activities.

- Farmers sell their produce at cheaper price, as there is no proper sales channel available. Creation of market linkage ensure more income for farmers. The implication of better crop production should be in realizing better price of the crop and availability of the competitive market that will offer better rates to farmers.

- Apply satellite- based weather data to disease and pest alert incidences and then help create early warning system for specific locations and crops.

Measuring Impact

We're transforming businesses through intelligence and insight.

6.1 Million
Acres Of Farmland Digitised

2.1 Million
Farmer's Globally Benifitted

388
Crop Data Captured

9400+
Crop Varieties

98%
Client Retention Rate

92%
Score on Adaptability

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We measure work not by the time put in, but by the number of acres impacted

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About CropIn

 CropIn is an Earth Observation & AI-led AgTech organization that empowers the farming community to 'Re-imagine Agriculture with Data'. CropIn is focused on helping the world's ag-ecosystem players to sustainably "maximize their per acre value" by combining pixel-level data derived from satellite imagery, in combination with IoT and field intelligence. CropIn is positioned to engage in a multi-disciplinary approach towards AI, Earth Observation, Agriculture, Meteorology and Computer

Sciences, all collaborating together to bring meaningful insight to improve the ag-ecosystem and impact the livelihood of a farmer. CropIn provides SaaS solutions to 225 agribusinesses and numerous governments and non-government organizations present in over 52+countries. CropIn thus enables businesses to leverage technology to effectively drive their initiatives around Digitization, Compliance, Predictability, Sustainability and Traceability. CropIn has digitized over 13 million acres of farmland, enriched the lives of nearly 4 million farmers, and gathered data on 388 crops and over 9,500 crop varieties. CropIn has 92% score on adaptability ,Over 98% client retention rate.

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