



PAKISTAN COUNCIL OF RESEARCH IN WATER RESOURCES (PCRWR)

First Progress Report

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

**Khayaban-e-Johar, Sector H-8/1, Islamabad – Pakistan
February, 2022**

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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 (ET_o) at a resolution of 10 km × 10 km, and crop coefficient values (K_c) 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_o 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. Progress on key deliverables

4.1 Identification of participating farmers

Farmer and site selection criteria was prepared and field teams of PCRWR has undertaken site selection three project districts; Tando Allah Yar, Multan and Bahawalpur. Project teams visited village sites and conducted meetings with perspective farmers. The credential of farmers is noted as; name, gender, cell phone number, level of education, national identification card number, land owned and types of crops grown. During the meetings farmers were explained the objective of the pilot project. They were also informed that in order to participate in the citizen science project they will have to enter in an agreement with PCRWR to share citizen science data with PCRWR using mobile phone app and protected the cellphones, gadgets provided to them. As a result, the credential of only willing farmers was noted in the site selection. Farmers were

informed that they will be invited for a training session related to Citizen science project at the regional offices of PCRWR located in Tandojam, Multan and Bahawalpur. Site selection criteria is enclosed as (**Annexure I**).

In each district site, up to 15 farmers have been selected present in 1-3 villages within 50 km premises of PCRWR regional offices in all three project districts. In site selection criteria high preference is given to the involvement of youth, students and females members of family. Farmers were also invited to involve female members of family to participate in this project. Presently, most of the shortlisted farmers are less than the age of 50 years and all of them are educated practical farmers permanently living in their villages.

- **Tando Allah yar:** A total of 15 farmers have been selected in this district belonging to 3 villages. Age range of farmers is 23-47 and all are male farmers
- **Bahawalpur:** A total of 11 farmers are selected from two villages, including two women farmers. These are a diverse group of farming families including high school and university students.
- **Multan:** These are a group of 14 farmers belonging to 3 different villages in Multan.

4.2. User/Training Modules for Farmers

In each project district three sets of 5 gadgets will be distributed among farmers in order to enhance daily data sharing frequency. These five weather gadgets include; Rain gauge, humidity sensor, digital thermometer, barometer and anemometer. Simple and smart gadgets are selected for farmers after thorough survey of local market. On the basis of this selection training modules for farmers have been developed (**Annexure-II**). These modules include a step-by-step methodology to read the gadget and enter the data on mobile phone app. At the back of these modules, simple troubleshooting advice and details of the contact persons are provided. These modules will be printed in form of cards and handed

over to the farmers after training. The training session at all three sites are tentative planned for the mid of February.

4.3 Development of Mobile Phone App

Beta version of app for citizen science data collection has been prepared and being tested by NUST and PCRWR teams on daily basis. Since 20th December 2021, weekly meetings with development team are on-going to keep the progress on track. A step wise glimpse of beta version of mobile phone is following;

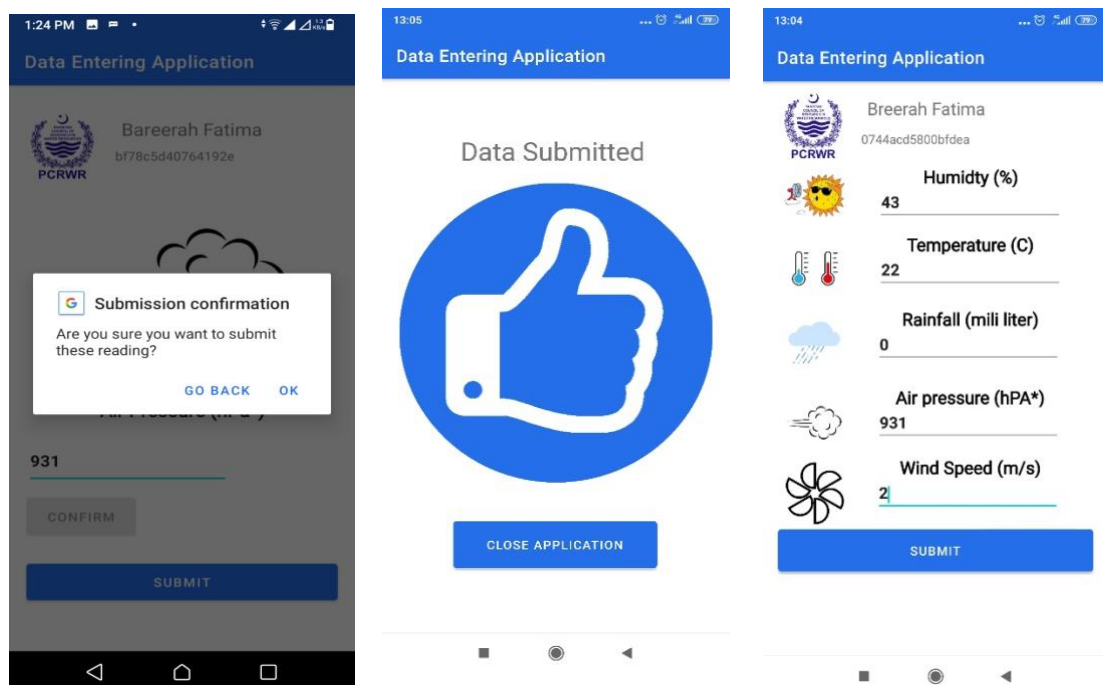
The figure displays three screenshots of the PCRWR mobile application interface, labeled a, b, and c.

Screenshot a: Shows the 'Welcome TO PCRWR Registration form' screen. It includes input fields for 'Enter Name' (Abdullah Masood), 'Enter Phone number' (0XXX-1234567), 'Android Address (default)' (bf78c5d40764192e), 'Select Region' (Bahawalpur), and 'Select Sensor' (Rain_Sensor). A blue 'SUBMIT' button is at the bottom.

Screenshot b: Shows the same 'Welcome TO PCRWR Registration form' screen, but with the user 'Bareerah Fatima' and phone number '03002070101'. The 'SUBMIT' button is also present.

Screenshot c: Shows the 'Data Entering Application' screen. It displays the user's name 'Bareerah Fatima' and ID 'bf78c5d40764192e' at the top. Below is a large cloud icon representing a weather station. The 'Air Pressure (hPa*)' is shown as '931'. There are two buttons: a blue 'CONFIRM' button and a grey 'SUBMIT' button.

- One time registration on app, selecting the suitable station and gadget
- Cell phone and farmer name with unique phone ID extracted by APP
- Data entry from the weather gadgets.



d. Submission message

review

e. Submission confirmation

f. Overall view of all data entry bars

To ensure the quality and authenticity of data following controls as been developed in the app;

- 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 his respective mobile app.
- Farmer can only enter data from a particular station, the citizen scientist should be present within 50 km radius of their respective project district.
- Only digital gadgets are provided to farmers to avoid human error in taking the note of reading
- The mobile app will automatically extract unique phone ID of each mobile phone being used for citizen science gadget.
- Before submission of data, the app will verify location of the sender.

4.4 Development of database for data processing

The development team at NUST has developed back-end database for citizen science application and now working on to development visualization of data shared by beta testing. Meanwhile the team is also working on database architecture for validation of satellite data with citizen science and Automatic Weather Stations data.

4.5 Procurement of necessary equipment

PCRWR has to follow the Public Procurement Regulatory Authority (PPRA), Government of Pakistan rules for major procurements of instruments. In this regard PCRWR had published a tender in two national dailies, PCRWR and PPRA websites. The sealed bids were invited through a competitive bidding process and the suppliers were given 15 working days to submit their bids. On January 12, 2022, PCRWR opened the bids in the presence of bidders. After thorough scrutiny by a notified tender evaluation committee work orders were issued to bidders on 28th January, 2021 for the procurement of following equipment;

- a. Automatic weather stations (3 Nos.) to be installed in each district. PCRWR regional offices are already located in these districts (Tandojam near Tando Allah Yar, Multan and Bahawalpur).
- b. Smart phones for farmers
- c. Smart phones for database management

The suppliers have accepted work order and have initiated their work to comply with supply order. The supplier for Automatic Weather Station will start to prepare installation sites for the deployment of Automatic Weather Stations by next week to avoid operation delays. Smart phones will be supplied with in a week's time.

Project team will assign ID's to these smart phones and prepare them for handing over to farmers after training.

The procurement of Hand-held small weather gadgets (barometer, humidity sensor, thermometer, anemometer and rain-gauge) for farmers was made through market survey and on invoice. Presently, the data necessary data setting for weather gadgets is going on before handing them over to farmers/citizen scientists/farmers.

Site Selection Criteria







Irrigation and Climate Advisory Services of PCRWR

Cluster size: 15 farmers

Cluster expansion: This farmer cluster may locate in 1-3 villages. Farmers per village will be decided after the willingness and availability of farmers.

- The cluster farmers should be located within 50 km premises of PCRWR office
- Farmers will be provided with a smart phone and weather measurement gadget after the signing on agreement. Therefore, while selecting farmers following willingness of farmers needs to be acquired;
 - To sign a formal agreement
 - To protect and safe guard the gadgets provided to them
 - To participate in the training program organized by PCRWR regarding project
 - To share data through mobile app on daily basis. He must be familiar with android mobile phone application use, data package availability etc.
- Farmer cluster may locate in 1-3 villages.
- Farmers with ability to read, write and use smart phones
- Preferably young farmers willing to cooperate and advocate citizen science
- Female members of farming family willing to participate in the citizen science will be an additional benefit
- Farmers already in contact with PCRWR regional offices through earlier projects may also be included

User Module for Barometer (Air Pressure)

Sr.#	Operating Instructions	Image
Step-1	<p>Press the "ALTITUDE" button and the screen will turn on.</p> <p>Read the value "BARO"</p>	
Step-2	<p>Open your mobile phone app. Add value of air pressure in the tab.</p>	 <p style="text-align: center;">Air pressure (hPA*) <u>Range (0) to (1000)</u></p>
Step-3	<p>Press "confirm" tab to check that you have entered the correct value</p>	 
Step-4	<p>Click on "submit" button. The "submission confirmation" window will pop up.</p>	 <p>Submission confirmation Are you sure you want to submit these reading?</p> <p style="text-align: right;">GO BACK OK</p>
Step-5	<ul style="list-style-type: none"> • If you want to re-check your values, click "go back". • If you want to go ahead with submission, click "ok". • Once you will click "ok" following message will appear. • Click "close application" <p>You have successfully submitted your data</p>	<p style="text-align: center;">Data Submitted</p>  <p style="text-align: center;">CLOSE APPLICATION</p>



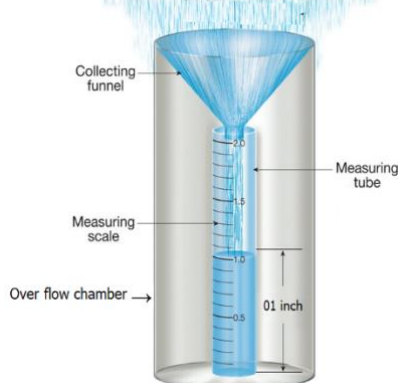
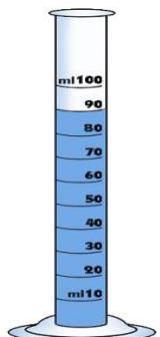



General Instructions


- Please make sure that you have sufficient internet data and good connection of Wifi to submit data.
- If battery is low, please replace the cell 3v before further use.



- In case of any issue in App please contact Mr. Muhammad Imran, Director In charge, Regional Office, Bahawalpur +923004931171

User Module for five-inch Rain gauge

Sr.#	Operating Instructions	Image
Step-1	Rain gauge parts <ul style="list-style-type: none"> • Funnel attached with sleeve • Measuring gauge/flask • Outer cylinder 	 
Step-2	The funnel collects rain into a flask underneath. The flask is a graduated measuring tube.	
Step-3	After 45 minutes of rainfall event, un cap the rain gauge and take out the measuring flask. Read value in “ml” from the graduated flask	
Step-4	Open your mobile phone app. Add value of amount of rainwater collected in flask (ml) in the tab.	 <div style="text-align: center;"> Rainfall (mili liter) Range (0) to (1000) </div>
Step-5	Press “confirm” tab to check that you have entered the correct value	 <div style="border: 1px solid black; padding: 5px; display: inline-block; background-color: #007bff; color: white; font-weight: bold;">CONFIRM</div>
Step-6	Click on “submit” button. The “submission confirmation” window will pop up.	 Submission confirmation Are you sure you want to submit these reading? <div style="text-align: right;"> GO BACK OK </div>



<p>Step-7</p>	<ul style="list-style-type: none"> • If you want to re-check your values, click “go back”. • If you want to go ahead with submission, click “ok”. • Once you will click “ok” following message will appear. • Click “close application” <p>You have successfully submitted your data</p>	<p>Data Submitted</p> 
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General Instructions

- The rain gauge should be placed in an open space.
- Place the gauge at least 2-5 feet away from structures (wall, tree etc.)
- Make sure the top of the rain gauge is level.
- The gauge should be truly vertical.
- If rain occurs more than measuring tube capacity. Please collect the excess water in the tube and measure it using this same flask.
- In case of any issue in App please contact Mr. Muhammad Imran, Director In charge, Regional Office, Bahawalpur +923004931171









User module for Digital Anemometer

Sr.#	Operating Instructions	Image
Step-1	Press and hold the "  " button	 
Step-2	Take the anemometer outside in the field facing your eyes. Once the fan of anemometer start moving, note the display reading	
Step-3	Open your mobile phone app. Add value of wind speed in the tab.	
Step-4	Press "confirm" tab to check that you have entered the correct value	
Step-5	Click on "submit" button. The "submission confirmation" window will pop up.	
Step-6	<ul style="list-style-type: none"> • If you want to re-check your values, click "go back". • If you want to go ahead with submission, click "ok". • Once you will click "ok" following message will appear. • Click "close application" <p>You have successfully submitted your data</p>	

Step-7	Press and hold the “  ” button for turn OFF the sensor	
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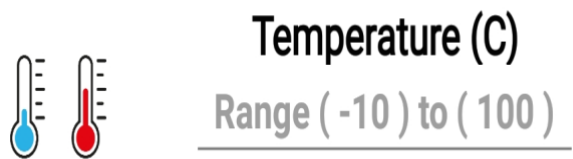

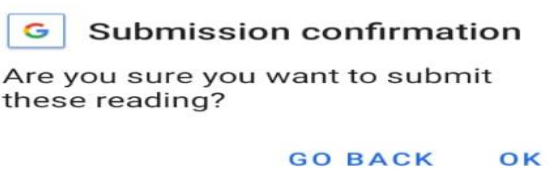

General Instructions

- The devices are provided with pre-select mode and units, for temperature degree C and for speed (m/s)
- If unit settings are changed, please change them using following method;

Step-1	Press the " Mode " button, to select Avg. function.		
Step-2	Press the " Unit " button, to select velocity unit m/s .		
Step-3	Press the “°C/°F” button, for Temperature range.		
Step-5	If battery symbol is low  ". Please replace the Batteries AAA (3 x 1.5v) before further use.		

- In case of any issue in App please contact Mr. Muhammad Imran, Director In charge, Regional Office, Bahawalpur +923004931171

User Module for Thermometer

Sr.#	Operation Instruction:	Display
Step-1	Insert battery in Htc-2 meter, the screen will display Indoor temperature, Outdoor temperature, Clock and Relative Humidity (RH)	
Step-2	Place Outdoor temperature sensor cord out of the window	
Step-3	Htc-2 meter will continuously display indoor Temperature and outdoor temperature	
Step-4	Open your mobile phone app. Add value of outdoor temperature	
Step-5	Press "confirm" tab to check that you have entered the correct value	
Step-6	Click on "submit" button. The "submission confirmation" window will pop up.	
Step-7	<ul style="list-style-type: none"> If you want to re-check your values, click "go back". If you want to go ahead with submission, click "ok". Once you will click "ok" following message will appear. Click "close application" <p>You have successfully submitted your data</p>	

General Instructions

- Always Keep on the Htc-2 meter, for stable measurement record.
- Please hang the HTC-2 meter on wall
- If installed inside a room, please make sure its sensing probe is hanging outside through a window
- The error may arise due to low battery, in this case change the battery and reset using following method



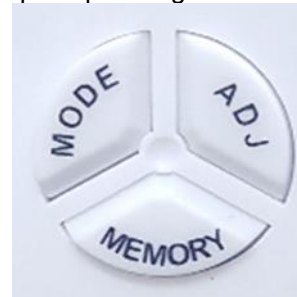
Press <C/F> push button at back of meter to switch degree display of centigrade(°C) and Fahrenheit (°F)



Press <MODE> button to set min, hours, change hour display, month, date and year on subsequent pressing.






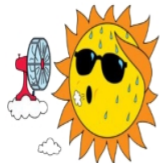



Press <ADJ > button to change minutes, hour, month date and year value for selected mode.



Press<MEMORY> to visualize maximum and minimum temperature and humidity value from last battery change.

- If problem persist, please contact Mr. Muhammad Imran, Director In charge, Regional Office, Bahawalpur +923004931171

User Module for Hygrometer (Humidity)

Sr.#	Operation Instruction:	Display
Step-1	Once your will insert the battery into HTC-2 meter it will show this display.	
Step-2	Place the outdoor sensor out of the window so that it may display humidity of outside.	
Step-3	Please note this value of relative humidity	
Step-4	Open your mobile phone app. Add value of outdoor relative humidity	 <div style="text-align: right;"> Humidity (%) Range (0) to (100) </div>
Step-5	Press “confirm” tab to check that you have entered the correct value	 <div style="border: 1px solid black; background-color: #007bff; color: white; padding: 5px; display: inline-block;">CONFIRM</div>
Step-6	Click on “submit” button. The “submission confirmation” window will pop up.	 Submission confirmation Are you sure you want to submit these reading? <div style="text-align: right;"> GO BACK OK </div>
Step-7	<ul style="list-style-type: none"> If you want to re-check your values, click “go back”. If you want to go ahead with submission, click “ok”. Once you will click “ok” following message will appear. Click “close application” <p style="text-align: center;">You have successfully submitted your data</p>	<p style="text-align: center;">Data Submitted</p>  <div style="text-align: center; margin-top: 10px;"> <div style="background-color: #007bff; color: white; padding: 5px 20px; display: inline-block;">CLOSE APPLICATION</div> </div>

General Instructions

- Htc- 2 meter will automatically display the humidity status as;
 - Humidity < 40% — Dry
 - Humidity < 70% — Wet
 - Humidity between 40 and 70% — Comfort
- Always Keep on the Htc-2 meter, for stable measurement record.
- Please hang the HTC-2 meter on wall
- If installed inside a room, please make sure its sensing probe is hanging outside through a window
- The error may arise due to low battery, in this case change the battery and reset using following method



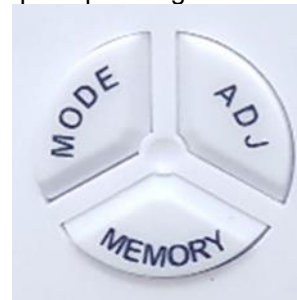
Press <C/F> push button at back of meter to switch degree display of centigrade(°C) and Fahrenheit (°F)



Press <MODE> button to set min, hours, change hour display, month, date and year on subsequent pressing.



Press <ADJ > button to change minutes, hour, month date and year value for selected mode.



Press<MEMORY> to visualize maximum and minimum temperature and humidity value from last battery change.

- If problem persist, please contact Mr. Muhammad Imran, Director In charge, Regional Office, Bahawalpur +923004931171