



## iCARE Innovation Fund

# Calculating Evapotranspiration Using GIS and Remote Sensing Techniques for Calculating Crop Water Productivity in Sindh Province, Pakistan

## Monthly Progress Report

**Reporting Period** *(June 2024)*

Prepared by: Asian Institute of Technology, Thailand

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## 1. Project Information

<b>Project Title:</b>	Calculating Evapotranspiration Using GIS and Remote Sensing Techniques for Calculating Crop Water Productivity in Sindh Province, Pakistan
<b>Project Code:</b>	WBCAR
<b>Partner Organisation:</b>	
<b>Reporting Period:</b>	1 June 2024- 30 June 2024
<b>Date of Submission:</b>	July 5, 2024
<b>Contact Name:</b>	Furqan Ali Shaikh
<b>Contact Position:</b>	Project Manager
<b>Contact Email Address:</b>	srp.ait@ait.asia
<b>Contact Telephone Number:</b>	+66875978284
<b>Status of project progress in this reporting period</b>	<input type="checkbox"/> Significant delay <input type="checkbox"/> Delay <input checked="" type="checkbox"/> On Track
<b>Report sign Off</b>	<p><input checked="" type="checkbox"/> I have reviewed all the information provided for each section including the number of beneficiaries. The information provided for each section of the report is complete.</p> <p>Name: <a href="#">Furqan Ali Shaikh</a>      Designation: Project Manager</p>

## 2. Key Achievements

1. Completed the first 4 Tasks successfully along with the first output report of the project **“Estimation and Analysis of Spatial and Temporal Variations in Evapotranspiration (ET) across different crops”**.

2. **Completed Calculation of Crop Water Productivity (CWP)**

Calculation of crop water productivity was completed using the crop yield data from the agriculture department of Sindh for the years 2020 and 2021 for both crops wheat and rice. The crop yield data was district-wise data. It was first calculated for each sub CCA on an area basis and then the seasonal ETa was used to calculate crop water productivity for the crops for each season for each Sub CCA. The results of the analysis are in tabular form and shown in ANNEXURE.

3. **Adding advanced features to the Dashboard**

The IT-based dashboard will facilitate the dissemination of project outcomes to a broader audience, including farmers, agricultural extension workers, policymakers, and researchers. It will provide an intuitive platform to understand complex data, make informed decisions, and promote the adoption of NbS and efficient water management practices. New features will be added to the dashboard such as selecting a point in a specific area and then generating the graph of ETa for all the stages for that specific crop for that point. Additionally, the end users will be able to download that data in Excel format and also in PNG and web-based formats such as HTML which can be used for multiple purposes. Multiple points selection features will be added where users can select multiple points and then get the data of those multiple points in different formats. Link to the dashboard <https://salmankhan72901.users.earthengine.app/view/test>

4. **Meeting with Stakeholders for recommendations in Dashboard design and processes**

The Stakeholder meeting focused on recommendations for designing an insightful dashboard for data visualization and decision-making in water management of canal command areas on the right side of the Indus. Concerned Irrigation Department, The Decision Support System (DSS) Data Center team of the Irrigation department joined the meeting for recommendations to enhance the dashboard's functionalities with user needs, ensuring it effectively supports agricultural productivity and water management in the region.

### 3. Implementation Progress

Activity Title	Last Month Progress	Current Month Progress	Activities, and Events, planned for the subsequent month
Activity 1.1.1: Pre-Pilot Preparation / Inception Phase (Dec-Jan,2024)	<b>Completed</b>	<b>Completed</b>	Meeting with Stakeholders
Activity 2.1.1: Remote Sensing and Image Processing (Jan,2024)	<b>Completed</b>	<b>Completed</b>	N/A
Activity 2.2.1: Remotely Sensed Data of ET (Feb,2024)	<b>Completed</b>	<b>Completed</b>	N/A
Activity 2.3.1: Reference Evapotranspiration (ET <sub>r</sub> ) (Feb,2024)	<b>Completed</b>	<b>Completed</b>	N/A
Activity 2.4.1: Actual Evapotranspiration (ET <sub>a</sub> ) (Feb-Mar,2024)	<b>Completed</b>	<b>Completed</b>	Meeting with the Irrigation Department Government of Sindh
Activity 3.1.1: Temporal Analysis and ET Variation for Adaptive Water Management (Feb-Mar,2024)	<b>Completed</b>	<b>Completed</b>	N/A

Activity 3.2.1.: Statistical Insights and Environmental Factors for Enhanced Resilience  (Mar,2024)	<b>Completed</b>	<b>Completed</b>	Ground truthing Survey in Progress
Activity 3.3.1: Water Demand and Efficiency Assessment for Sustainable Practices  (Mar-April,2024)	<b>Completed</b>	<b>Completed</b>	Ground truthing Survey in Progress
Activity 3.4.1: Temporal Variation and Ground Truth Validation for Informed Decision-Making  (April-May,2024)	<b>Completed</b>	<b>Completed</b>	N/A
Activity 4.1.1: Spatial Mapping of Efficiency and Identification of Inefficiencies  (May-June,2024)	<b>Completed</b>	<b>Completed</b>	Activity completed and results added in First Output report
Activity 4.2.1: Comparative Assessment and Sustainable Performance  (June - July,2024)	<b>Completed</b>	<b>Completed</b>	
Activity 5.1.1.: Categorization and Delineation for Targeted Interventions  (July - August 2024)	<b>Not started</b>	<b>In Progress</b>	

<p>Activity 5.2.1.: Comparative Analysis and Best Practices</p> <p>(July - August 2024)</p>	<p><b>Not started</b></p>	<p><b>In Progress</b></p>	
<p>Activity 7.1.1: Design and Development of the Dashboard</p> <p>(Oct - Nov 2024)</p>	<p><b>In Progress</b></p>	<p><b>In Progress</b></p> <ul style="list-style-type: none"> <li>• Dashboard Development using Google Earth Engine is in progress.</li> </ul>	<p>Meeting with Stakeholders</p>

## 4. Results Framework Indicators Progress

<b>PDO Indicator Description:</b> Government agencies and Citizens who have access to climate-resilient solutions tested under the project				
	Baseline	Actual (Previous)	Actual (Current)	End Target
Value	0	0	10 4 (SID Government Official) 6 (Farmers)	10 Access to Sindh Irrigation Department and Farmers
Date	15 Dec 2023	31 May 2024	30 June 2024	Nov 2024
Comments	The Stakeholder Meeting was held on 15 Feb 2024 at Karachi and discussed the project details with the Sindh Irrigation Department and farmers from different areas of Jamshoro District. <b>The final product will be tested with the SID and Farmers</b> during Nov 2024.			
<b>Indicator 1: Number of People Trained (In Person)</b>				
Value	0	0	10	20
Date	1 Jan 2024	15 April 2024	30 June 2024	15 Jan 2025
Comments	Local Training was held during May 2024 on output 1 and the climate change awareness training program, another training will be conducted after the final dashboard testing.			
<b>Indicator 2: Number of People Trained (Online)</b>				
Value	0	0	0	35
Date	1-Feb-2024			15 Jan 2025
Comments	This will be conducted after the completion of output 2.			
<b>Indicator 3: Number of Knowledge Products Provided</b>				
Value	0	0	0	15

Date	1-Feb-2024	25 Nov 2024		15 Jan 2025
Comments	Product Development in Progress			
<b>Indicator 4: Number of People / Organizations Provided with Knowledge Products</b>				
Value	0	0	0	25
Date	1-Feb-2024	25 Nov 2024		15 Jan 2025
Comments	Product Development in Progress			
<b>Indicator 5: Number of Events Supported</b>				
Value	0	0	2	4
Date	1-Feb-2024	25 Nov 2024	30 June 2024	15 Jan 2025
Comments	A workshop with stakeholders has been conducted in Karachi during May 2024.			
<b>Indicator 6: Number of People Participating in Supported Events</b>				
Value	0	0	10	50
Date	1-Feb-2024		30 June 2024	15 Jan 2025
Comments				



## 5. Challenges, Lessons Learned, and Way Forward

The comprehensive overview that ensues intends to summarise our learnings, experiences, and subsequent phases to achieve the project objectives.

### Challenges:

1. The crop yield data was district-wise data. It was first calculated for each sub CCA on an area basis and then the seasonal ETa was used to calculate crop water productivity for the crops for each season for each Sub CCA.
2. Conducting a ground-truthing survey presents several challenges, including accessibility issues in remote or difficult terrain, weather-related disruptions, and security concerns that can limit data collection in certain areas.
3. Finding Crop Coefficient values for each crop and all four stages on a local scale is one of the challenging tasks as globally we have data available from FAO but to get more accurate results it is important to use the local datasets. Local data may not always be readily available and require extensive research, which can be time-consuming and resource-intensive.
4. To Ensure that the images chosen for Evapotranspiration (ET) calculation are both consistent over time and free from excessive cloud cover and noise is a complex and time-consuming task. This involves carefully selecting images that represent different stages of crop growth, while also making sure they have minimal interference from clouds or other distortions. Additionally, manual verification is essential to guarantee the quality of the selected images.

### Lessons Learned:

1. Collaborative Partnerships: The success of the project depends on establishing partnerships with technical specialists, provincial government departments, and local communities.
2. Adaptive Planning: It became apparent that the project's planning required to be adaptable to overcome unforeseen obstacles.

### The Way Forward:

1. Enhanced Stakeholder Engagement: Continued efforts to foster community involvement and understanding through focused awareness initiatives such as workshops and training.

The collective efforts of all stakeholders will be pivotal in realizing the long-term impact and success of this transformative project on the right bank of the River Indus.

## Annexures:

### Crop Yield Data of Districts within the Study Area (Metric Tons)

Districts	Wheat 2020	Wheat 2021	Rice 2020	Rice 2021
Jacobabad	72,568	78,641	381,551	365,026
Kashmore	110,847	106,077	308,617	285,466
Shahdad Kot	149,442	182,905	301,394	266,020
Shikarpur	108,623	107,557	357,654	380,466
Larkana	165,887	201,406	409,516	361,061
Dadu	225,621	259,596	192,434	160,744
<b>Sum</b>	<b>832,988</b>	<b>936,182</b>	<b>1,951,166</b>	<b>1,818,783</b>

### Percentage of Crops Area of each Sub CCA (%) (Pixel Counts based Area)

S.No.	Name	Wheat 2020	Wheat 2021	Rice 2020	Rice 2021
1	Pat Feeder	4.1914	3.4716	4.3676	17.3646
2	Begari Canal	19.6345	17.2826	22.5344	26.0755
3	North West Canal	24.0250	27.0216	18.6425	20.6911
4	Rice Canal	22.3527	24.8237	18.1517	20.6911
5	Dadu Canal	20.9432	21.5479	18.1517	6.6414
6	Desert Canal	8.8530	5.8523	18.1517	8.5359

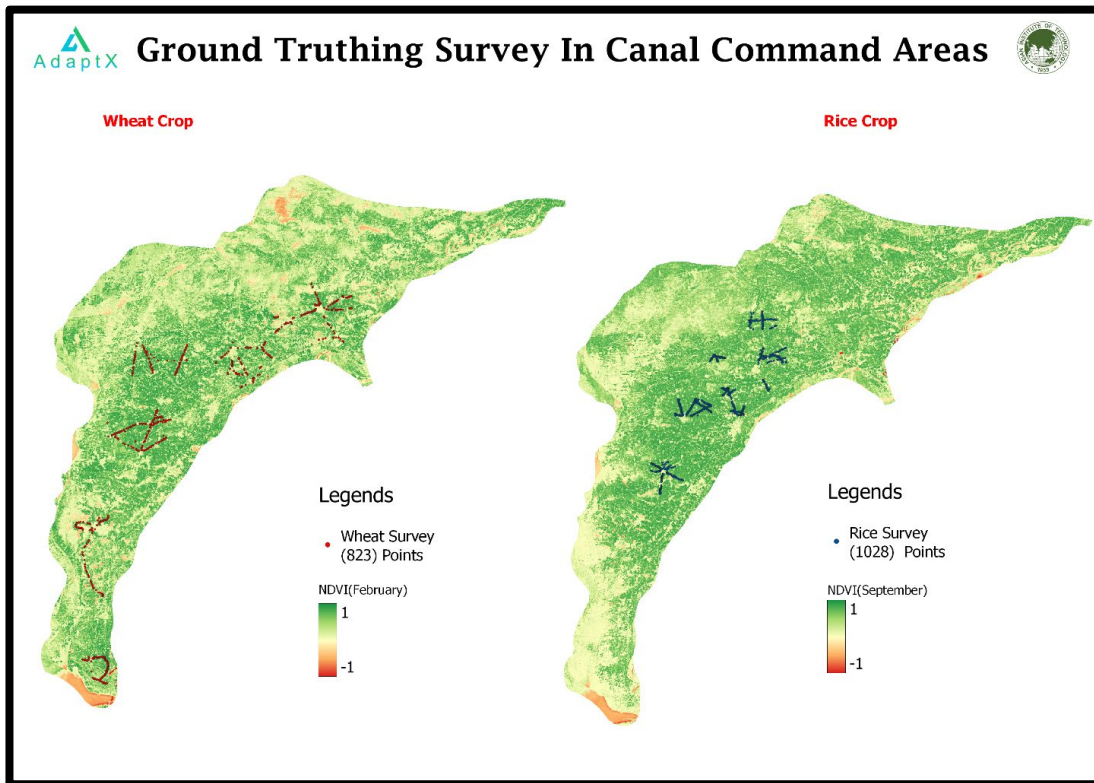
### Sub-CCA Crop Yield Data (Metric Tons)

Districts	Wheat 2020	Wheat 2021	Rice 2020	Rice 2021
Pat Feeder	34,914	32,501	85,220	315,825
Begari Canal	163,553	161,797	439,684	474,257
North West Canal	200,125	252,971	363,747	376,328
Rice Canal	186,196	232,396	354,172	376,328
Dadu Canal	174,455	201,728	354,172	120,794
Desert Canal	73,745	54,788	354,172	155,251
<b>Sum</b>	<b>832,988</b>	<b>936,182</b>	<b>1,951,166</b>	<b>1,818,783</b>

### Crop Water Productivity (CWP) (kg/m<sup>3</sup>)

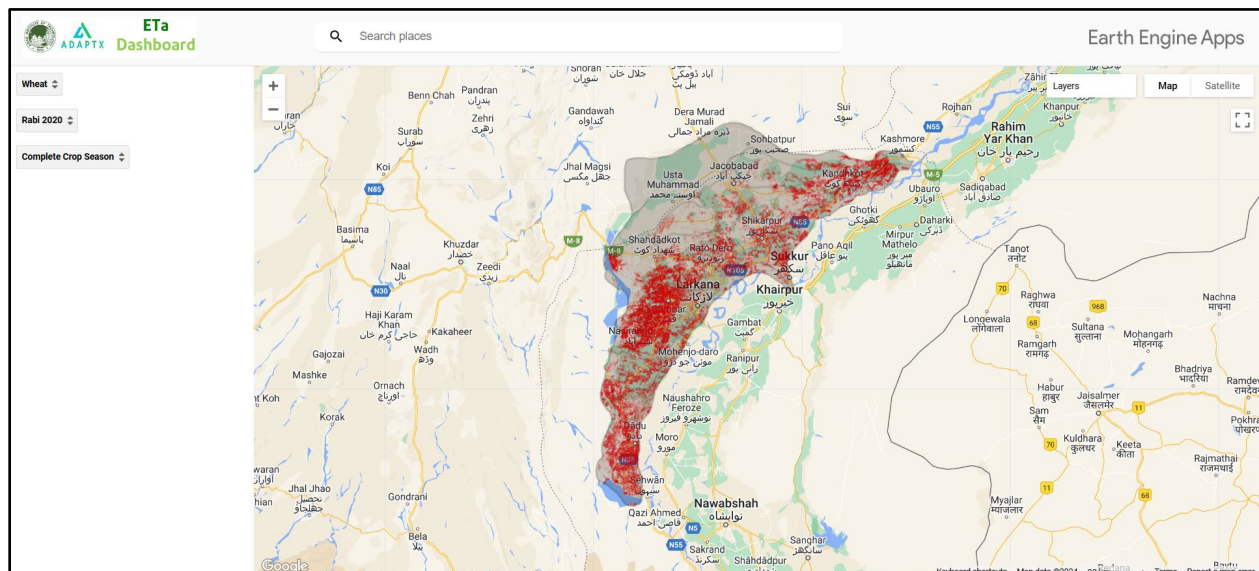
S.No.	Name	Wheat 2020	Wheat 2021	Rice 2020	Rice 2021
1	Pat Feeder	0.306686295	0.285486594	0.173713543	0.643778831
2	Begari Canal	0.40994959	0.405548101	0.192556002	0.207697177
3	North West Canal	0.42007667	0.531003894	0.218226143	0.225773972
4	Rice Canal	0.428518268	0.534845077	0.239385778	0.254361268
5	Dadu Canal	0.407897587	0.471667353	0.55090245	0.187891001
6	Desert Canal	0.400589126	0.297616038	0.401604065	0.176043013

## Ground Truthing survey data along with NDVI of Rabi and Kharif Season.

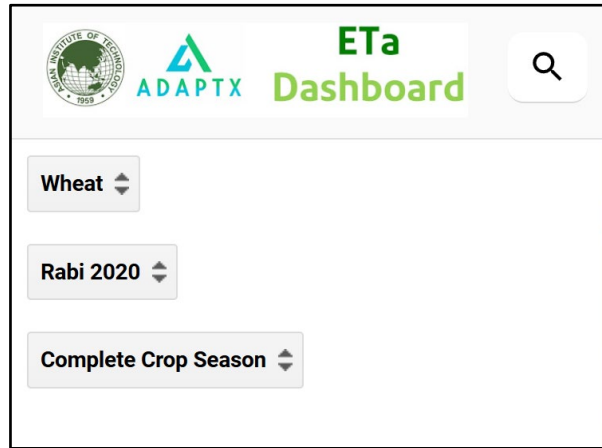


## Screenshots for Dashboard Development Initial Process

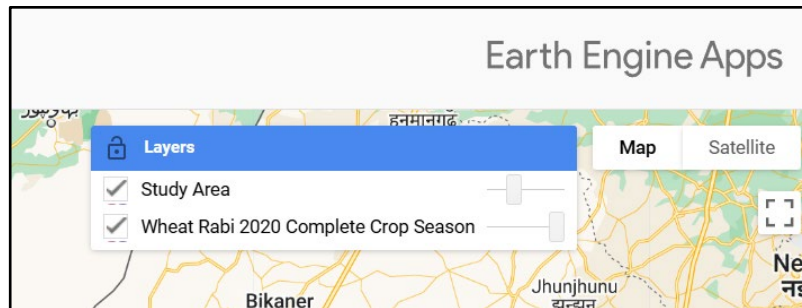
Basic Web Interface of the Dashboard.



User Interface Panel of the dashboard for selecting crop, season, and crop growth stage.



Layers panel of the dashboard for turning on and off different layers and changing the visualization opacity and background maps.



**List of Involve Staff under AIT Payroll: (Tentative)**

<b>Sr.</b>	<b>Name</b>	<b>Position in the project</b>	<b>Working time (Man-Months)</b>
1.	Mr. Furqan Ali Shaikh	Water Resource Management Specialist	6
2.	Mr. Suhail Ahmed	Hydrologist	6
3.	Ms. Nadia Almarri	Strategy and Finance Lead	6
4.	Mr. Zafarullah Memon	Project Coordinator (National)	6
5.	Mr. Salman Khan	Remote Sensing, GIS & Spatial Data Expert	3
6.	Ms Thitichaya Pongsub	Support Staff	6

## Glossary

<b>Project Title</b>	means	Exact and full name of the project as defined in the Sub Grant Agreement
<b>Project Code</b>	means	A five-digit code assigned by ADPC
<b>Partner Organization</b>	means	The lead agency(ies) responsible for the implementation of the project
<b>Key Achievements</b>	means	The actual outcome or impact of your work, such as reaching a PDO, or outcome or output defined in the final and agreed Results Framework.
<b>Implementation Progress</b>	means	Implementation progress means the steps or actions taken to achieve the PDO or outcomes or outputs. In this case it would be the list of activities defined in the final and approved work plan
<b>Challenges</b>	means	The most significant and persistent areas of risk that affect the project's ability to achieve its objectives. Challenges could be related to managing the Sub Grant, sustaining development gains, coordinating with stakeholders, and implementing core management functions. Please also discuss the solutions to mitigate these risks.
<b>Lessons Learned</b>	means	Lessons learned are contextual or operational information that may affect planning and future performance. They highlight the insights gained from the activity's implementation practices and progress, such as staff feedback, stakeholder interviews, data analysis, and success stories. They also include any changes required by or support requested from ADPC or partners.



**Asian Institute of Technology (AIT)**

Address: 58 Moo 9, Km. 42, Paholyothin Highway,  
Klong Luang, Pathumthani 12120, Thailand  
Tel: +66 2 524 5691; Email: [adaptx@ait.asia](mailto:adaptx@ait.asia)