PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES (PCRWR)

Inception Report

Project Title: Customized irrigation and climate advisory service through citizen science

Location: Pakistan

Timeframe: 20th December 2021 to 31st July 2022

Funding Agency: Asian Disaster Preparedness Centre (ADPC), Bangkok, Thailand

Khayaban-e-Johar, Sector H-8/1, Islamabad – Pakistan
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1. Background and the Context

Communities living in the Southern Punjab (a province of Pakistan) and the Indus delta (the lowest riparian of the Indus Basin) are extremely vulnerable to climate variability. During the last three years, farming communities in the Southern Punjab have suffered severe yield loss in their cotton-wheat crops due to unprecedented weather trends. Likewise, communities living in the Indus Delta experienced extreme monsoon rainfall in August 2020. Due to poor drainage, farmers had to suffer from the loss of standing crop during and after the storm events. Solution to this challenge is to inform farmers regarding a more frequent and precise climate information. The Irrigation Advisory Service has the potential for irrigation planning as well as weather resilience.

In partnership with the University of Washington (UW), USA, PCRWR is providing weekly short message services to 20,000 registered farmers in 43 districts of Pakistan. This service enables beneficiary farmers to plan irrigation according to their crop water requirement given. In a recent IAS evaluation survey, 65% of the users recorded the benefits of IAS text messages both in terms of irrigation and time savings. Farmers also requested for other forms of information related to crop production. Some farmers also suggested increase in the frequency of climate advisory services twice a week helping them to be more resilient towards climate variability.

In a country like Pakistan, where different weather systems persist, there is a need to enhance the spatial coverage of weather observatories in response to this challenge. However, this is time consuming as it needs huge investment for establishment and operation of weather stations. The option which is being offered through this proposed solution, is more actionable, community centric and requires much less investment, time and easy to apply. The citizen science concept will add value into the irrigation advisory services by making citizens

"satellites" or "weather observatories" for the greater benefit of farmers in Pakistan and across the region.

2. About the Innovation

The innovation encompasses the evolution of presently functioning Irrigation Advisory Service (IAS) into Irrigation and Climate Advisory Service (ICAS). IAS is a classic example of converting highly complexed remotely sensed and field research data into useful information in simple language to be used by farmers in the country and in the region. Its climate resilience potential would further be integrated into the citizen science concept.

The IAS is based on actual crop water requirements computed from remotely sensed data of Evapotranspiration (ETo) at a resolution of 10 km × 10 km, and crop coefficient values (Kc) determined through drainage-type lysimeter by PCRWR. Mostly, such scientific knowledge and data generated through public funding is either archived or shelved without any return on investment. In this venture, both PCRWR and the University of Washington, USA used their expertise for the development of IAS. The UW has programmed a raster visualization of daily ETo values for Pakistan which is generated from the Global Numerical Water Product model. This data is downloaded on server located at PCRWR on daily basis. PCRWR incorporated its field research insight and crop coefficient values. The ultimate product is a text message in local language (Urdu) through cellular network. This message advises farmers of particular district in a specific crop zone that how much water has been consumed by his crop during the preceding week (in terms of "inches").

The proposed solution "Irrigation and Climate Advisory Services (ICAS)" is an advanced version of IAS integrating remotely sensed, field research, citizen science data performing analytics simultaneously. The citizen science data collection and analytics will be piloted in two most vulnerable communities;

farming communities of cotton-wheat zone of the Southern Punjab and communities of the Indus Delta in the lower Sindh. The citizen observed weather parameters would be analyzed for improving climate forecast. The communities would benefit from a sound climate forecast and would also be able to help other communities once their confidence is built up.

3. Objectives

The purpose of the proposed solution are:

a) Farmers using irrigation and climate advisory service build climate resilient farming communities; and

b) Farmers are able to send climate information and in return receive better advisory through an automated system supported by Artificial Intelligence and algorithms.

4. Methodology

Following methodology will be adopted to achieve the desired outputs:

4.1 Identification of participating farmers and their training

The districts for pilot project have already been identified as; Multan and Bahawalpur districts in the South Punjab and Tando Allahyar district in Sindh. PCRWR regional office teams will identify farmer clusters who are willing to participate in the pilot. The farmer cluster selection will be made on the basis of selection criteria. Key features of the criteria include; education level, gender, age, land holding ownership, level of understanding of problem, willingness to participate, can easily use android phone and weather gadgets and can protect these tools. Priority will be given to young and educated persons to serve as a

source of weather information and to enhance their contribution to citizen science.

Following instruments will be procured while adopting the standard procedure of Public Procurement Rules of the Government of Pakistan:

a. Automatic weather stations (3 Nos.) to be installed in each district. PCRWR regional offices are already located in these districts. Therefore, these will be installed in these locations for the safety purpose.
b. Android phones for farmers
c. Hand-held small weather gadgets (barometer, humidity sensor, thermometer, anemometer and rain-gauge) for farmers.

After the procurement of citizen science gadgets, training modules will be developed in order to help farmers for becoming the part of citizen science project. Selected farmers will be imparted training through a training workshop at PCRWR's regional offices. Three one-day training sessions will be organized on "class room basis". The training will encompass following aspects of citizen science;

- Training on reading the gadget
- Training on using mobile phone app to input the recorded data
- Training on understanding ICAS message
- Training on sharing feedback on ICAS messages
- Training on troubleshooting minor issues in weather gadget used by the farmers.

The project research team has the experience of educating farmers through Discovery Learning Model envisaging the concept of "learning by doing". The core of this aspect will be the same but necessary education material such as cards, information sheets, posters will be developed for the cluster of farmers to facilitate technology learning process. In addition to this training component, a motivator/facilitator may also be selected. The task for this farmers will be to help other farmers with minor issues in participating citizen science and assist PCRWR's

local team in working with farmers. This facilitator will also keep cluster farmers motivated to share citizen science data when needed.

4.2 Development of Mobile Phone App

Collecting citizen science data is a challenge. This challenge would be addressed by developing a mobile app to collect citizen science data from farmers. As an incentive and a motivating factor, mobile phones will be provided to all participating farmers to share the data of citizen science. A small agreement will be signed with the farmers that they will protect the weather gadgets and share the data of citizen science. At the end of the project, motivated farmers will be handed over weather gadgets and smart phones. Up to 15 weather gadget will be provided to farmers in each site. These weather gadgets will cover five weather parameters; rainfall, maximum/minimum temperature, humidity, barometer and anemometer. Each farmer will have one gadget and will be assigned a unique identification code. Likewise, input feature specific to weather gadget will be enabled in the application.

4.3 Development of database and validation of satellite data

PCRWR is partnering with National Center for Artificial Intelligence, National University of Science and Technology (NUST), Islamabad. This Center is going to develop a smart phone app android/iOS for citizen science data input which would be supported with a web-based database. This database would have multiple functions viz. collect, analyze and visualize citizen science data, receive and analyze data from automatic weather stations, validate satellite data using real-time input form citizen science and automatic weather stations. This database would then help in improving the satellite sensed weather forecast followed by the customization of irrigation and climate advisory service.

4.4 Data incorporation into ICAS

After processing of climate data supported by citizen science and Automatic Weather Station (AWS), the forecast efficacy will be tested. Once the confidence on data is achieved, climate advisory will be made part of irrigation advisory service and cluster farmers will be provided with the advisory messages to have their feedback on the performance of ICAS.

4.5 Mobile phone service provider contract

PCRWR is already providing irrigation advisory service through a cellular phone service. The services of this private company was hired through an open bidding process. During ICAS transformation phase, the services of the same company will be used.

4.6 Farmer feedback and servicing

Farmer feedback is the crucial resource of data and essential for the success of the pilot project, which is based on the concept of "citizen science". The feedback frequency will be maintained through social mobilization. Web interface will have the option for customization to optimize climate advisory services on the basis of regular feedback.

4.7 Final workshop and project report

During last two months of the pilot, focus will be given to conclude the project by planning a final workshop. In this event, resource person from University of Washington will be invited to Pakistan to interact with PCRWR staff and the participating farmers. This workshop will be planned in PCRWR head office in Islamabad and all participating farmers will be invited to share their feedback on the pilot in a formal gathering. At the final stage, ICAS will be provided to all the registered farmers in Bahawalpur, Multan and Tando Allahyar districts, scaling out

gradually to neighboring districts with greater confidence on satellite and citizen science data.

4.8 Dissemination and Information Sharing

The following knowledge products will be developed during the implementation of the pilot:

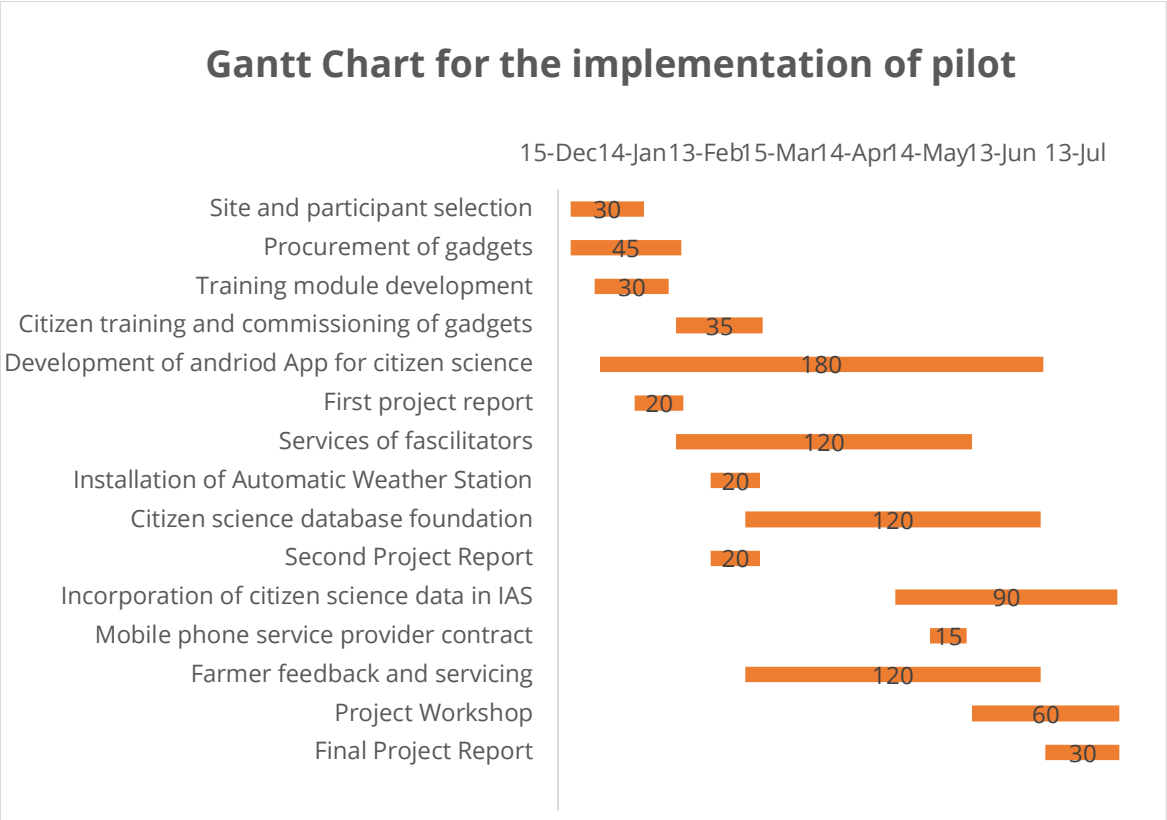
a) Training modules for training of farmers
b) Case stories from participating farmers
c) Posters for displaying to scientific community
d) Brochures for the dissemination of ICAS for wider distribution to potential users.

The knowledge and information gained from the project will be disseminated through:

a) Leaflet (local languages)
b) PCRWR website and social media platforms
c) PCRWR newsletter having wide circulation
d) A workshop
e) ADPC CIC webpage.

All the materials will also be shared with ADPC.

5. Work Plan



5.1 Key Metrics

Metric	Time frame	Characterization
Identification of 10-15 farmers on each site for participation	1 month	At least 10 farmers from 3 sites (total 30) willing to participate.
Training	1.5 months	Training module developed. At least 30 beneficiary farmers trained
Procurement of essential gadgets and Automatic Weather Stations	3 months	Equipment installed and provided to farmers along with necessary training
Web database development for the integration of citizen science data into ICAS	6 months	Android mobile application, database development, validation of satellite data with citizen science data, servicing of the database, ICAS automated generating advisory SMS to participating farmers
Transmission of ICAS to beneficiary farmers	7 months	Satellite data validated with citizen science and improved

		message sent to beneficiary farmers
Dissemination of ICAS to wider audience	7 months	One national workshop in Islamabad held Brochures developed and distributed to stakeholders

6. Expected Outputs and Outcomes

The intended key project outputs are:

a) Project inception report containing detailed methodology of implementation, expected outputs and outcome, timeline, role of project team, etc.

b) First progress report outlining farmer selection, development of Mobile app, farmer training modules, procurement of smartphones and weather gadgets for farmers as well as Automatic Weather stations.

c) Second Progress Report, handing over citizen science gadgets and mobile app to farmers, installation/commissioning of automatic weather stations and foundation of back end database.

d) Final Project report detailing a comprehensive database for citizen science data collection and analysis, testing of ICAS with selected farmers, dissemination to farmers at district level, development of information brochure and organization a project workshop.

The key project outcomes are:

a) Practicing Citizen Science Concept into action.

b) Citizen led climate resilience.

c) Improved information for better decision making on water scheduling at

large scale.

d) Scaled out the concept in other agricultural support systems and replication of this idea to other areas.

7. Anticipated Risks and Mitigation

One of the biggest risks is limited or no data sharing by the farmers. In order to mitigate this risk younger members of farming community will be selected to become part of citizen science. Moreover, in each cluster farmer, a male and may be a female farmer facilitator will be involved during the data generation period. The second major risk is farmer leaving the pilot before its completion. Farmers will be kept motivated and at the time of selection of farmers, they will be given an agreement and smart phone set to become part of the project. The cell phone and weather gadgets will serve as incentive to farmers in kind to gain their motivation and commitment to participate in the project. Another risk may be spread of new wave of COVID in the project areas. To cope with, necessary guidelines and measures will be taken to minimize the risk.

8. Project Research Team

Names	Responsibility
Dr. Muhammad Ashraf, Chairman, PCRWR	Overall guidance and advisory role, review of technical reports
Dr. Faisal Hossain Professor at University of Washington, USA	Guide the research team in Pakistan and make necessary arrangement for development of web interface for satellite data validation through citizen science.
Ms. Bareerah Fatima, Deputy Director	Focal person of the project. Manage the technical and financial progress of the project. Ensure the delivery of key milestones by time execution of activities according to SOW and contract with ADPC. Training of farmers.
Mr. Faizan ul Hasan, Secretary PCRWR	Manage the technical and financial progress of the project. Ensure the delivery of key milestones by time execution of activities

	according to SOW and contract with ADPC. Training of farmers.
Hafiz Abdul Salam, Director In-charge, PCRWR DRIP Tandojam	Facilitate farmers of pilot site in the Lower Indus.
Mr. Mummad Imran, Deputy Director Incharge, PCRWR Bahwalpur and Multan offices	Look after the execution aspect of the pilot in sites in the South Punjab and to coordinate with other stakeholders for wider dissemination of the ICAS.
Mr. Arslan Mumtaz Assistant Director PCRWR	Responsible for delivering ICAS and collecting farmer feedback.
Mr. Nabeel Khan Assistant Director	Coordinate with participating farmers in citizen science and data processing from Automatic Weather Station. Coordinate with other stakeholder farmers for wider dissemination of ICAS to vulnerable communities surrounding the project area.
Mr. Wasim Ashraf, Assistant Director Multan	Coordinate with farmers in Multan and coordinate with other stakeholders farmers in the same district for wider dissemination of the ICAS
Ms. Mufeezah Ahsan, Research Officer	PCRWR support team for database management and analysis in development of the ICAS messaging services for farmers.
Admin/Finance Officer	Responsible for maintaining all records of the project including technical and financial progress. Maintain the record according to the requirements of project agreement.
Dr. Adnan ul Hasan, National Center for Artificial Intelligence, NUST	Responsible for development of mobile app, web-interface, dashboard, database, algorithm for data validation