

**PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES (PCRWR)**

## **Second Progress Report**

<b>Project Title:</b>	Customized irrigation and climate advisory service through citizen science
<b>Location:</b>	Pakistan
<b>Timeframe:</b>	20 <sup>th</sup> December 2021 to 31 <sup>st</sup> July 2022
<b>Funding Agency:</b>	Asian Disaster Preparedness Centre (ADPC), Bangkok, Thailand

**Khayaban-e-Johar, Sector H-8/1, Islamabad – Pakistan  
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# Contents

<b>1. <u>BACKGROUND AND THE CONTEXT</u></b> .....	<b>3</b>
<b>2. <u>ABOUT THE INNOVATION</u></b> .....	<b>4</b>
<b>3. <u>OBJECTIVES</u></b> .....	<b>5</b>
<b>4. <u>PROGRESS ON KEY DELIVERABLES</u></b> .....	<b>5</b>
<b>4.1 TRAINING OF FARMERS IN PROJECT SITES</b> .....	<b>5</b>
<b>4.1.1. GLIMPSES OF CITIZEN SCIENCE ACTIVITIES</b> .....	<b>8</b>
<b>4.2. CITIZEN SCIENCE DATA ON THE BACK-END DATABASE</b> .....	<b>10</b>
<b>4.3 COMMISSIONING OF AUTOMATIC WEATHER STATIONS</b> .....	<b>13</b>
<b>4.5 PROCUREMENT OF NECESSARY EQUIPMENT</b> .....	<b>13</b>

## 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 (ET<sub>o</sub>) at a resolution of 10 km × 10 km, and crop coefficient values (K<sub>c</sub>) 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 ET<sub>o</sub> 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 is:

- 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. Progress on key deliverables**

#### **4.1 Training of Farmers in project sites**

Citizen science component was launched by training of farmers to become the part of Irrigation and Climate Advisory Services (ICAS). Farmers were informed in detail about their role in ICAS and how citizen science can play role in improving climate resilience and information. Farmers were also informed about the ICAS mobile phone application and its link to the database. In the second part, farmers were handed over weather gadgets, each gadget in the set of three, and given the training to use these instruments. A separate Whatsapp group was made for each site to get day-to-day progress on citizen science and help farmers in resolving day-to-day issues. The citizen science component was launched on 14<sup>th</sup> February in Bahawalpur, on 16<sup>th</sup> February in Multan and 1<sup>st</sup> March in Tando Allah yar

through three different training sessions. The agenda of training program included;

- Introduction to Irrigation and Climate Advisory Services
- Introduction to the concept of citizen science
- Inviting farmer's participation in interacting with weather tools and their use
- Hands on training of farmers on ICAS mobile application, reading of data and upload
- Demonstration exercise on weather gadget use and installation
- Troubleshooting of app and interaction with database
- Information about securing end to end validation of data submitted by farmers
- Handing over the gadgets and smart phones to the farmers

During first training program held in the Bahawalpur district, 15 farmers joined. In this group, one female farmer also joined as a citizen scientist. Few glimpses of training in sessions in Bahawalpur district are following;





Fig. Farmer training in Bahawalpur

In Multan District, 10 farmers joined in the training session to become citizen scientists on voluntarily basis in this pilot. Some glimpses of training sessions in Multan are following;



Glimpses of farmer training in Multan

In Tando Allahyar district, a total of 15 farmers joined to become citizen scientists. Farmers shown very keen interest in weather gadgets and their role in the pilot. Some glimpses of training program are following;





#### Glimpses of farmers trainings for Tando Allahyar

A total of 40 farmers have finally joined to become citizen scientist in ICAS project. All of these farmers/citizen scientists have joined on voluntarily basis and agreed to share weather data on regular basis. Farmers have also rendered their willingness to participate feedback surveys, use of ICAS message service and knowledge dissemination activities under this pilot.

#### 4.1.1. Glimpses of Citizen Science activities in field

Farmers are interacting in citizen science projects very actively and they have also shared the images of how they take the weather data before sending it through the mobile app. On 3<sup>rd</sup> March 2022, the first rainfall data has been recorded by the farmers in Bahawalpur district and it not only shows the variability in rainfall

depth within a district but also determine farmer’s interest in understanding the citizen science concept;

Table 1: Citizen science data and its variations

Sr #	Data source	Rainfall depth (mm)	Images
1	Pakistan Meteorology Department (Radar Corrected)	5.9	
2	Farmer 1	8.9	
3	Farmer 2	6.74	
4	Farmer 3	5.5	

In the scenario shown in the table above, the back-end database is designed to take the average value of rainfall from each site. The citizen science calculated value of rainfall estimates that at an average 7.1 mm rainfall was received in Bahawalpur which is 1.2 mm more than the radar estimated value. The inclusion of Automatic Weather station data from Bahawalpur will further strengthen

citizen advisory. The data is logged against each registered farmer in following format;

Name	Region	Android Application ID	Phone Number	Sensor	
shahnawaz	Tando Allah Yar	69f9cad8648822f2	03473539593	All Sensor	VIEW DATA
Muhammad Rabnawaz	Bahawalpur	4df4e9d75ebec393	03016508723	Rain Gauge	VIEW DATA
Zahoor Ahmed	Bahawalpur	e5704f4f31d40490	03006826892	Rain Gauge	VIEW DATA
Adeel ur Rahman	Bahawalpur	5830e68665d12274	03017740523	Rain Gauge	VIEW DATA
Muhammad Tariq Abbas	Bahawalpur	24f970d5293b0fc7	03009688741	Barometer	VIEW DATA

Fig. Data log of citizen science data shared by each farmer district wise Through daily communication farmers also send visuals of them sending data giving us more insight on how citizen science is progressing in the field.



Fig. Farmer taking barometer reading in his field



Fig. Anemometer data reading (Day and night time)



#### 4.2. Citizen science data on the back-end database

Soon after the citizen science component was launched, data is received and visualization of citizen science data is being developed. The dashboard shows line graphs of; temperature, humidity, air pressure, air speed and bar graphs of rainfall from three project sites. This database also stores weather parameter

values shared by farmers and which can also be downloaded separately. The mobile phone application also collects the location of the data sender within a 50km radius of the pilot district. A few glimpses of the dashboard are following;



Fig. Plot of relative humidity data shared by farmers in districts Multan, Bahawalpur and Tando Allahyar



Fig. Plot of Air pressure data shared by citizen scientists in districts Multan, Bahawalpur and Tando Allahyar

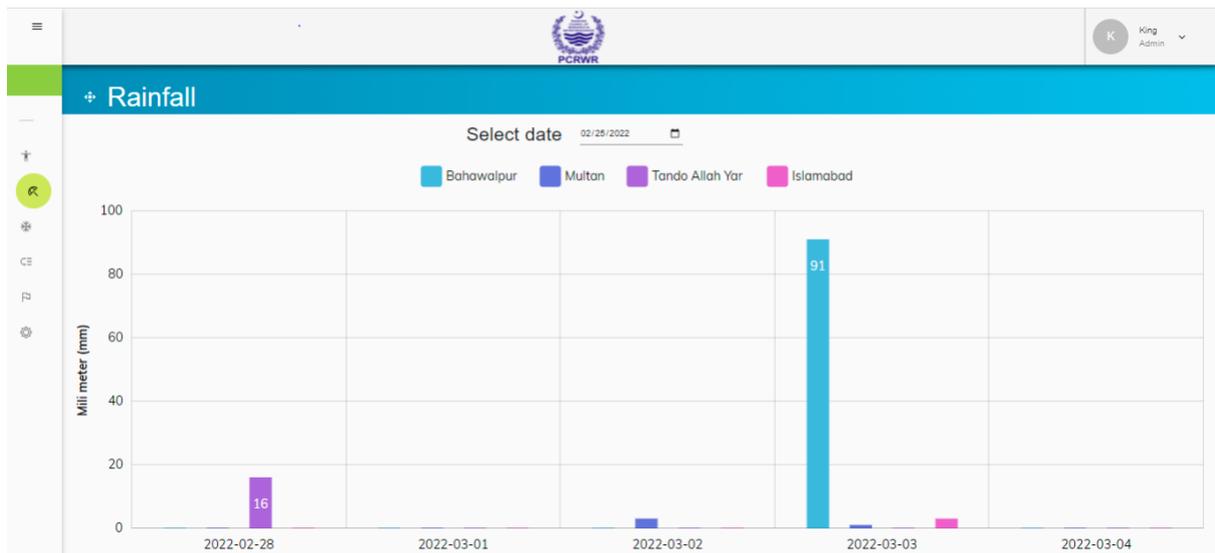


Fig. Rainfall plot of data shared by citizen scientists in districts Multan, Bahawalpur, Tando Allahyar



Fig. Temperature blot of data shared by citizen scientist in districts Multan, Bahawalpur, Tando Allahyar

The database has to provision to delete any abnormal data shared by farmers. From each district three set of values are received against each weather parameter. The database automatically takes a mean of these values and display only the average values in bar and line graphs.

### 4.3 Commissioning of Automatic Weather Stations

The commissioning of Automatic weather stations has been initiated in all three sites. The necessary work for site preparation has been completed and necessary computer programming for receiving and analyzing automatic weather station data is being made. The hardware component of Automatic weather station is expected to be completed by the end of March and data reception will be started soon. In parallel, the development team is working on database interface for remotely sensed and automatic weather station data.



*Weather Station tower in Multan*



*Weather station tower in Bahawalpur*



*Weather station tower in Tando Jam*

### 4.5 Procurement of necessary equipment

- Procurement of smart phones have been completed and the devices are handed over to the farmers.
- Supply of Automatic Weather Stations is in process
- PCRWR has procured a web domain for ICAS dashboard, ICAS.pk to access irrigation and climate advisory data from any place under user privileges.