



iCARE Innovation Fund

**PROJECT NAME: CALCULATING EVAPOTRANSPIRATION USING
GIS AND REMOTE SENSING TECHNIQUES FOR
CALCULATING CROP WATER PRODUCTIVITY IN
SINDH PROVINCE, PAKISTAN.**

MONTHLY PROGRESS REPORT

Reporting Period: March 2024

Prepared by: Asian Institute of Technology, Thailand

1. Project Information

Project Title:	Calculating Evapotranspiration using GIS and Remote Sensing Techniques for Calculating Crop Water Productivity in Sindh Province, Pakistan
Project Code:	A-05177- WBCAR.
Partner Organisation:	
Reporting Period:	March 2024
Date of Submission:	04 April 2024
Contact Name:	Furqan Ali Shaikh
Contact Position:	Project Manager
Contact Email Address:	adaptx@ait.asia
Contact Telephone Number:	+66875978284
Status of project progress in this reporting period	<input type="checkbox"/> Significant delay <input type="checkbox"/> Delay <input checked="" type="checkbox"/> On Track
Report sign Off	<input checked="" type="checkbox"/> I have reviewed all the information provided for each section including number of beneficiaries. The information provided for each section of the report is complete. Name: Furqan Ali Shaikh Designation: Project Manager

2. Key Achievements

1. Completed Task - 1 (Pre-Pilot Preparation / Inception Phase) and Task 2 (Estimation of Evapotranspiration (ET) using Remote Sensing and GIS)

2. Completed Downloading ETrf data for both years from EEFLUX

As part of Activity 2.1.1, involving remote sensing and image processing, we are working on a two-year dataset for this pilot project. We have downloaded all the required ETrf data from the EEFLUX portal, and this activity is completed.

3. Started new Activity 2.2.1: Remotely Sensed Data of ET

After successfully downloading all required remotely sensed ET (Evapotranspiration) data, we have initiated the process of analyzing and interpreting this satellite data. This involves a multi-step procedure, including data cleaning, calibration, and validation. Firstly, we are meticulously checking the acquired data for any inconsistencies or errors. This is crucial as any inaccuracies in the raw data can significantly impact the subsequent analysis and results. Finally, the processed data will be validated against ground-truth survey and other known sources of ET data.

4. Training for ground truthing survey team

Conducted extensive training for the ground truthing team to collect crucial ground data and coordinate training sessions to enhance their proficiency in data collection methodologies. Additionally, detailed plans for field visits and data validation exercises are developed to streamline the ground truthing process effectively.

3. Implementation Progress

Activity Title	Last Month's Progress	Current Month Progress	Activities and Events, planned for the subsequent month
Activity: 1.1.1 Pre-Pilot Preparation / Inception Phase	Completed the inception report, procurement plan, and other required documents, and addressed all the comments from ADPC.	Activity Completed	Activity Completed
Activity 2.1.1: Remote Sensing and Image Processing	Downloaded 1-year ET data from EEFLUX, second-year data downloading is in progress. Also, the dates for all four cropping periods are analyzed to select the respective dates for each type of crop for each sub-command area. The areas of each crop for each sub-command area were extracted using ArcGIS. Meeting with the concerned Department and other stakeholders for data collection. and successfully got the crop mask data for further process calculating crop water	Downloaded all required ET data from EEFLUX, also the dates for all four cropping periods are analyzed to select the respective dates for each type of crop for each sub-command area. The areas of each crop for each sub-command areas were extracted using ArcGIS.	Activity Completed

Activity Title	Last Month's Progress	Current Month Progress	Activities and Events, planned for the subsequent month
	productivity using GIS and remote sensing data		
Activity 2.2.1: Remotely Sensed Data of ET	Initiated the process of analyzing and interpreting the satellite data, and crop mask data.	Using the study area shapefile and the crop masks the Images were preprocessed for the study area by mosaicing the Tile. The area is covered by four tile which has overlapping region. The nearest neighbour technique is used to get the values for the overlapping tiles and prepared for the next step using model builder.	Activity Completed
Activity 2.3.1: Reference Evapotranspiration (ETr)	Initiated calculation of Reference Evapotranspiration	ETrf values were calculated for the study area for each year tiles for different days. The outliers having more than 1.1 values were set to null in the initial stage and the scrip and model was runned for each year data using the raster iterator, which iterates over the whole dataset and extracted the ETrf of the study areas using the study area shapefile and export it to a new folder. This dataset will be used	Activity Completed

Activity Title	Last Month's Progress	Current Month Progress	Activities and Events, planned for the subsequent month
		for the computation of ET requirement of the crops for the two years.	
Activity 2.4.1: Actual Evapotranspiration (ETa)		Calibrated EEFlux images providing daily Eta values through ETr multiplication, processed for Rabi and Kharif seasons. Landsat images and crop masks extract ETr for wheat, cotton	Activity Completed
Activity 3.1.1.: Temporal Analysis and ET Variation for Adaptive Water Management		This activity is in the process of the temporal trends and generating spatial maps of evapotranspiration fluctuations for different crop types. Temporal maps for each stage of the crop and for the whole season will be generated.	Will generate maps, complete this analysis, and share findings
Activity 3.2.1.: Statistical Insights and Environmental Factors for Enhanced Resilience		This task is in the process of Employing statistical analyses (ANOVA or regression) to assess evapotranspiration rate disparities among crop types	Will complete this activity and share the results in the next report.

4. Results Framework Indicators Progress

PDO Indicator Description:				
	Baseline	Actual (Previous)	Actual (Current)	End Target
Outcome 1: Increased perception and understanding of the tasks through the delivery of a detailed inception report				
Value	0	0	10	10
Date	15 Dec 2023	10	1	29 Feb 2025
Comments				
Outcome 2: Understanding the dynamics of evapotranspiration (ET) and promoting climate-resilient agricultural practices involves the evaluation of crop water productivity, efficient irrigation water use, and the delineation of climate-resilient water use zones across the Right Bank of the Indus River in Sindh Province.				
Value	0	10	10	20
Date	1 - Jan-2024	10	10	30 April 2024
Comments	A Stakeholder Meeting is Planned for Last week of April 2024			
Outcome 3: Propose recommendations, development of web-based dashboard for effective dissemination, and establishing future research directions to enhance sustainable water management practices.				
Value	0	20	0	100
Date	1Feb-2024	0	3	15 Jan 2025
Comments	Discussions with community members from the project area along with the irrigation team on a regular basis.			

5. Challenges, Lessons Learned and Way Forward

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

Challenges:

1. Downloading ETr data for 2020 and 2022 from the Google Earth Engine EFFLUX Portal was hindered by server issues.
2. We have managed to obtain data for 2021 but encountered difficulties accessing data from other years due to server overload.
3. Despite repeated requests, the data processing system at EFFLUX processes Landsat data tile by tile, causing delays and hindrances in downloading the required data.
4. Finding Crop Coefficient values for each crop and for all the four stages on local scale is one of the challenging tasks as globally we have dataset 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.
5. 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:

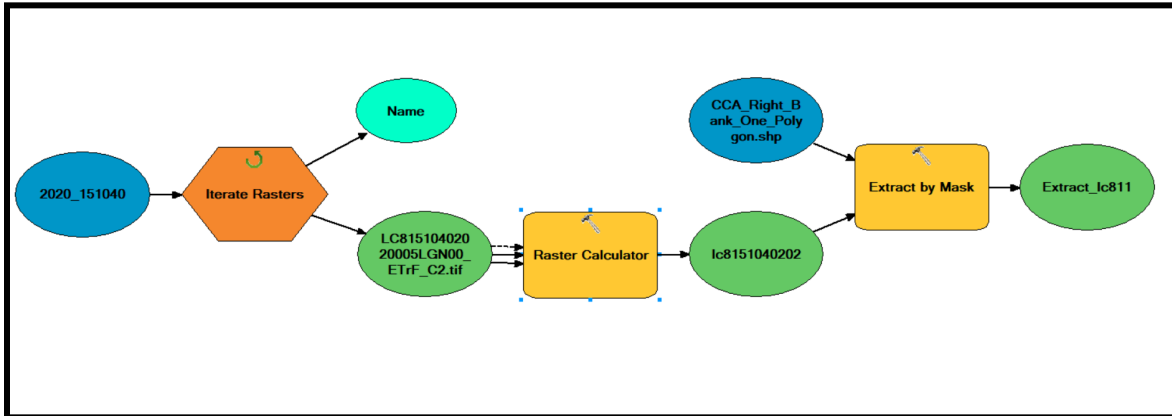
1. Enhanced Stakeholder Engagement: Continued efforts to foster community involvement and understanding through focused awareness initiatives such as workshops and trainings.

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:

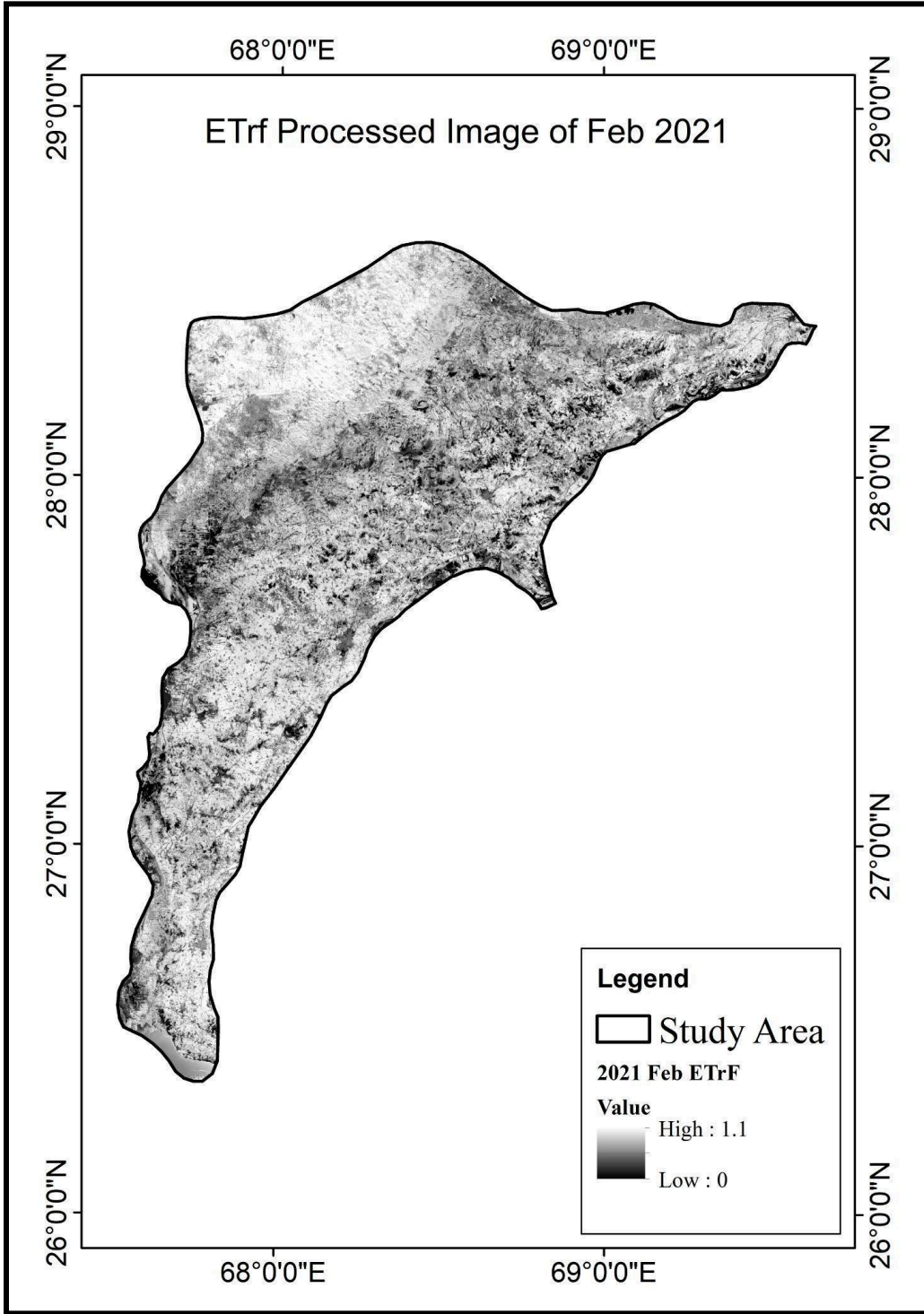
Annexure-I:

Model and Script for Preprocessing of downloaded data of EFFLUX



```
8
9 # Import arcpy module
10 import arcpy
11
12 # Load required toolboxes
13 arcpy.ImportToolbox("Model Functions")
14
15
16 # Local variables:
17 v2020_151040 = "F:\\ET_Project_Sindh\\1.Downloaded Data\\2020\\2020_151040"
18 Name = "LC81510402020005LGN00 ETrF_C2"
19 LC81510402020005LGN00 ETrF_C2.tif = "F:\\ET_Project_Sindh\\1.Downloaded Data\\2020\\2020_151040\\LC81510402020005LGN00 ETrF_C2.tif"
20 lc8151040202 = "c:\\users\\salman khan\\documents\\arcgis\\default.gdb\\lc8151040202"
21 CCA_Right_Bank_One_Polygon_shp = "F:\\ET_Project_Sindh\\2.Processed Data\\CCA_Right_Bank_Shapefiles\\CCA_Right_Bank_One_Polygon.shp"
22 Extract_lc811 = "C:\\Users\\Salman Khan\\Documents\\ArcGIS\\Default.gdb\\Extract_lc811"
23
24 # Process: Iterate Rasters
25 arcpy.IterateRasters_mb(v2020_151040, "", "TIF", "NOT_RECURSIVE")
26
27 # Process: Raster Calculator
28 tempEnvironment0 = arcpy.env.snapRaster
29 arcpy.env.snapRaster = LC81510402020005LGN00 ETrF_C2.tif
30 arcpy.gp.RasterCalculator_sa("SetNull(\\\"%LC81510402020005LGN00 ETrF_C2.tif%\" > 1.1,\\\"%LC81510402020005LGN00 ETrF_C2.tif%\"), lc8151040202)
31 arcpy.env.snapRaster = tempEnvironment0
32
33 # Process: Extract by Mask
34 arcpy.gp.ExtractByMask_sa(lc8151040202, CCA_Right_Bank_One_Polygon_shp, Extract_lc811)
35
```

Output of the Model after as ETrF for calculating ET



List of Involve Staff under AIT Payroll: (Tentative)

Sr.	Name	Position in the project	Working time (Man-Months)
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

Annexure-II: Glossary

Project Title	means	Exact and full name of the project as defined in the Sub Grant Agreement
Project Code	means	A five-digit code assigned by ADPC
Partner Organization	means	The lead agency(ies) responsible for the implementation of the project
Key Achievements	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.
Implementation Progress	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
Challenges	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.
Lessons Learned	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.



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