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Regional Centre on
Urban Water Management
(RCUWM - Tehran)

14th Governing Board Meeting

December 4, 2025

Tehran International Exhibition Centre, Isfahan Hall

Adoption of Agenda

No.	Iran Standard Time	Item
1	09:00 – 09:10	National Anthem and Reciting the Holy Quran
2	09:10 – 09:20	Opening, Minister of Energy & RCUWM GB Chair
3	09:20 – 10:10	Speech by Representative of UNESCO-DG (5 mins) Speeches by GB Members at the ministerial level (5 mins) Speeches by other GB members (3 mins)
4	10:10 – 10:25	Director Report on the activities between the 13th and 14th GBMs and work plan of the next years
5	10:25 – 11:00	Presentation of 4 cooperation proposals by RCUWM scientific advisors
6	11:00 – 11:20	Comments and approvals on the director's report Interventions & contributions by GB Members on the proposals
7	11:20 – 11:25	Determining the venue and tentative date of the next GBM
8	11:25 – 11:30	Closing
9	11:30 – 13:00	Visit to the International Water & Wastewater Exhibition

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GBM 14: Opening

H.E. Mr. Aliabadi

Minister of Energy, I.R. Iran

& RCUWM GB Chair

Agenda

No.	Iran Standard Time	Item
1	09:00 – 09:10	National Anthem and Reciting the Holy Quran
2	09:10 – 09:20	Opening, Minister of Energy & RCUWM GB Chair
3	09:20 – 10:10	Speech by Representative of UNESCO-DG (5 mins) Speeches by GB Members at the ministerial level (5 mins) Speeches by other GB members (3 mins)
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5	10:25 – 11:00	Presentation of 4 cooperation proposals by RCUWM scientific advisors
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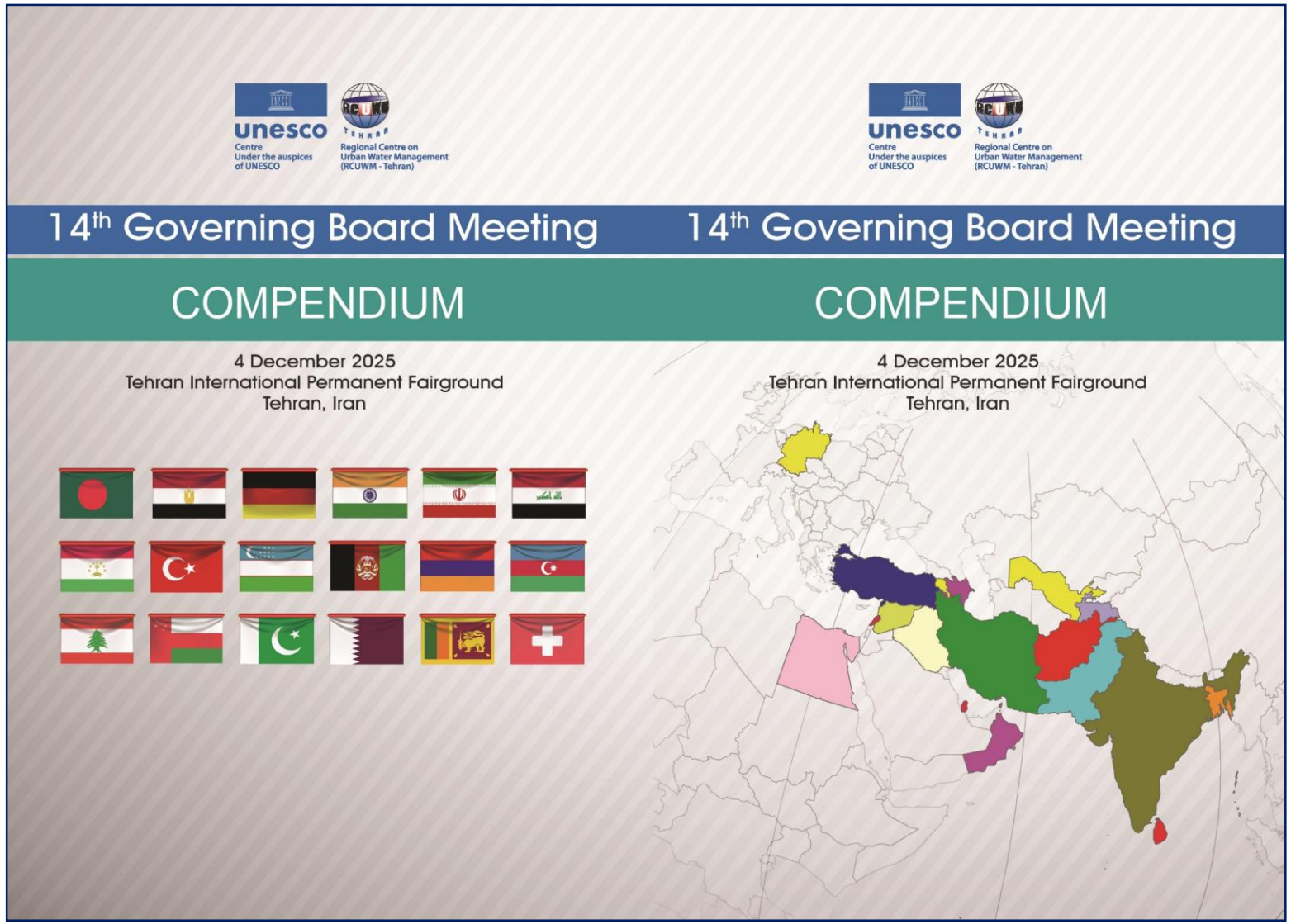
GBM 14: Director Report

On Centre Activities between GBM 13 and 14

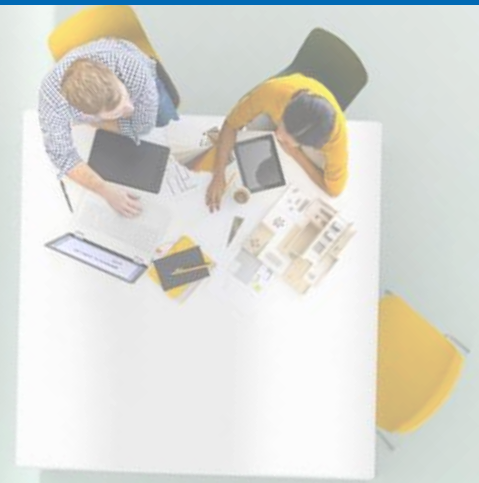
RCUWM Director, Mohammad Hajrasouliha

Compendium



- RCUWM Introduction (Administrative and Organizational)
- Governing Board: Introduction and History
- Work Plan and Activities (2023-2025)
- Roadmap 2026-2028

Organizational Chart



Minister of Energy and Chair of Governing Board
Mr. Aliabadi

Director
Mr. Hajrasouliha

Deputy
Mr. Salamat

Logistics
Ms. Akhavan

Research and Capacity Building
Mr. Dehghanian

Network & Information
Mr. Alipour

Contracts & Projects Coordinator
Mr. Yazdani

Staffing Table

Position	Sex		Education				Years of Experience			
	M	F	PhD	MS	BS	N/A	<5	5~10	10~20	>20
Director	1			1						1
Deputy	1			1						1
Senior Advisers (part time)	11	1	9	3						12
Experts	2			2			1	1		
Program Specialists / Researchers	2	2	2	2				2	1	1
Financial Affairs (part time)		2		1	1				1	1
Supporting Staff	3			1		2			3	
Total	**20**	**5**	**11**	**11**	**1**	**2**	**1**	**4**	**4**	**16**

Field of Activities and Objectives

The Centre's field of activity is to promote scientific research, strengthen regional networks, and support capacity-building in matters related to urban water management.

The Centre's Objectives, based on the Agreement, are:

- 1- To generate and provide scientific and technical information on urban water management issues in the region that will allow the formulation of sound policies leading to sustainable and integrated urban water management.
- 2- To promote research on urban water management issues through regional cooperative arrangements using and strengthening local capabilities and involving international institutions and networks, in particular those under the auspices of UNESCO.
- 3- To undertake effective capacity building activities at institutional and professional levels, and awareness-raising activities targeted at various audiences, including the general public.
- 4- To enhance cooperation with international institutions in order to advance knowledge in the field of urban water management.

Functions

1. To promote scientific research on the issues and problems related to urban water management of the region.

2. To create and reinforce networks for the exchange of scientific, technical and policy information on urban water issues among the institutions and individuals in the region and in other countries.

3. To develop and coordinate cooperative research activities on urban water management issues, taking advantage particularly of the installed scientific and professional capacity of the region and of the relevant UNESCO-IHP networks and non-governmental organizations.

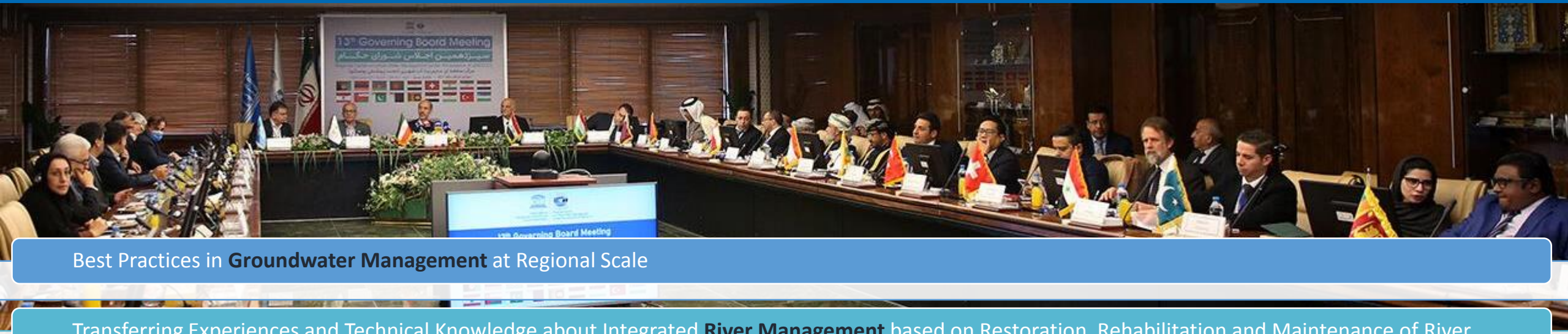
4. To organize knowledge and information transfer activities on the subject, including international training courses, symposia or workshops, and to engage in appropriate awareness raising activities.

5. To develop a strong programme of information and communication technology to further the Centre's objectives.

6. To provide technical consulting and advisory services in the region and beyond as required.

7. To produce technical publications and other media items related to the activities of the Centre

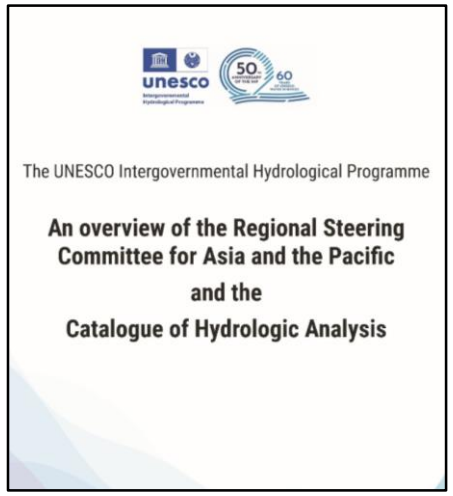
13th GB Meeting | February 2023 – Tehran, Iran



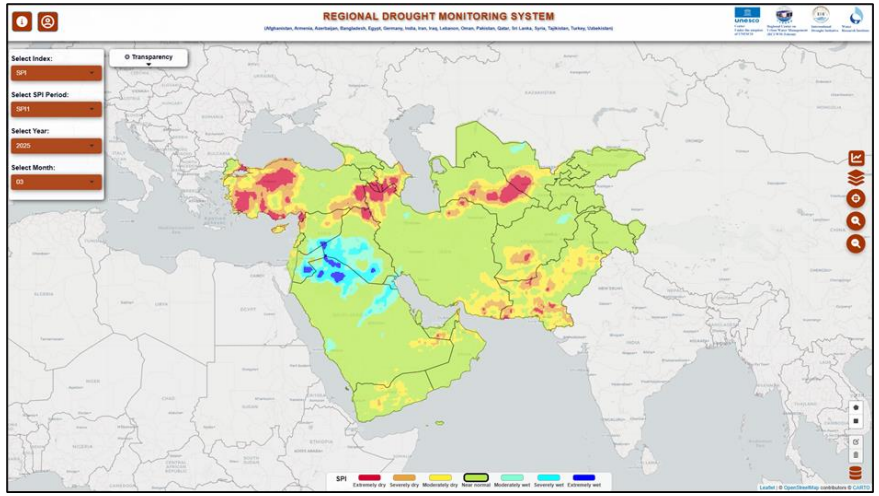
- Best Practices in **Groundwater Management** at Regional Scale
- Transferring Experiences and Technical Knowledge about Integrated **River Management** based on Restoration, Rehabilitation and Maintenance of River
- Improving **Water Governance** in RCUWM Governing Board (GB) Member States
- Development of a Regional Collaborative Platform for Adaptation of Urban Water Systems to **Climate Change**
- Development and Implementation of a Regional **Drought Monitoring**, Prediction and Risk Management System
- **New Technologies** in Water and Wastewater Treatment and Recycling
- **Skill Improvement** for Urban Water Practitioners and Technicians
- **Improving Water Quality** in the Region: from Capacity Building to Capacity Development and Developing Standards for Water Sector

Activities between GBM 13 and 14: Research

Type of Activity	Quantity	Supported Plans / Functions	Supported SDGs
Published Research Article	1	Groundwater Management, Water Governance	
Developed Drought Monitoring System	1	Climate Change, Drought Monitoring	



Title	• Groundwater resources management in Iran through implementing the restoration plan
Journal	• UNESCO IHP: an overview of the Regional Steering Committee for Asia and the Pacific and the Catalogue of hydrologic analysis
Year of publication	• 2025
Country of publication	• Indonesia
Corporate authors	• UNESCO Office in Jakarta and IHP Regional Steering Committee for Asia and the Pacific
Indexing	• UNESDOC-UNESCO



Title	• Regional Drought Monitoring System (RDMS)
Principal Approach	• Integrated Drought Management (IDM)
Geographical Scope	• West and Central Asia (focusing on RCUWM GB Members)
Supported Indices	• SPI
Design Architecture	• Three-tier Architecture including Data, Processing and Presentation Layers

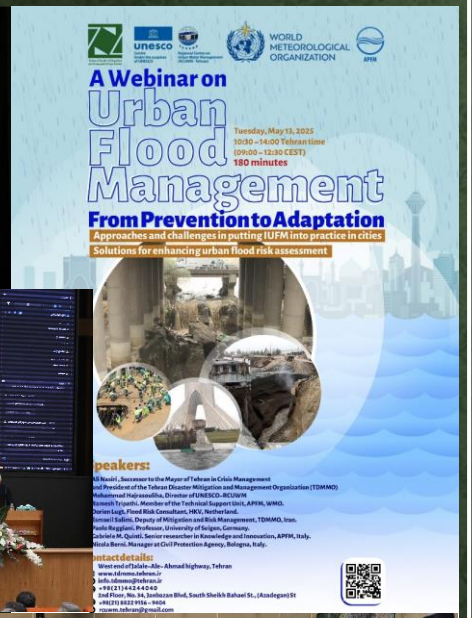
Activities between GBM 13 and 14: Capacity Building

Type of Activity	Quantity	Supported Plans / Functions	Supported SDGs
Organizing Training Workshop	9	Climate Change, Groundwater Management, River (Flood) Management, Drought Monitoring, Water Governance, Media Literacy, Wastewater Recycling, Supply & Demand Management	
Developing Educational Materials	4	Groundwater Management, Wastewater Recycling, IFM, Climate Change	

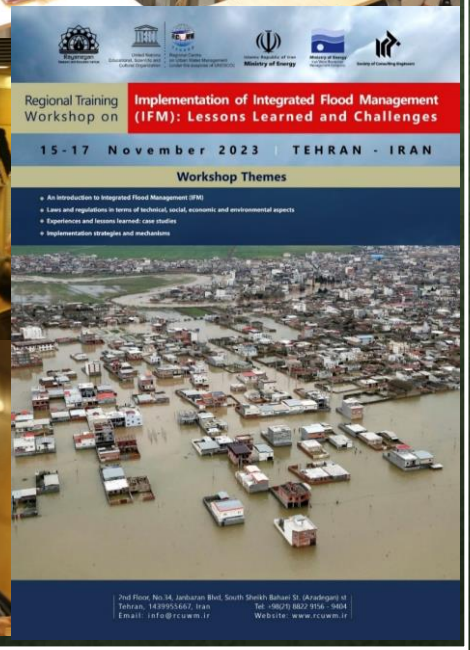
Title	• Water Media Literacy
Date & Venue	• May 2023, Tehran – Iran
Participants	• 140 in-person & 25 online
Counterparts	• UNESCO-IHP, PR of MOE-Iran
Involved GB members	• Oman, Iraq, Syria, Turkie, Srilanka, pakistan

Title	• Climate Change
Date & Venue	• Oct. 2023, Tehran – Iran
Participants	• 100 in-person & 1000 online
Counterparts	• WMO, IRIMO
Involved GB members	• Oman, Lebanon, India, Jordan

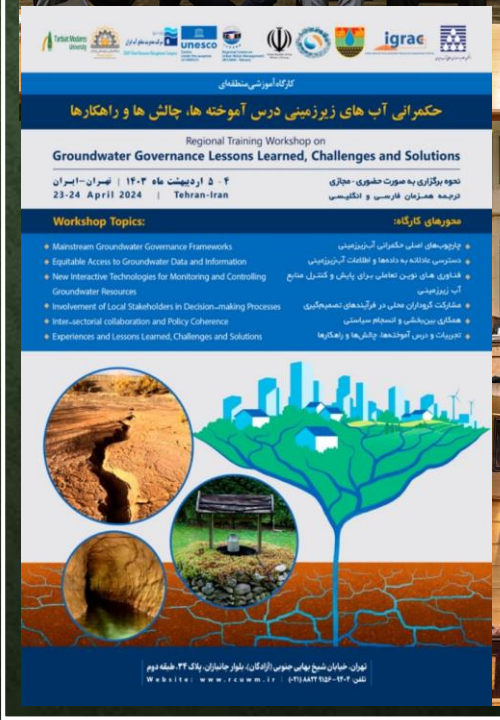
Title	•Urban Flood Management
Date & Venue	•May 2025, Tehran – Iran
Participants	•60 in-person & 150 online
Counterparts	•WMO, Crisis Management Org.
Involved GB members	• Oman



Title	•IFM
Date & Venue	•Nov.2023, Tehran – Iran
Participants	•140 in-person & 300 online
Counterparts	•Iran Consulting Engineers Association, , WMO-APFM
Involved GB members	• Iraq, Syria, Oman, India, Pakistan



Title	•Groundwater Governance
Date & Venue	•May 2024, Tehran – Iran
Participants	•100 in-person & 1500 online
Counterparts	•Iran Chamber, UNESCO-IGRAC
Involved GB members	• Iraq



Title	•Wastewater Reuse
Date & Venue	•Feb. 2025, Tehran – Iran
Participants	•90 in-person & 500 online
Counterparts	•IWA, UNESCO-Water Recycle Chair
Involved GB members	• Oman

Title	•IFM-Iraq
Date & Venue	•Oct. 2025, Baghdad-Iraq
Participants	•140 in-person & 300 online
Counterparts	•Ministry of Water resources, Iraq
Involved GB members	• Iraq, Oman, Turkie

Title	•Integrated Drought Management
Date & Venue	•Oct. 2025, Tehran – Iran
Participants	•140 in-person & 60 online
Counterparts	•WMO, IRIMO
Involved GB members	• Iraq, Oman, Afghanistan

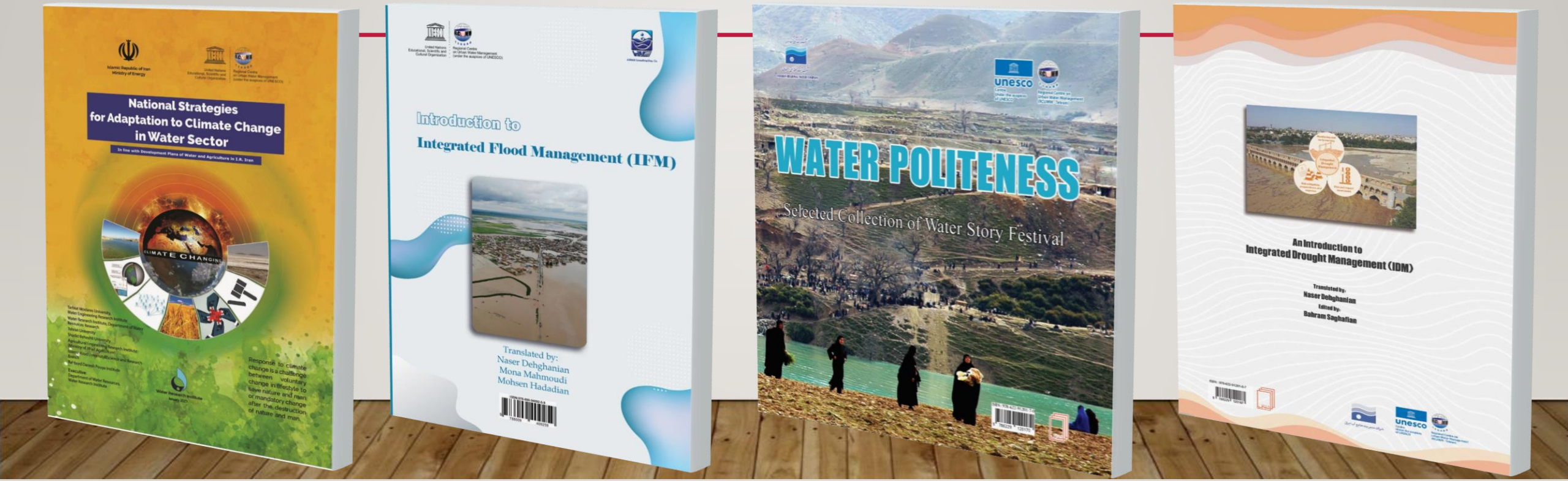
Title	•IFM-Iraq
Date & Venue	•Oct. 2025, Baghdad-Iraq
Participants	•80 in-person
Counterparts	•Ministry of Water resources of Iraq – APFM,WMO
Involved GB members	•Iraq, Oman, Turkie

Activities between GBM 13 and 14: Networking

Type of Activity	Quantity	Other Parties
Signing MOU	**4**	Water and Agriculture Strategic Study Center of Iran Iranian Consulting Engineers Association Iran Water Research Institute Tajikistan Institute of water problems, hydropower engineering and ecology
Engagement Letter	**1**	WMO-APFM
Delivering Speech / Attending at Events	3	Kyoto University and UNESCO Workshop on Flood Mapping Iran Azad University Conference on Desalination Iranian Consulting Engineers Association Seminar on Engineering Ethics

Activities between GBM 13 and 14: Information & Publications

Type of Activity	Quantity	Supported Plans / Functions
Published Book	13	Drought, Flood, Groundwater, Water Economics, Wastewater Treatment, Climate Change, Water Recycling Reuse



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GBM 14: Proposals

For future cooperation

Main Plans of the Centre (2023-2029)

No.	Plan Title		
1	Best Practices in **Groundwater** Management at Regional Scale		**Ali Bagheri, PhD**
2	Transferring experiences and technical knowledge about integrated **river management** based on restoration, rehabilitation and maintenance of river balance		**Mohammad Reza Majdzadeh Tabatabai, PhD**
4	Development of a Regional Collaborative Platform for Adaptation of Urban Water Systems to **Climate Change**		**Mohammad Javad Zareian, PhD**
5	Development and Implementation of a Regional **Drought Monitoring**, Prediction and Risk Management System		**Mahnoosh Moghaddasi, PhD**
*	**Conclusion** by the UNESCO-RCUWM		**Naser Dehghanian, PhD**

Ali Bagheri received his PhD in Water Engineering from Lund University, Sweden. He is an Associate Professor of Water Resources Management at Tarbiat Modares University, Tehran. With 25 years of experience in the water industry, his research interests focus on **Sustainable Development, Systems Dynamics, Social Learning, Water and Land Resources Planning and Management, Water and Environmental Institution and Governance**.

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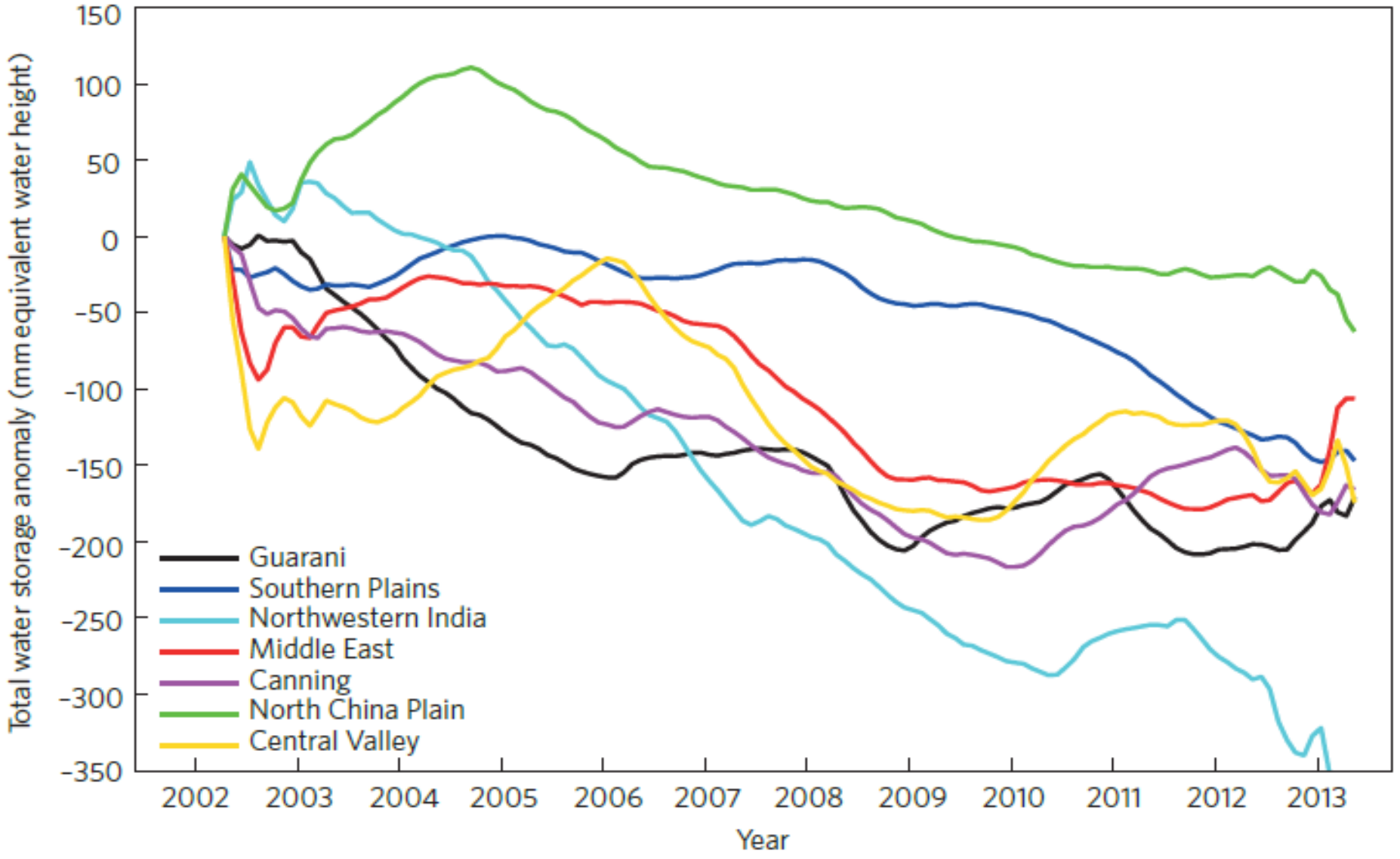
1st Plan (2023-2029)

Best Practices in Groundwater Management at Regional Scale

Dr. Ali Bagheri

Groundwater drawdown in the World Major Aquifers

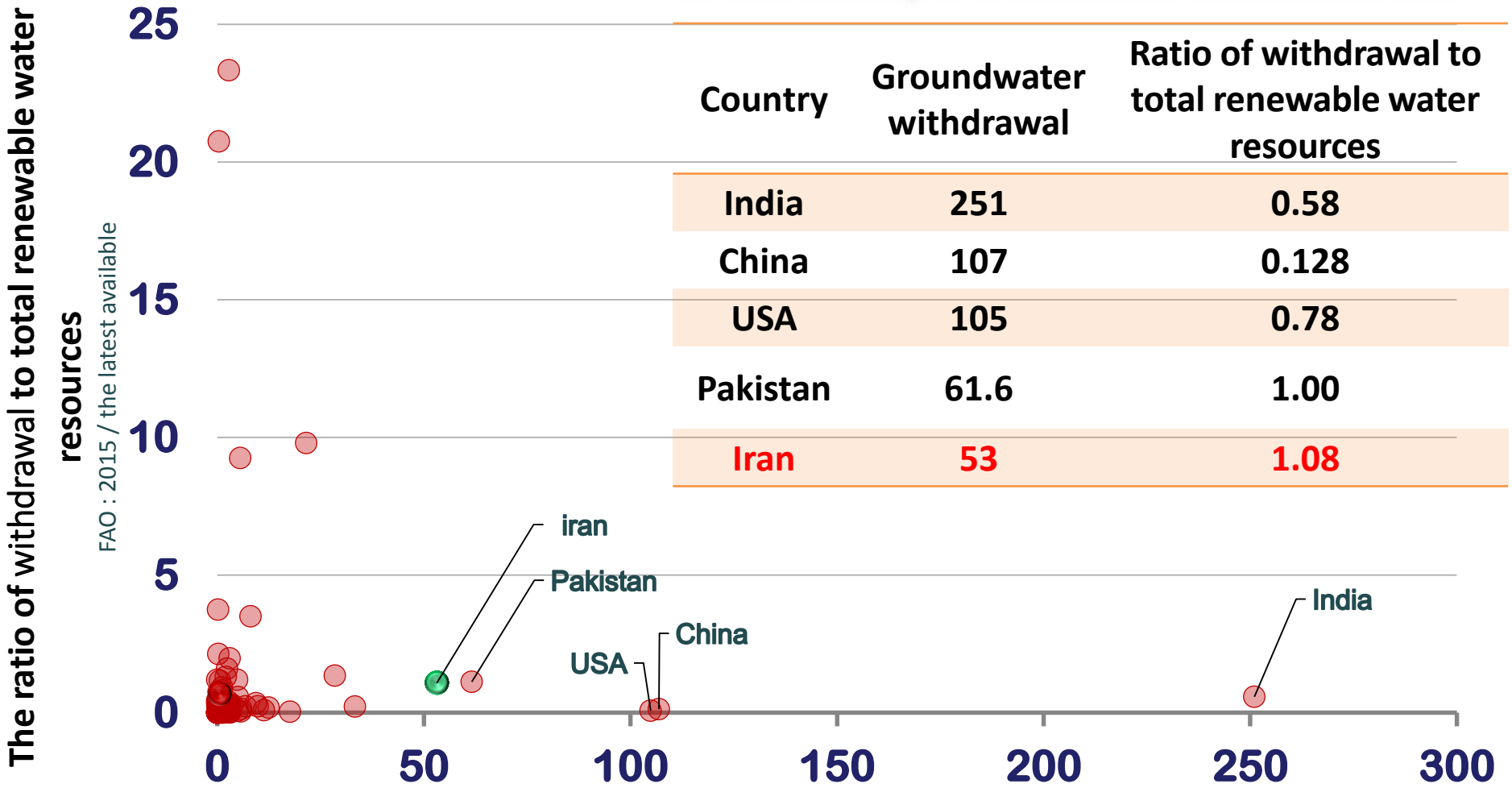


Source: Famiglietti, 2014

Groundwater withdrawal

The fifth country in Groundwater withdrawal: Iran

Country	Groundwater withdrawal	Ratio of withdrawal to total renewable water resources
India	251	0.58
China	107	0.128
USA	105	0.78
Pakistan	61.6	1.00
Iran	53	1.08



Source: FAO, 2015 / the latest available

Land Subsidence due to Overexploitation of Groundwater

Groundwater: Research

Title: Smart Management System for Water and Electricity (Case Study: I.R.Iran)

Smart monitoring of the energy consumption of agricultural wells and smart/combined management of water and electricity for the maintenance and protection of groundwater resources and flow delivery to aquifers, in accordance with exploitation license and preventing unpermitted withdrawals.

Smart water meter

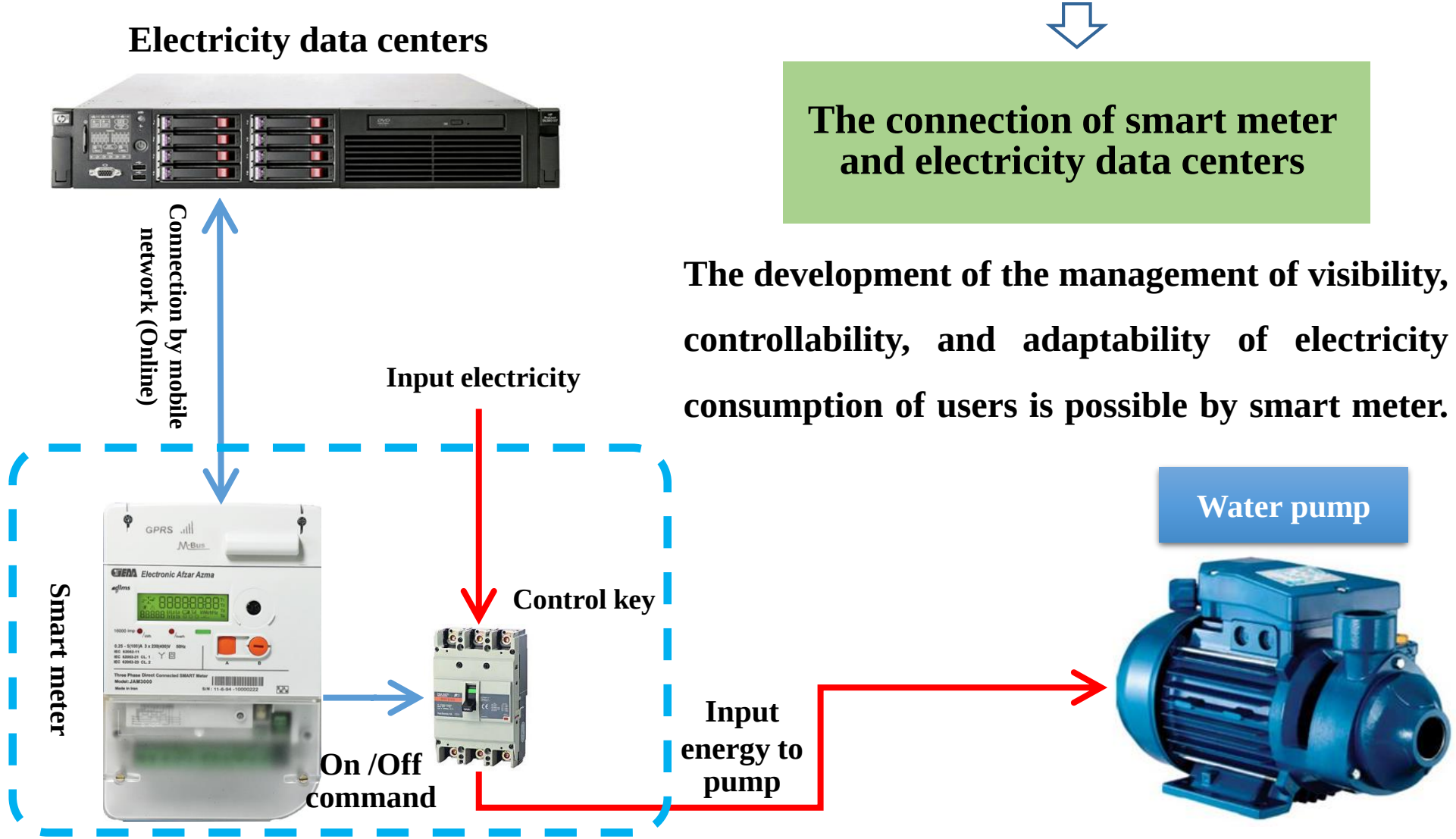
Groundwater: Research

Title: Smart Management System for Water and Electricity (Case Study: I.R.Iran)

Method of managing electricity meter?

The connection of smart meter and electricity data centers

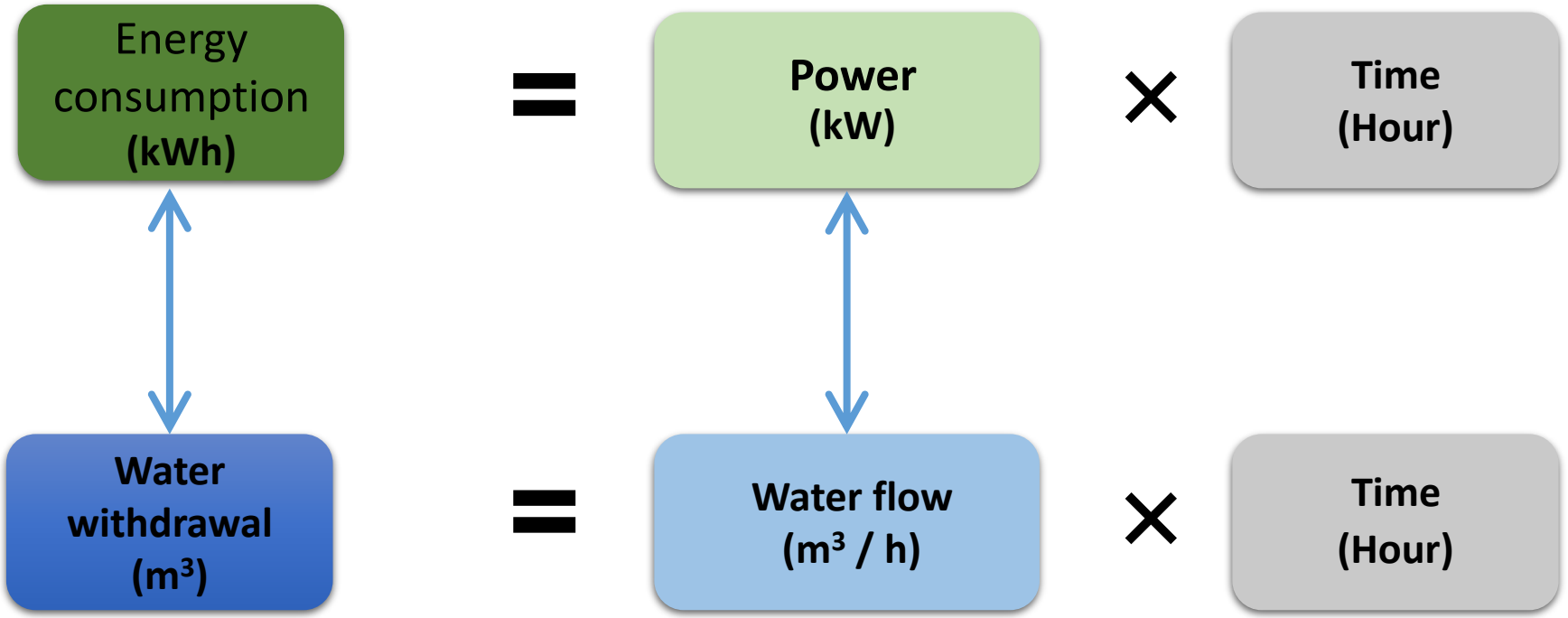
The development of the management of visibility, controllability, and adaptability of electricity consumption of users is possible by smart meter.



Groundwater: Research

Title: Smart Management System for Water and Electricity (Case Study: I.R.Iran)

Equalization parameters in electricity and water



Groundwater: Training and Capacity Building

A Regional Workshop on "Groundwater Governance: Lessons Learned, Challenges and Solutions"

Co-organizers: RCUWM, MOE, ICCIMA - May 2024, Tehran, Iran

Speakers: Australia, Iran, Italy, Netherlands, Spain and 2 invited presenters from IGRAC and IAH

Participants: 100 in-person and 1500 online

Groundwater: Research

Title: Smart Management System for Water and Electricity (Case Study: Iran)

Expectations, Case Study: Iran

Reduction of unpermitted withdrawal of 7 BCM water from agricultural wells

Saving 2 BCM of water by turning off electricity from unpermitted wells

The capacity to save 1700 MW of energy by replacing worn out devices

Groundwater : Ongoing Projects

Activity	Co-organizers	Contribution	Remarks
Regional Training Workshop on **“Groundwater Governance in GB Member States: Challenges and Solutions”, 2026.**	RCUWM	Iran	Concept Note
Smart Management System for Water and Electricity – Phase 1	RCUWM	Iran and …	In progress

Main Plans of the Centre (2023-2029)

No.	Plan Title		
1	Best Practices in **Groundwater** Management at Regional Scale		**Ali Bagheri, PhD**
2	Transferring experiences and technical knowledge about integrated **river management** based on restoration, rehabilitation and maintenance of river balance		**Mohammad Reza Majdzadeh Tabatabai, PhD**
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5	Development and Implementation of a Regional **Drought Monitoring**, Prediction and Risk Management System		**Mahnoosh Moghaddasi, PhD**
*	**Conclusion** by the UNESCO-RCUWM		**Naser Dehghanian, PhD**

Mohammad Reza Majdzadeh Tabatabai received his Ph.D. degree in Water Engineering. He is currently a Faculty Member at the Shahid Beheshti University, Abbaspoor College of Engineering. With 27 years of experience in the water industry, his research interests focus on **river and flood management in drylands, image processing applications in fluid mechanics and river engineering**. His work on fluid monitoring using image processing techniques has contributed significantly to flood zone mapping in the vicinity of hydraulic structures and lowland areas.

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Regional Centre on
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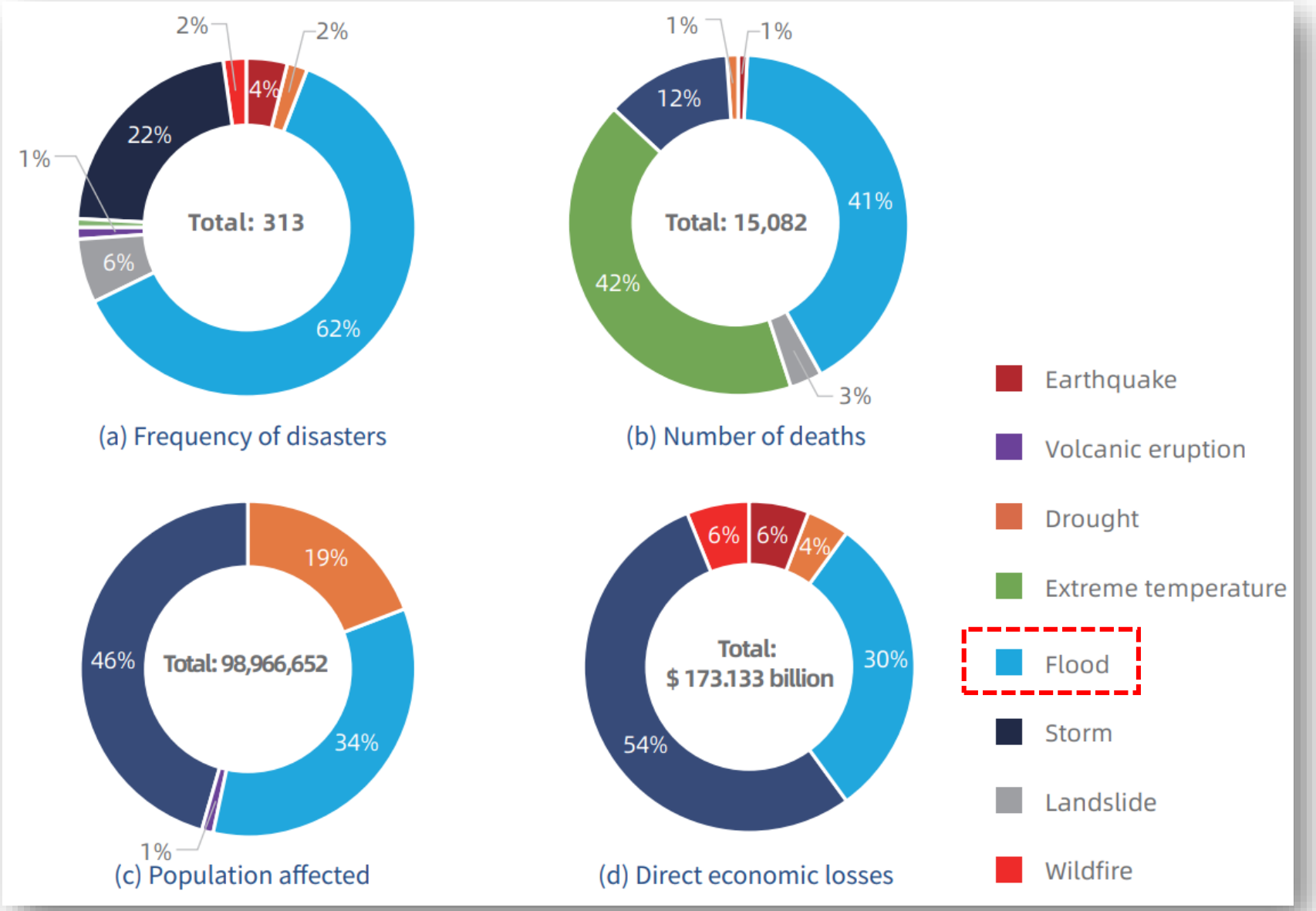
2nd Plan (2023-2029)

Transferring Experiences and Technical Knowledge about Integrated River Management based on Restoration, Rehabilitation and Maintenance of River Balance

Dr. Mohammad Reza Majdzadeh Tabatabai

Flood Damages: Facts and Figures



Source: 2020 Global Natural Disaster Assessment Report, October 2021

Flood Challenges in GB Member States

1- Climate and Meteorological Factors *(flash floods and climate change)*

2- Hydrological Challenges

3- Infrastructure Deficiencies

4- Urban Planning Issues

5- Early Warning and Monitoring

6- Institutional and Governance

7- Transboundary Issues

8- Socioeconomic Vulnerabilities

9- Water Resource Paradox

10- Environmental Degradation

11- Response and Recovery Limitations

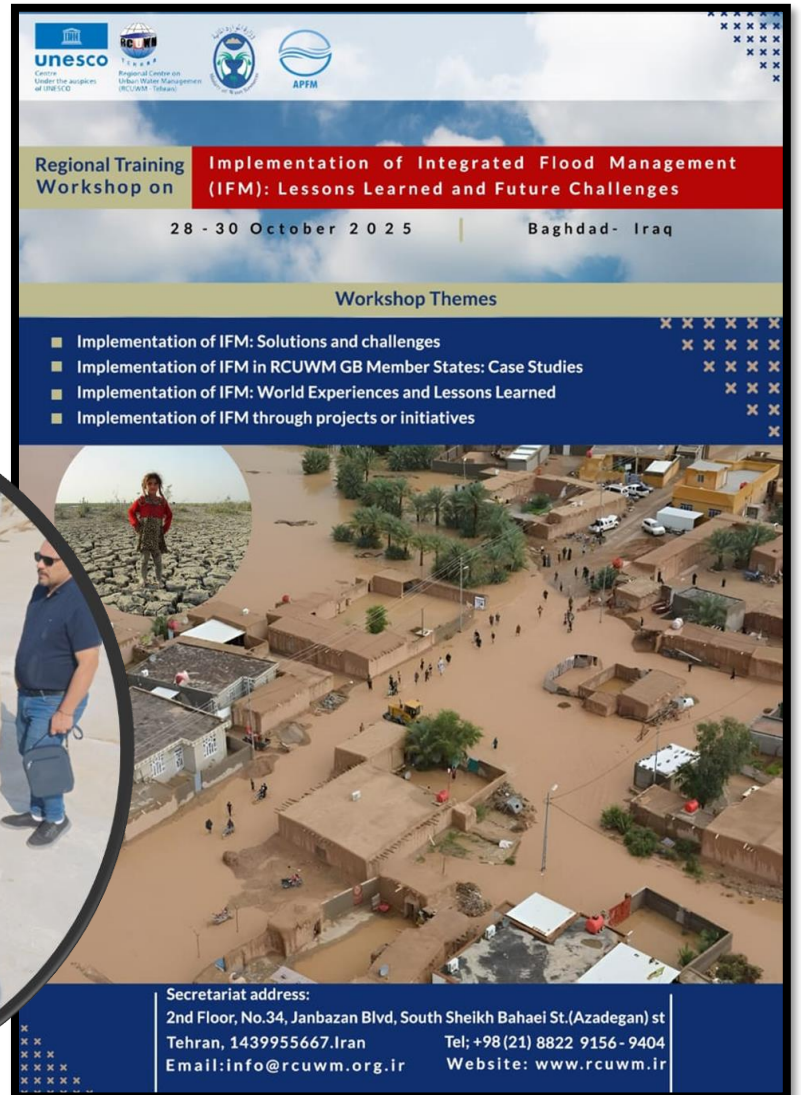
IFM: Training and Capacity Building

A Regional Training Workshop on "Implementation of IFM: Lessons Learned and Challenges"

Co-organizers: MWR-Iraq, RCUWM, APFM - October 2025, Baghdad, Iraq

Speakers: Afghanistan, India, Iran, Iraq, Oman, Pakistan and 5 invited presenters by APFM

Participants: 70 in-person



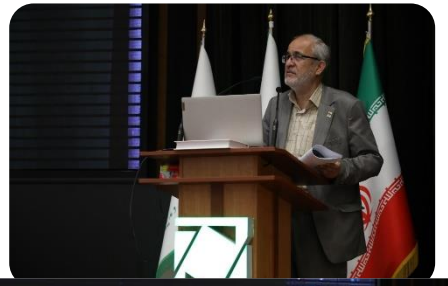
IFM: Training and Capacity Building

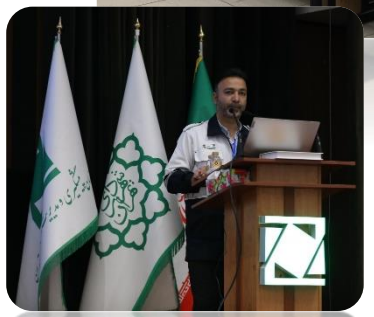
A Webinar on "Urban Flood Management: From Prevention to Adaptation"

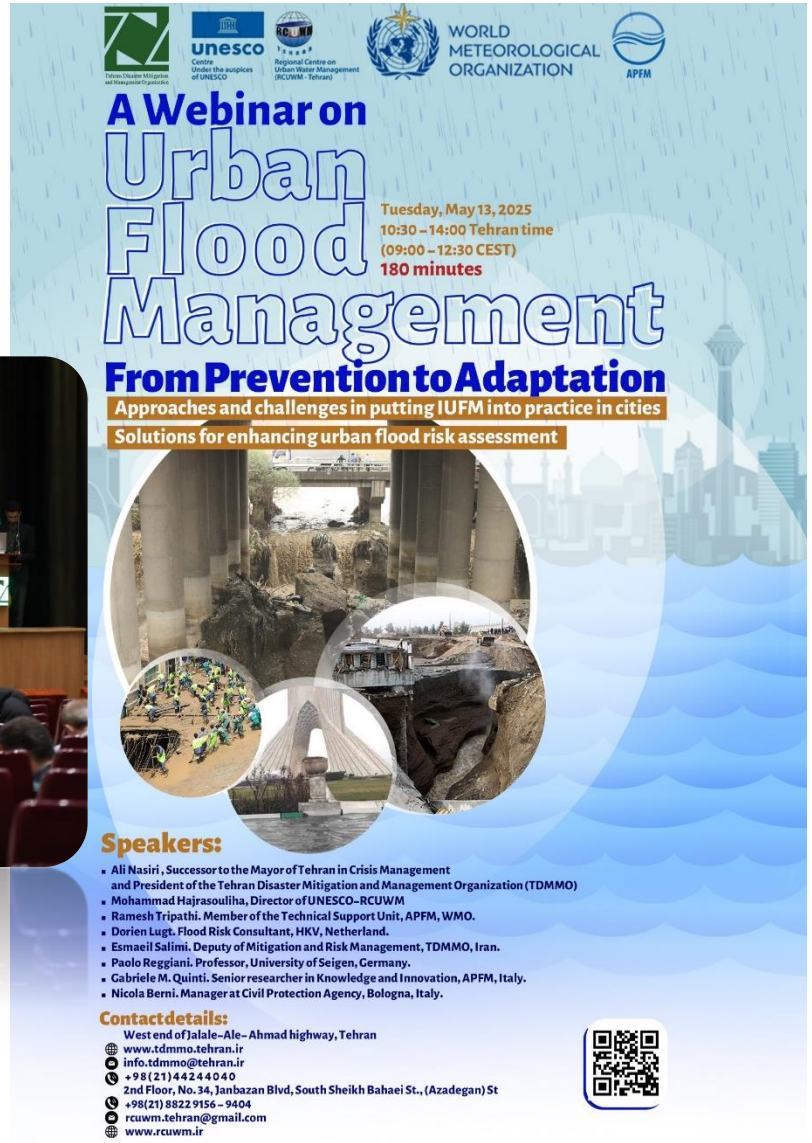
Co-organizers: RCUWM, TDMMO, APFM - May 2025, Tehran, Iran

Speakers: Iran and 5 invited presenters by APFM

Participants: 60 in-person & 150 online







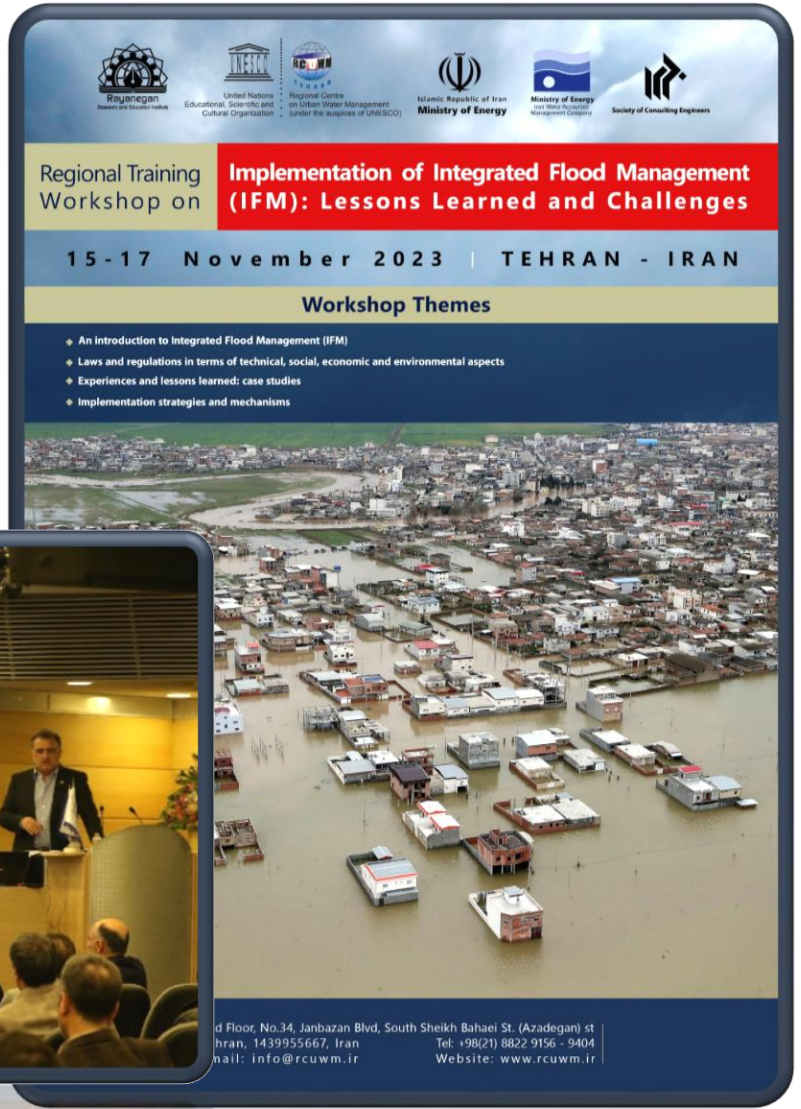
IFM: Training and Capacity Building

A Regional Training Workshop on "Implementation of IFM: Lessons Learned and Challenges"

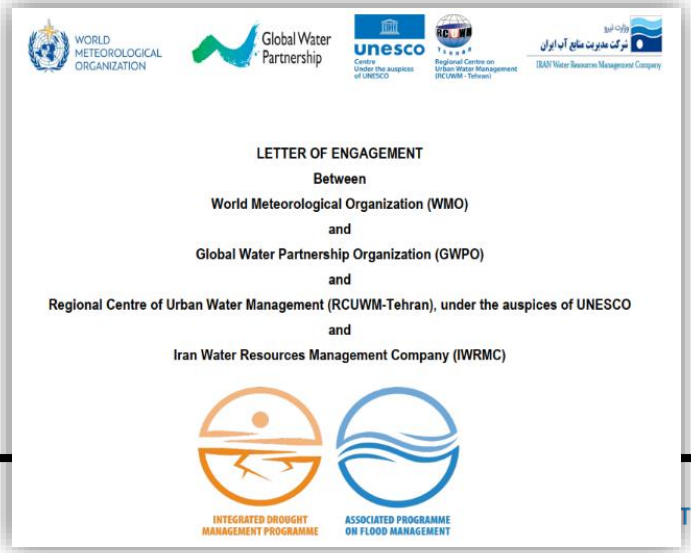
Co-organizers: RCUWM, MOE, ISCE, APFM - November 2023, Tehran, Iran

Speakers: Iran, Iraq, Oman, Syria and 7 invited presenters by APFM

Participants: 140 in-person & 300 online



Letter of Engagement (LoE) Signed between RCUWM and WMO&GWP, 2024



LETTER OF ENGAGEMENT

Between

World Meteorological Organization (WMO)

and

Global Water Partnership Organization (GWPO)

and

Regional Centre of Urban Water Management (RCUWM-Tehran), under the auspices of UNESCO

and

Iran Water Resources Management Company (IWRMC)

APFM Support Base Partners

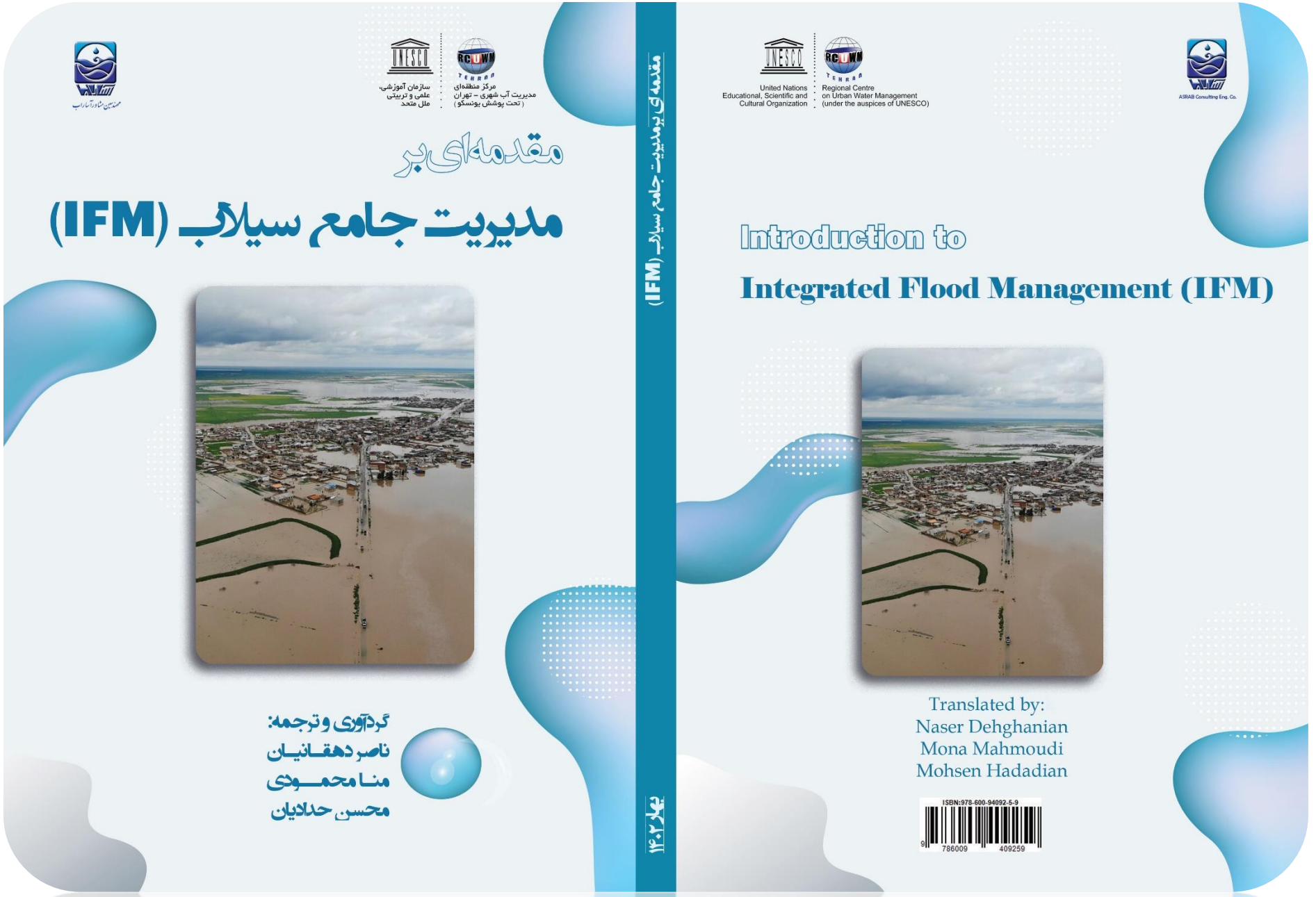
https://www.floodmanagement.info/sbp-catalogue-of-services/

PROHIMET

Regional Centre of Urban Water Management (RCUWM) and Iran Water Resources Management Company (IWRMC)

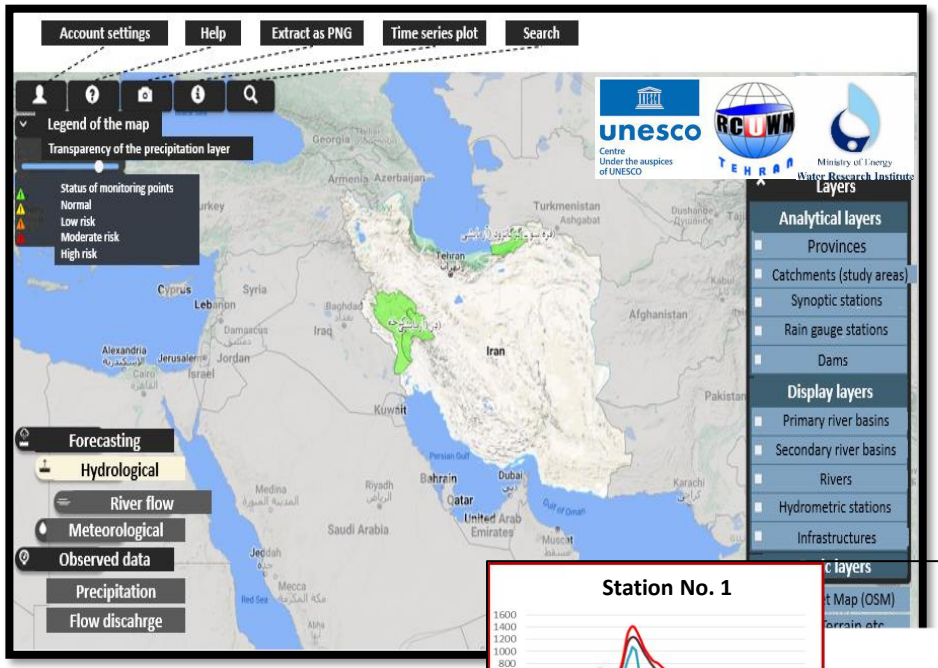
Rivers without Boundaries

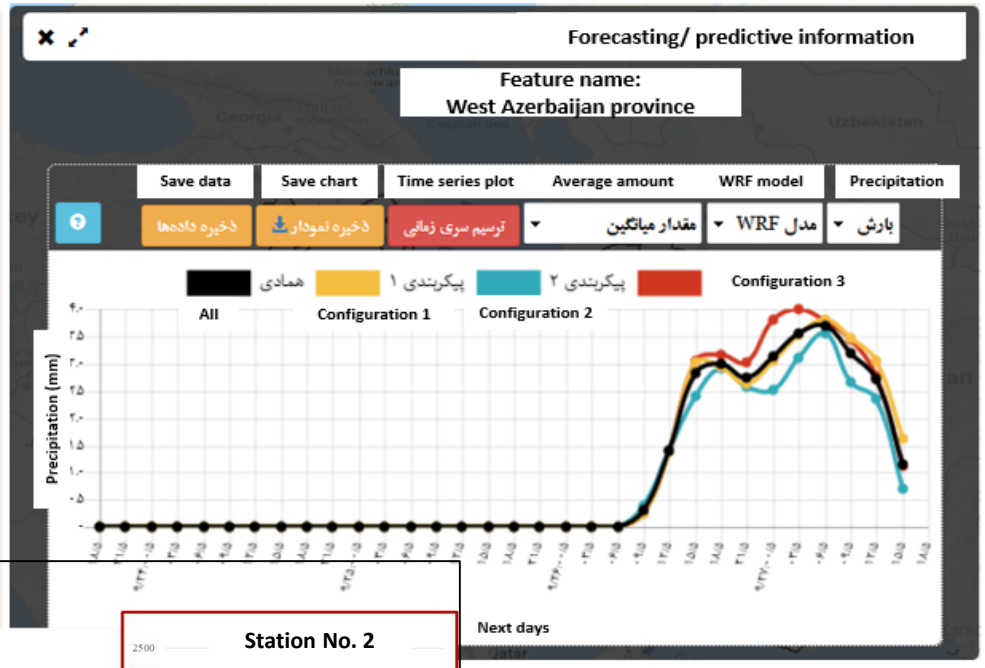
IFM: Publication

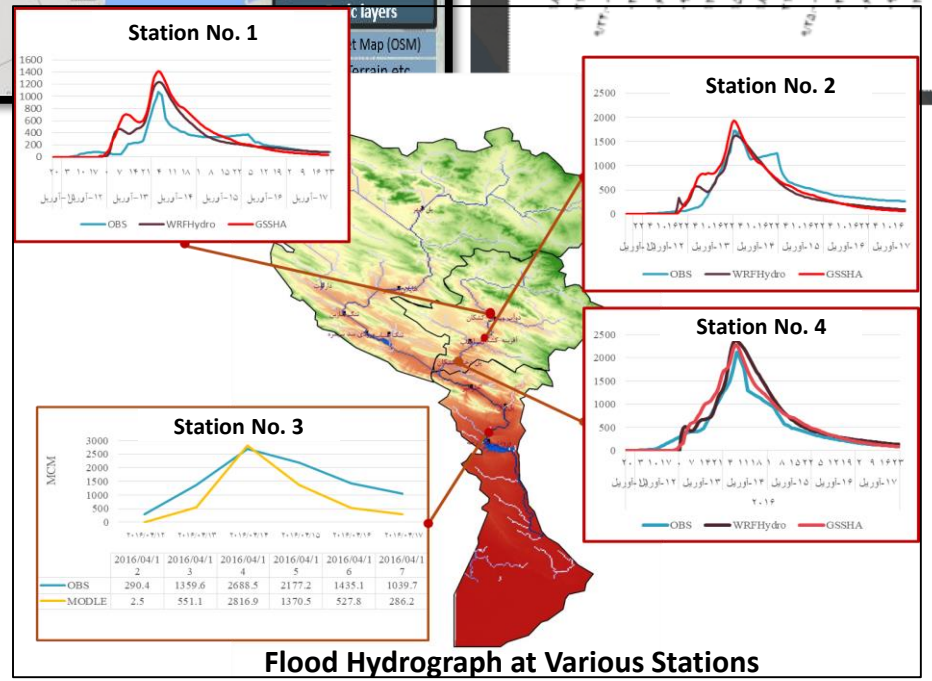


IFM: Research Projects

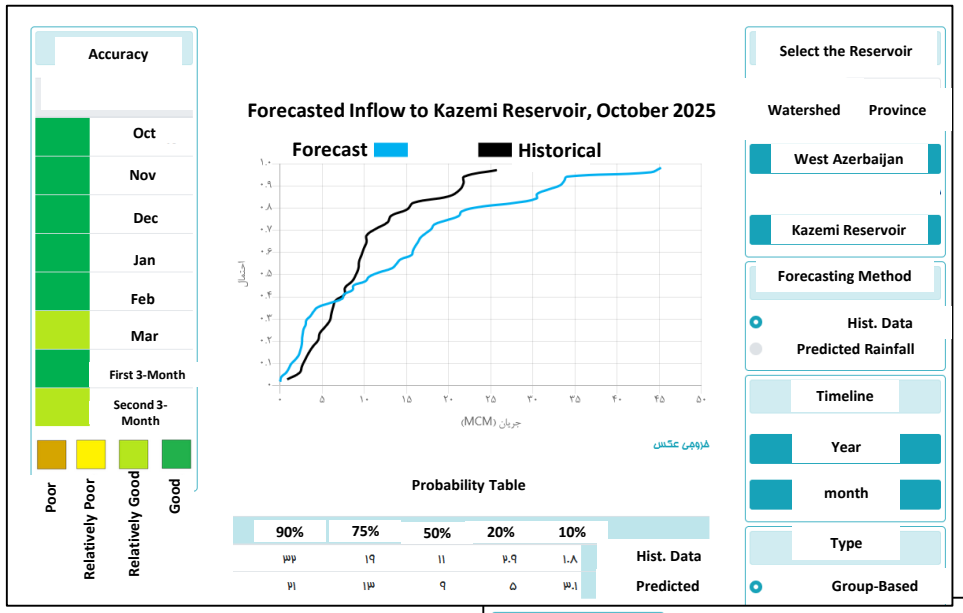
1- Flood Monitoring and Warning System

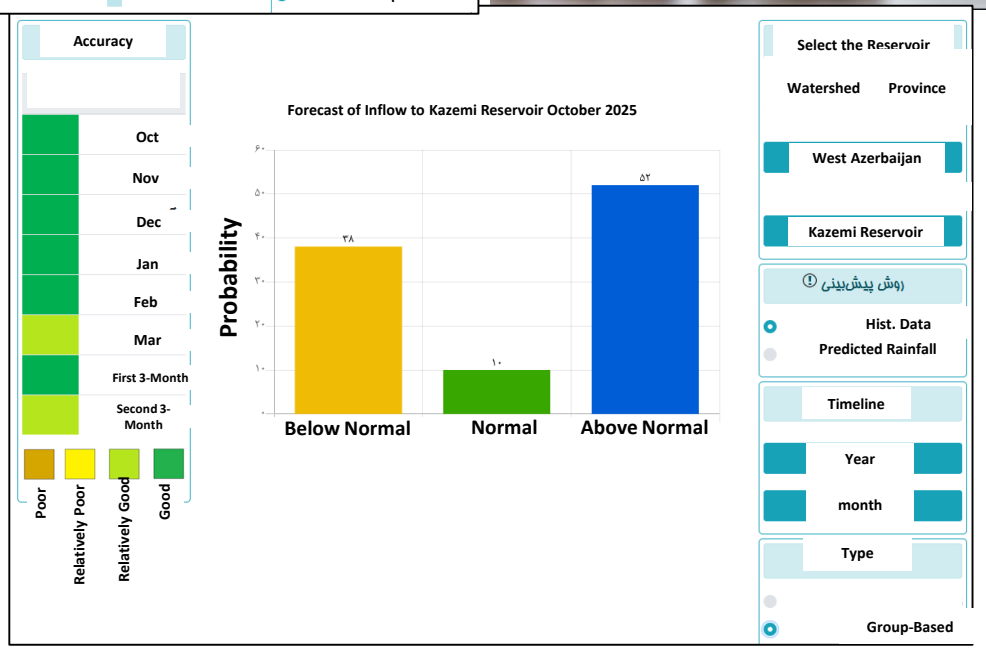






IFM: Research Projects
2- Reservoir Inflow Forecasting System





IFM: Ongoing Projects

Activity	Co-organizers	Contribution	Remarks
Regional Training Workshop on **"Flood and Sediment Management in line with IFM: Challenges and Solutions", January, 2026.**	RCUWM, KWPA, APFM	Iran	In progress
Compile a book entitled **"Guidelines for Adaptive River Management in Drylands"**	RCUWM, APFM	Iran	Concept Note
Develop regional systems for **1- Flood monitoring and warning** **2- Reservoir inflow forecasting**	RCUWM	Iran and …	In progress

Mohammad Javad Zareian received his Ph.D. in Water Engineering. Currently he is a faculty member and the director of the Water Resources Research Center at the Iran Water Research Institute (WRI), Ministry of Energy. His main research interests include **climate change, water resources management and the Water–Food–Energy–Carbon NEXUS**. He has conducted many studies on how climate change influences temperature, rainfall and extreme weather events in Iran and neighboring countries. He also studies how these changes impact water resources and related systems, providing useful insights for more sustainable resource management.

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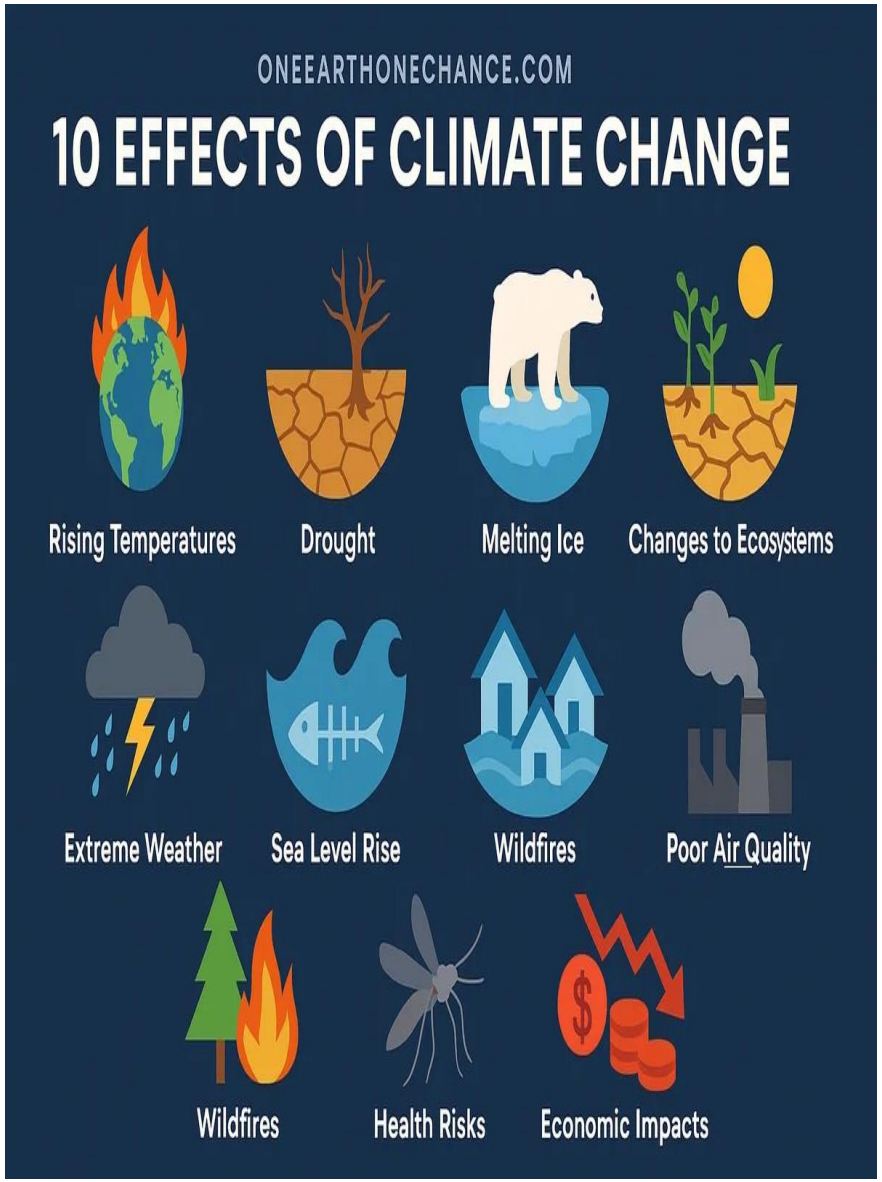
Regional Centre on
Urban Water Management
(RCUWM - Tehran)

4th Plan (2023-2029)

Development of a Regional Collaborative Platform for Adaptation of Urban Water Systems to Climate Change

Dr. Mohammad Javad Zareian

Climate Change: Facts and Figures



- Global surface temperature has risen by about **1.1 °C** from 1850–1900 to the present
- From around 1900 to 2016, global mean sea level rose by **16 to 21 cm**
- From 1993 to 2018, mountain glaciers lost an estimated **5,500 gigatons** of ice.

Climate Change Challenges in GB Member States

1- Changes in temperature (mainly increasing)

2- Changes in precipitation levels (mainly decreasing)

3- Water stress

4- Reduce agricultural productivity

5- More frequent extreme climate events

6- More severe droughts

7- More destructive floods

8- Sea-level rise in coastal areas

9- Socio-economic impacts

10- Challenges in water resources management

Climate Change: Training and Capacity Building

Regional Workshop on "Climate Change (Impacts and Adaptation)"

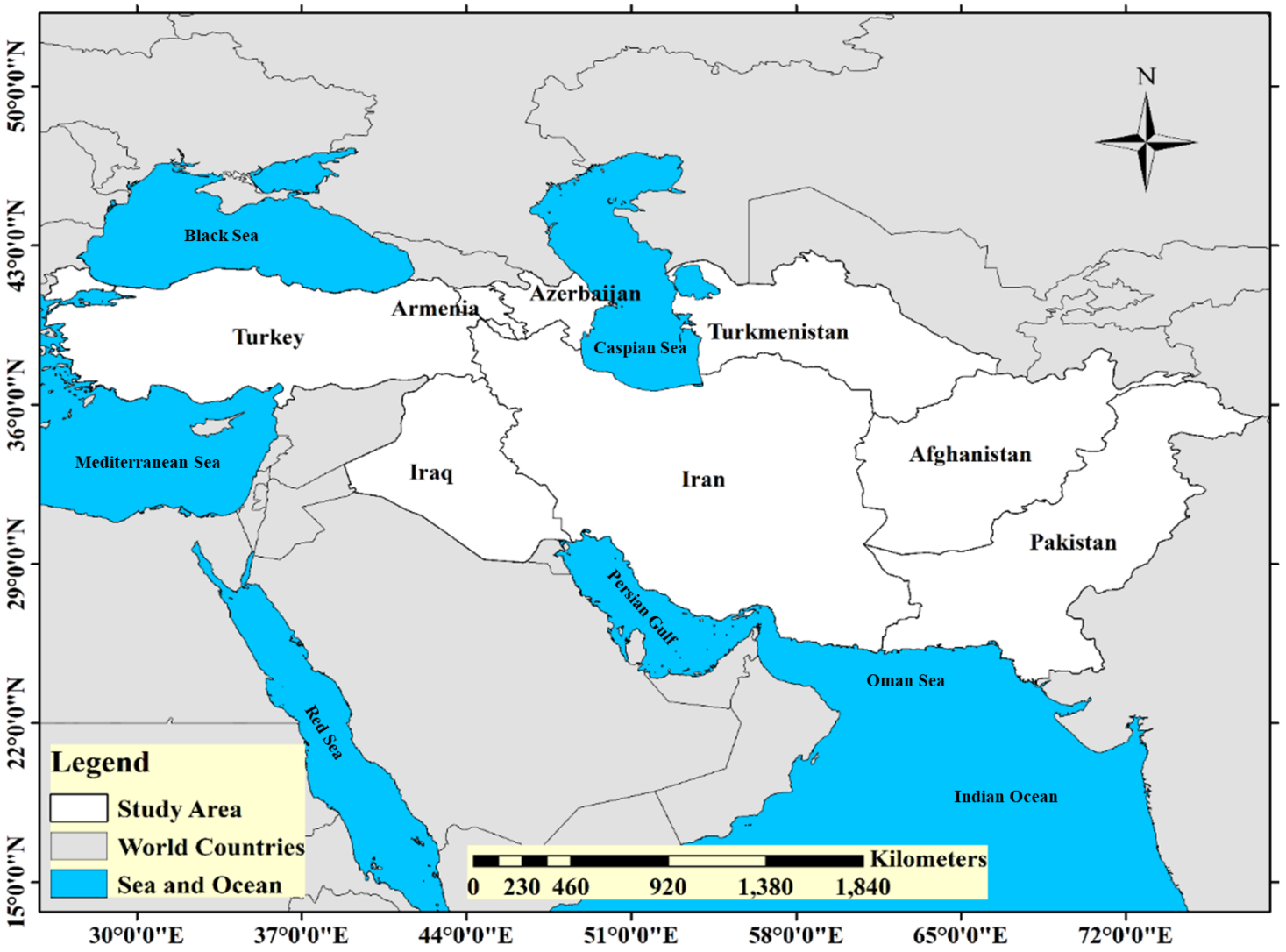
Co-organizers: RCUWM, WMO, IRIMO

October 2023, Tehran– Iran / Participants: 60 in-person & 1500 online

Speakers: Iran, India, Jordan, Thai, WMO

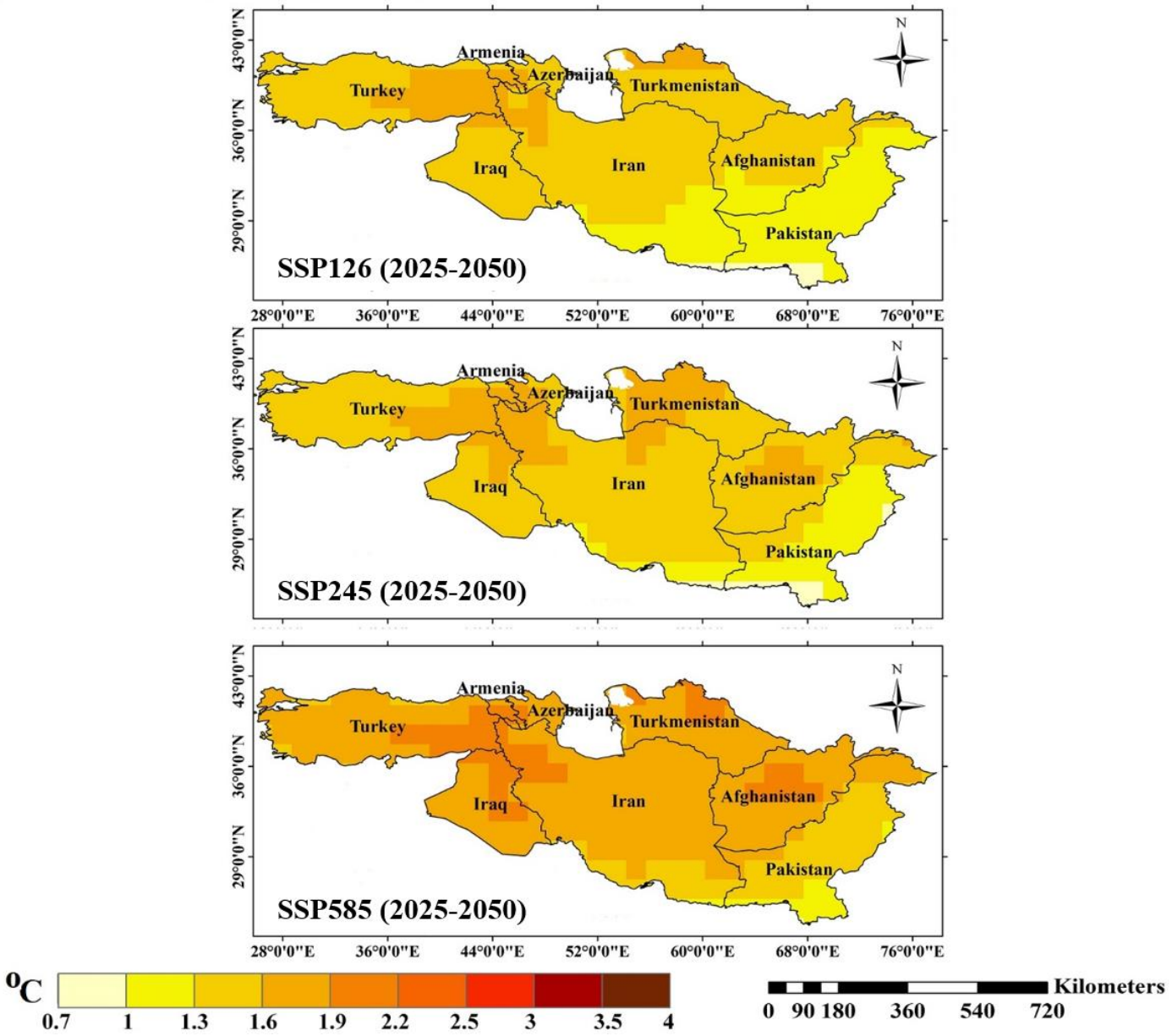
Climate Change: Research

A Regional Study on "The Impact of Climate Change on Temperature and Precipitation in Iran and Neighboring Countries"



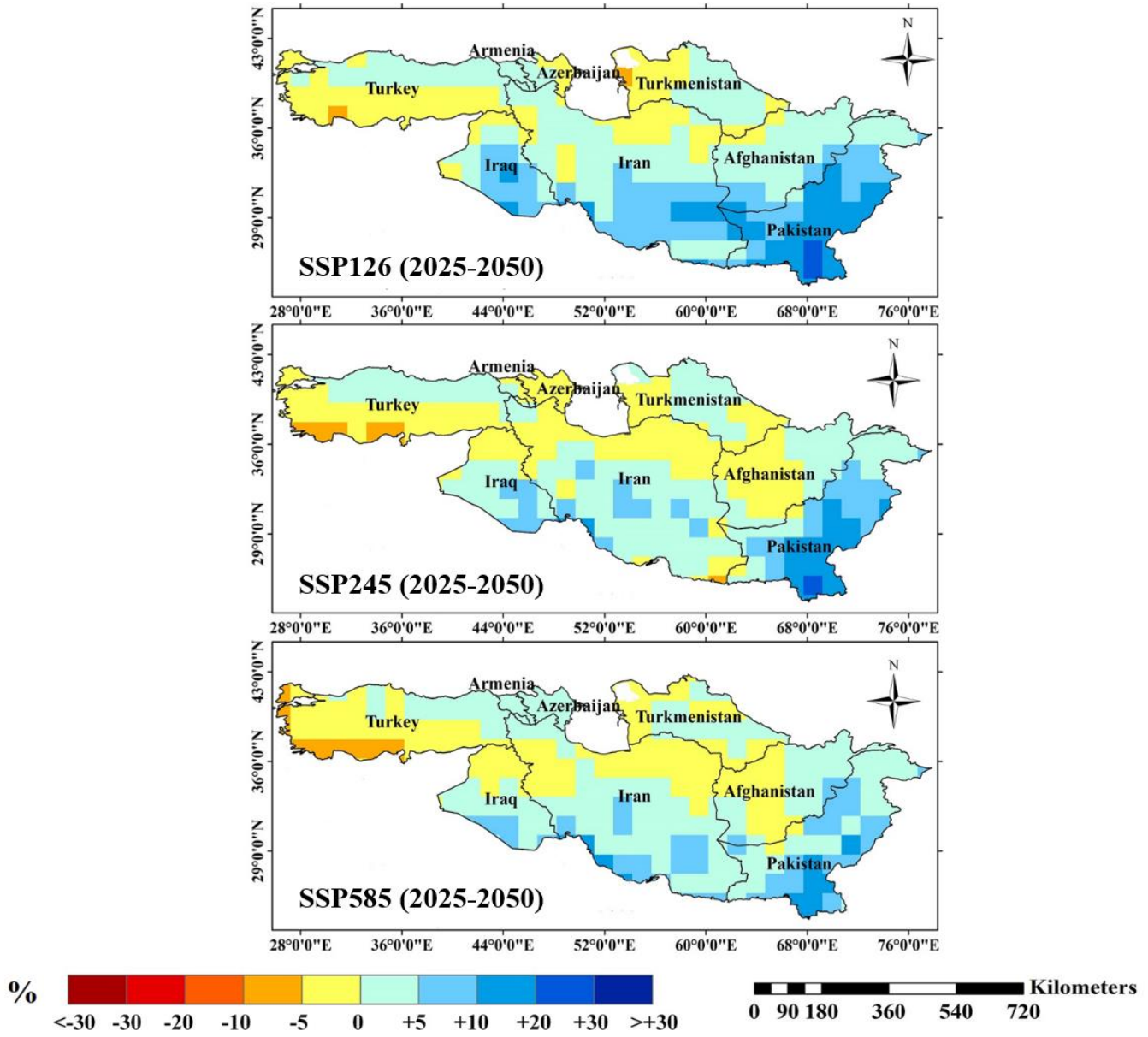
Climate Change: Research

Projected Annual Temperature Changes in Different Countries



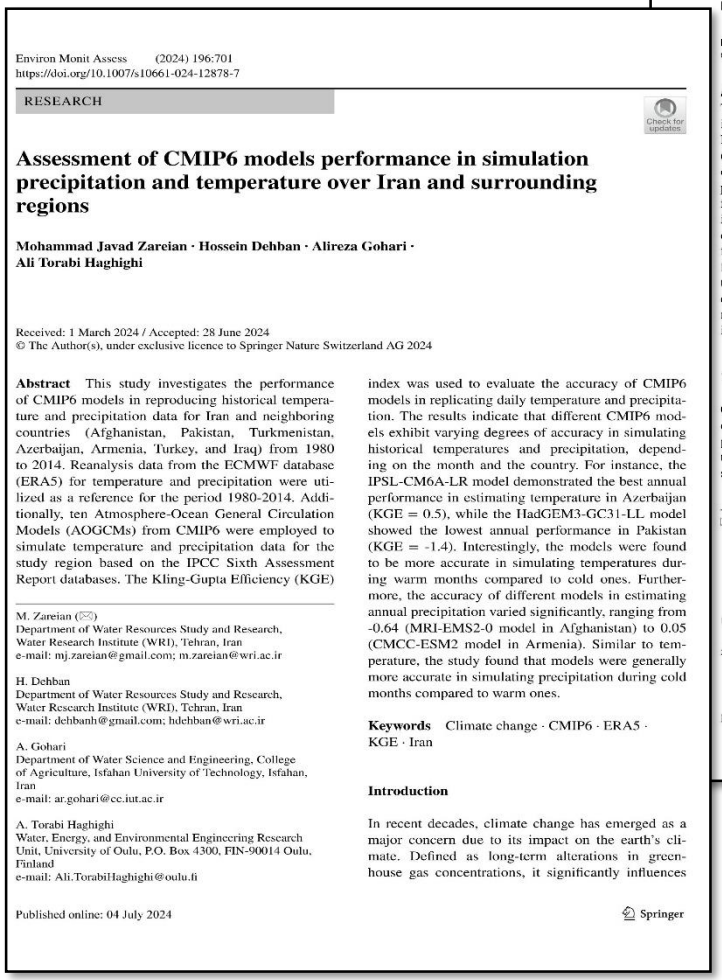
Climate Change: Research

Projected Annual Precipitation Changes in Different Countries



Climate Change: Research

Publication of Several Articles in International Journals



Environ Monit Assess (2024) 196:701
https://doi.org/10.1007/s10661-024-12878-7

RESEARCH

Assessment of CMIP6 models performance in simulation precipitation and temperature over Iran and surrounding regions

Mohammad Javad Zareian · Hossein Dehban · Alireza Gohari · Ali Torabi Haghighi

Received: 1 March 2024 / Accepted: 28 June 2024

Abstract This study investigates the performance of CMIP6 models in reproducing historical temperature and precipitation data for Iran and neighboring countries (Afghanistan, Pakistan, Turkmenistan, Azerbaijan, Armenia, Turkey, and Iraq) from 1980 to 2014. Reanalysis data from the ECMWF database (ERA5) for temperature and precipitation were utilized as a reference for the period 1980-2014. Additionally, ten Atmosphere-Ocean General Circulation Models (AOGCMs) from CMIP6 were employed to simulate temperature and precipitation data for the study region based on the IPCC Sixth Assessment Report databases. The Kling-Gupta Efficiency (KGE) index was used to evaluate the accuracy of CMIP6 models in replicating daily temperature and precipitation. The results indicate that different CMIP6 models exhibit varying degrees of accuracy in simulating historical temperatures and precipitation, depending on the month and the country. For instance, the IPSL-CM6A-LR model demonstrated the best annual performance in estimating temperature in Azerbaijan (KGE = 0.5), while the HadGEM3-GC31-LL model showed the lowest annual performance in Pakistan (KGE = -1.4). Interestingly, the models were found to be more accurate in simulating temperatures during warm months compared to cold ones. Furthermore, the accuracy of different models in estimating annual precipitation varied significantly, ranging from -0.64 (MRI-EMS2-0 model in Afghanistan) to 0.05 (CMCC-ESM2 model in Armenia). Similar to temperature, the study found that models were generally more accurate in simulating precipitation during cold months compared to warm ones.

Keywords Climate change · CMIP6 · ERA5 · KGE · Iran

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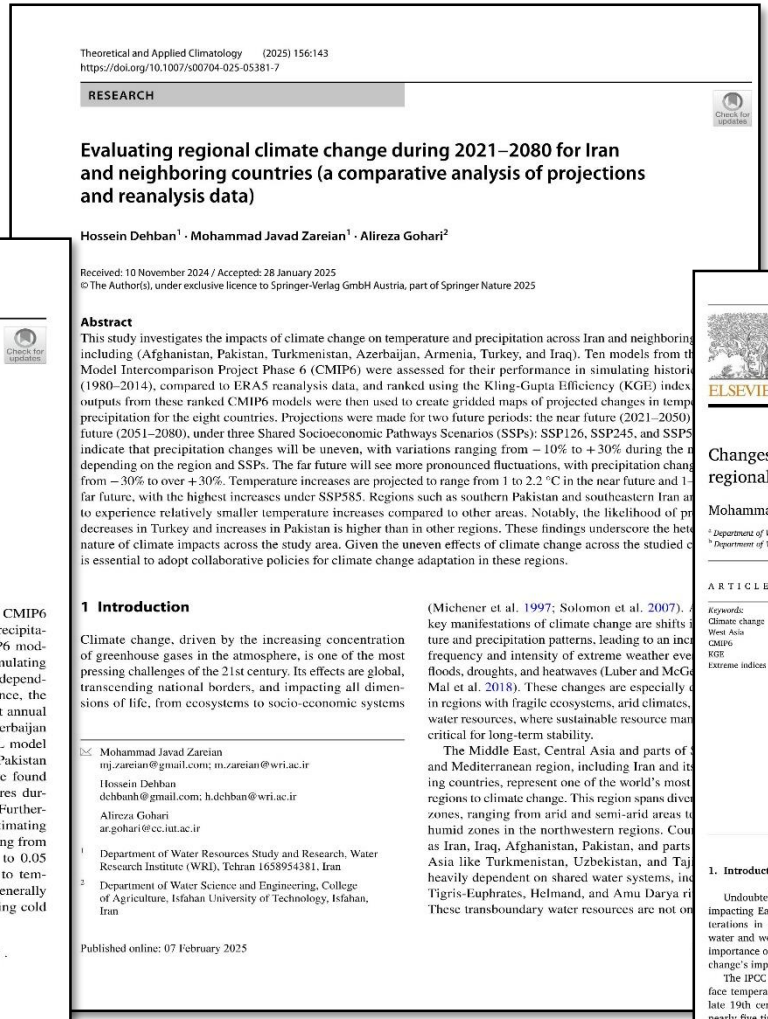
Introduction

In recent decades, climate change has emerged as a major concern due to its impact on the earth's climate. Defined as long-term alterations in greenhouse gas concentrations, it significantly influences



Theoretical and Applied Climatology (2025) 156:143
https://doi.org/10.1007/s00704-025-05381-7

RESEARCH

Evaluating regional climate change during 2021–2080 for Iran and neighboring countries (a comparative analysis of projections and reanalysis data)

Hossein Dehban[1] · Mohammad Javad Zareian[1] · Alireza Gohari[2]

Received: 10 November 2024 / Accepted: 28 January 2025

Abstract
This study investigates the impacts of climate change on temperature and precipitation across Iran and neighboring
including (Afghanistan, Pakistan, Turkmenistan, Azerbaijan, Armenia, Turkey, and Iraq). Ten models from th
Model Intercomparison Project Phase 6 (CMIP6) were assessed for their performance in simulating historic
(1980–2014), compared to ERA5 reanalysis data, and ranked using the Kling-Gupta Efficiency (KGE) index
outputs from these ranked CMIP6 models were then used to create gridded maps of projected changes in temp
precipitation for the eight countries. Projections were made for two future periods: the near future (2021–2050)
future (2051–2080), under three Shared Socioeconomic Pathways Scenarios (SSPs): SSP126, SSP245, and SSP5
indicate that precipitation changes will be uneven, with variations ranging from − 10% to + 30% during the n
depending on the region and SSPs. The far future will see more pronounced fluctuations, with precipitation chang
from −30% to over +30%. Temperature increases are projected to range from 1 to 2.2 °C in the near future and 1-
far future, with the highest increases under SSP585. Regions such as southern Pakistan and southeastern Iran ar
to experience relatively smaller temperature increases compared to other areas. Notably, the likelihood of pr
decreases in Turkey and increases in Pakistan is higher than in other regions. These findings underscore the hete
nature of climate impacts across the study area. Given the uneven effects of climate change across the studied c
is essential to adopt collaborative policies for climate change adaptation in these regions.

1 Introduction

Climate change, driven by the increasing concentration of greenhouse gases in the atmosphere, is one of the most pressing challenges of the 21st century. Its effects are global, transcending national borders, and impacting all dimensions of life, from ecosystems to socio-economic systems (Michener et al. 1997; Solomon et al. 2007).
key manifestations of climate change are shifts i
ture and precipitation patterns, leading to an inc
frequency and intensity of extreme weather eve
floods, droughts, and heatwaves (Luber and McG
Mal et al. 2018). These changes are especially
in regions with fragile ecosystems, arid climates,
water resources, where sustainable resource man
critical for long-term stability.

The Middle East, Central Asia and parts of
and Mediterranean region, including Iran and its
ing countries, represent one of the world's most
regions to climate change. This region spans diver
zones, ranging from arid and semi-arid areas t
humid zones in the northwestern regions. Cou
as Iran, Iraq, Afghanistan, Pakistan, and parts
Asia like Turkmenistan, Uzbekistan, and Taj
heavily dependent on shared water systems, inc
Tigris-Euphrates, Helmand, and Amu Darya ri
These transboundary water resources are not on

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Changes in temperature and precipitation extremes over Western Asia: A regional ensemble from CMIP6

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ARTICLE INFO
Keywords:
Climate change
West Asia
CMIP6
KGE
Extreme indices

ABSTRACT
This study investigates the impacts of climate change on temperature and precipitation extremes in eight West Asian countries (Iran, Afghanistan, Pakistan, Turkmenistan, Azerbaijan, Armenia, Turkey, and Iraq) using a regional ensemble of CMIP6 models. Ten models were evaluated based on their performance in simulating historical temperature and precipitation using the KGE index. Four climate extreme indices (T_{max}, P_{max}, TX90p and R95p) were employed to assess changes in temperature and precipitation extremes in the study area. The analysis of climate extremes reveals significant projected changes. T_{max} is expected to increase in all countries, with the most pronounced rise anticipated in Turkmenistan, where T_{max} in the main part of the country is projected to increase by more than 5 °C under the SSP585. Projections for P_{max} show a more nuanced picture. Pakistan is expected to experience the highest overall P_{max}. TX90p is projected to increase in all countries, indicating a rise in the frequency of extreme heat events. Pakistan is expected to experience the most significant increase in TX90p, reaching up to 36.1 % under the SSP585 (PP) scenario by 2074, followed by Iran and Afghanistan. R95p does not show a clear future trend. Pakistan is anticipated to see the highest increase in R95p, reaching up to 15.2 mm under the SSP585 scenario by 2074, while Turkey might experience a decrease of up to 7.8 mm under the SSP245 scenario. These findings highlight the diverse and concerning impacts of climate change on temperature and precipitation extremes across West Asia. The projected increase in T_{max}, TX90p and potential shifts in precipitation patterns pose significant challenges for the region. This study emphasizes the need for region-specific adaptation strategies to address the multifaceted challenges of climate change in West Asia.

1. Introduction

Undoubtedly, climate change is one of the most critical issues impacting Earth's environmental condition. It leads to significant alterations in expected weather patterns, profoundly affecting future water and weather cycles (Goyal, 2004; Woodward et al., 2014). The importance of these effects has driven continuous research into climate change's impact on the planet's future (IPCC, 2013).

The IPCC Sixth Assessment Report (AR6) indicates that global surface temperatures have increased by approximately 1.09 °C from the late 19th century (1850–1900) to the present. Heat waves are now nearly five times more frequent than they were fifty years ago. Precipitation patterns have also changed, with high-latitude regions and parts of the tropics experiencing significant increases in annual precipitation, while areas such as the Mediterranean parts of Africa and South America have seen reductions, leading to more frequent and severe droughts. If global warming reaches 1.5 °C above pre-industrial levels, extreme precipitation events will become 1.5 times more frequent and intense. Future projections suggest global temperatures could rise by 2.1 to 3.5 °C by the end of the 21st century, resulting in unprecedented heat extremes and more frequent, intense precipitation events, particularly in Asia, North America, and Europe (IPCC, 2021).

Significant changes in temperature and precipitation patterns due to climate change also affect processes related to the water resource cycle and consumption. This includes changes in the return period and intensity of precipitation, leading to altered patterns of floods and droughts. An increase in flood and drought events has been reported globally (Hidalgo-Hidalgo et al., 2022; Tabari, 2020), presenting serious challenges for water resource management. Key challenges include water allocation, reservoir management, and crisis management during

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0169-8095/

Climate Change: Ongoing Projects

Activity	Co-organizers	Contribution	Remarks
Workshop on **Climate Change and Regional Adaptation**, 2026.	RCUWM, WMO	Iran	Concept Note
Compile a book entitled "**Climate Change Adaptation Approaches and Experiences in the RCUWM Governing Board Member States**"	RCUWM, WMO	Iran	Concept Note

Mahnoosh Moghaddasi received her Ph.D. in Water Engineering. She is an Associate Professor of Water engineering in Faculty of Agriculture and Environment at the Arak University. With 15 years of experience, her main research interests include **drought monitoring, drought risk management, developing compound drought indices, prediction and drought modeling under climate change**

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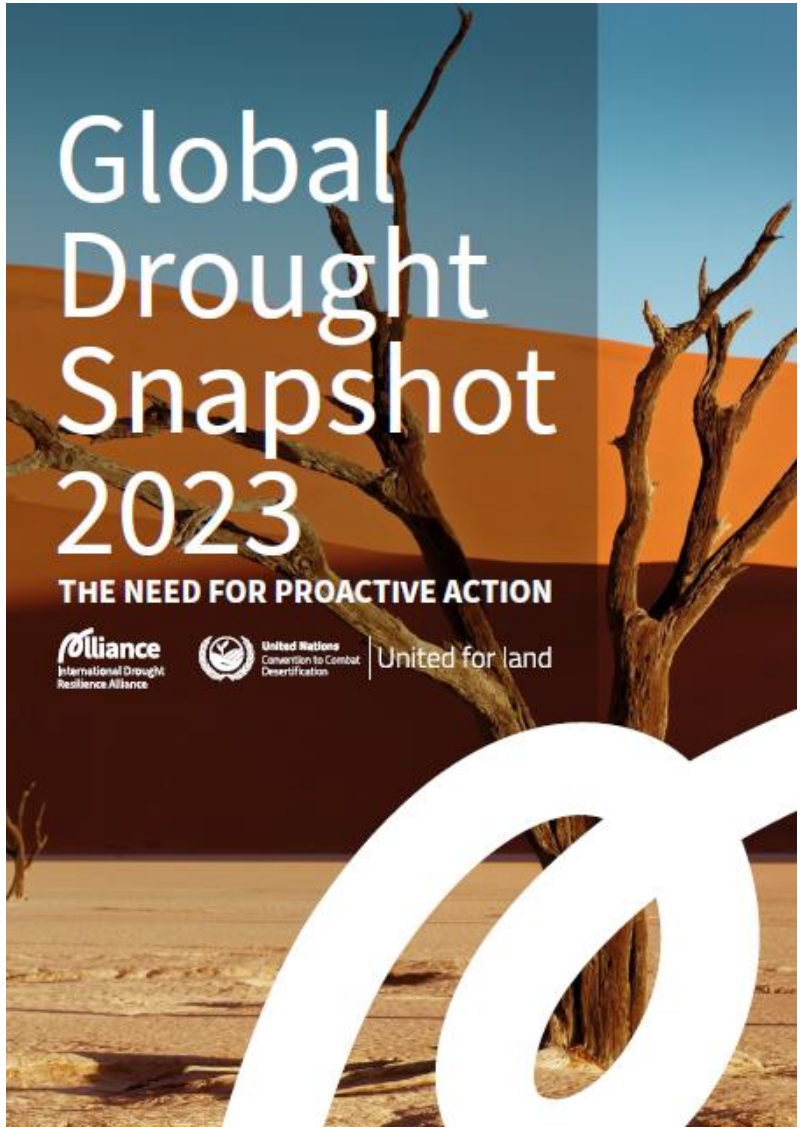
5th Plan (2023-2029)

Development and Implementation of a Regional Drought Monitoring, Prediction and Risk Management System

Dr. Mahnoosh Moghaddasi

Drought Damages: Facts and Figures

- 85% of people affected by droughts live in **low-or middle-income countries** (World Bank, 2023).
- Based on data reported by **101 country Parties to the UNCCD**, **1.84 billion** people are drought stricken, out of which 4.7 per cent are exposed to severe or extreme drought (UNCCD, 2023).
- Drought conditions in the **La Plata basin in Brazil–Argentina** in 2022 were the most severe since 1944, impacting agriculture by reducing crop production and affecting global crop markets (WMO, 2023a).
- In 2022, **Europe** experienced its hottest summer and second warmest year on record, and consequently the largest overall drought impacted area over **630,000km^2**, as opposed to the **167,000 km^2** annual average between 2000 and 2022.



Drought Challenges in GB Member States

1. **Climate Drivers & The New Normal**
Changing rainfall patterns and rising temperatures
Increased frequency of flash droughts

2. **The Multivariate Reality of Modern Drought**
Interconnected impacts across water systems, agriculture, and ecosystems
Compound effects of temperature, soil moisture, and precipitation deficits

3. **Systemic Gaps in Drought Response**
Inadequate monitoring and early warning capabilities
Aging water infrastructure and storage limitations

4. **Impacts & Vulnerabilities**
Environmental damage and economic losses
Disproportionate effects on farmers and vulnerable communities

5. **Pathway to Mitigation**
Short-term: Emergency response and water restrictions
Long-term: Infrastructure modernization and integrated water governance

IDM: Training and Capacity Building

A Regional Training Workshop on "Implementation of IDM: Challenges and Solutions"

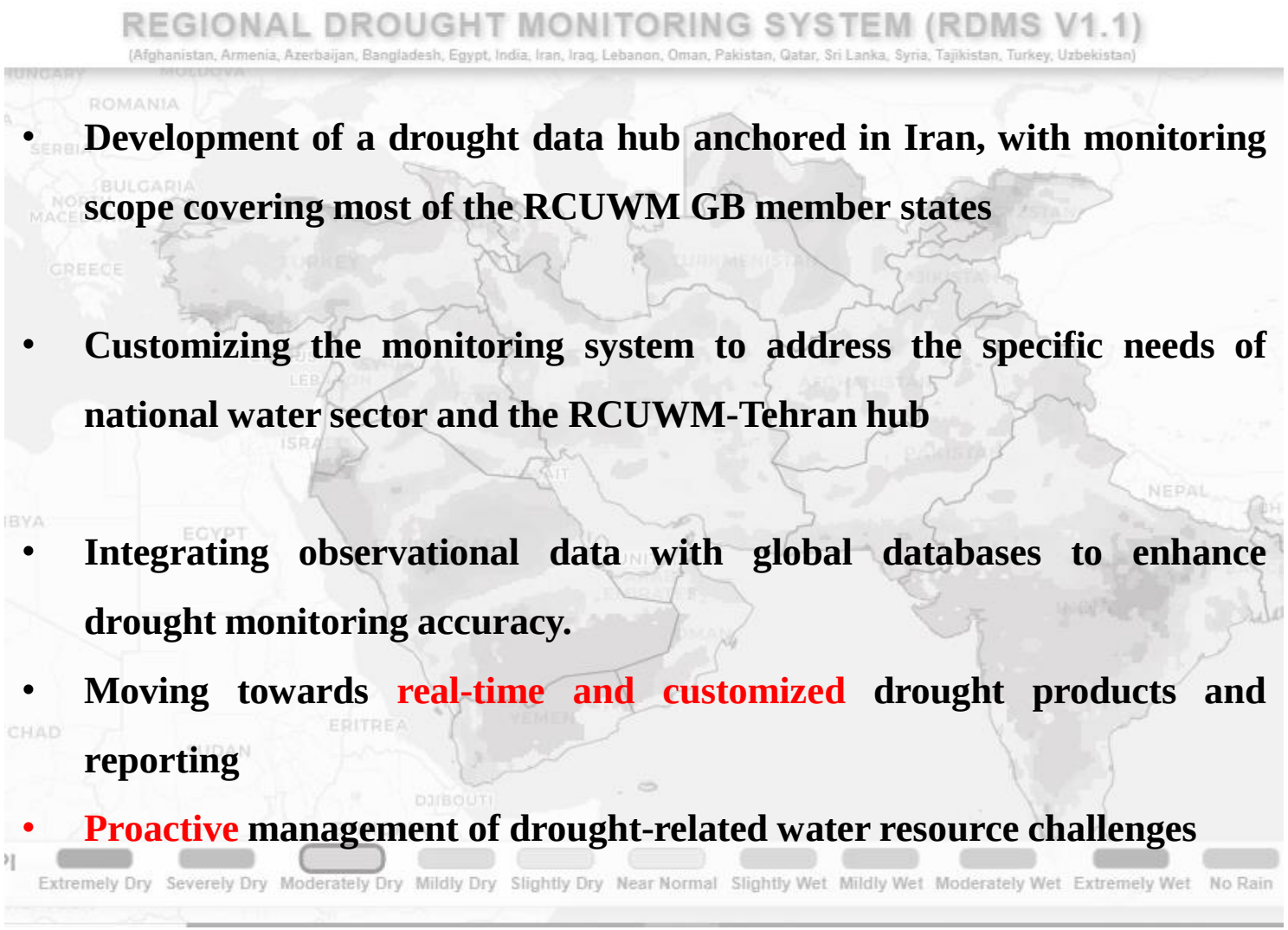
Co-organizers: RCUWM, IDI, IRIMO, IDMP - October 2025, Tehran, Iran

Participants: 140 in-person & 600 online

Speakers: Afghanistan, Iran, Iraq, Oman, Pakistan, Türkiye and 10 invited presenters by IDMP

IDM: Publication

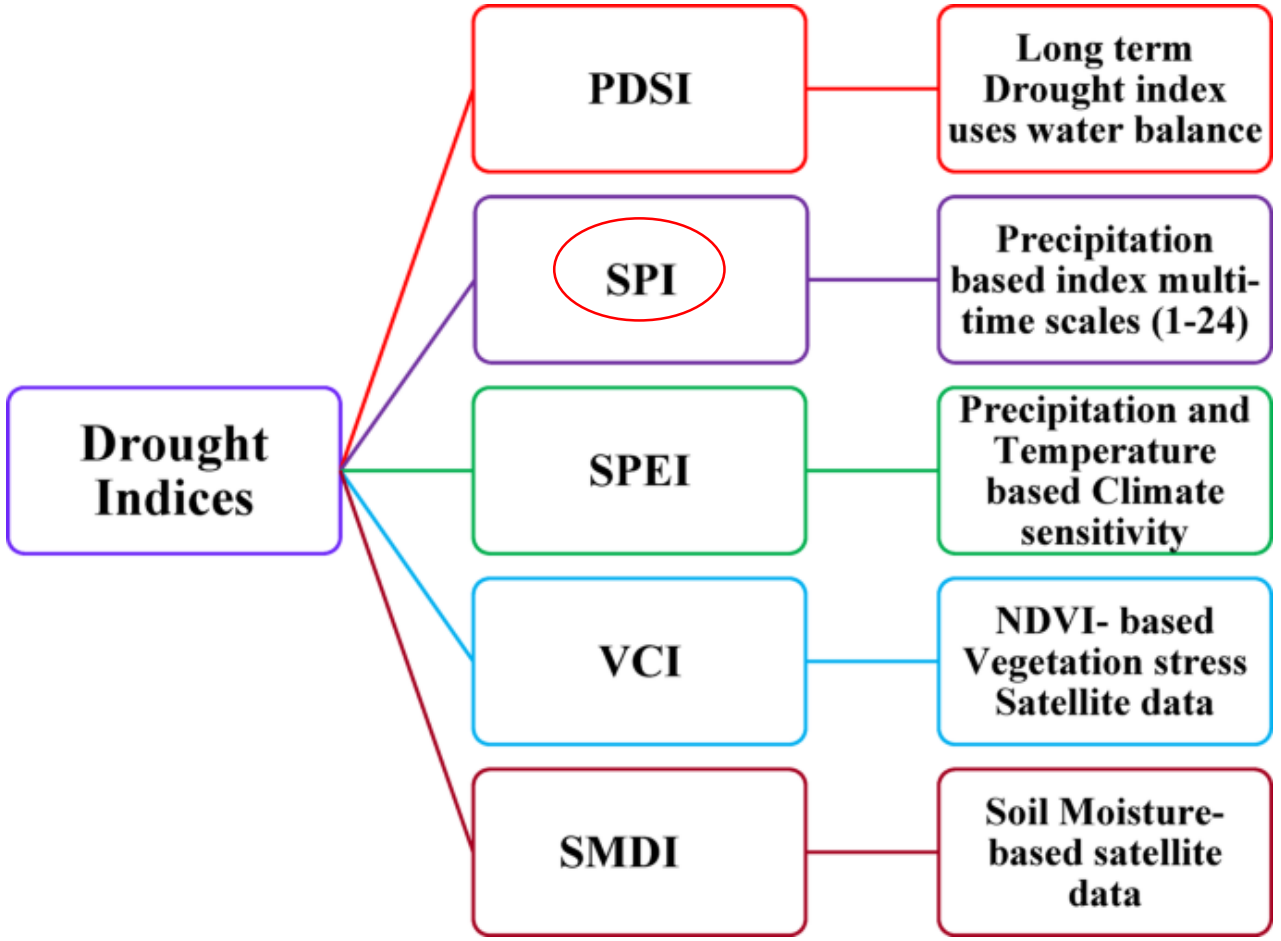
A Regional Drought Monitoring System (RDMS) to implement IDM



- **Development of a drought data hub anchored in Iran, with monitoring scope covering most of the RCUWM GB member states**
- **Customizing the monitoring system to address the specific needs of national water sector and the RCUWM-Tehran hub**
- **Integrating observational data with global databases to enhance drought monitoring accuracy.**
- **Moving towards real-time and customized drought products and reporting**
- **Proactive management of drought-related water resource challenges**

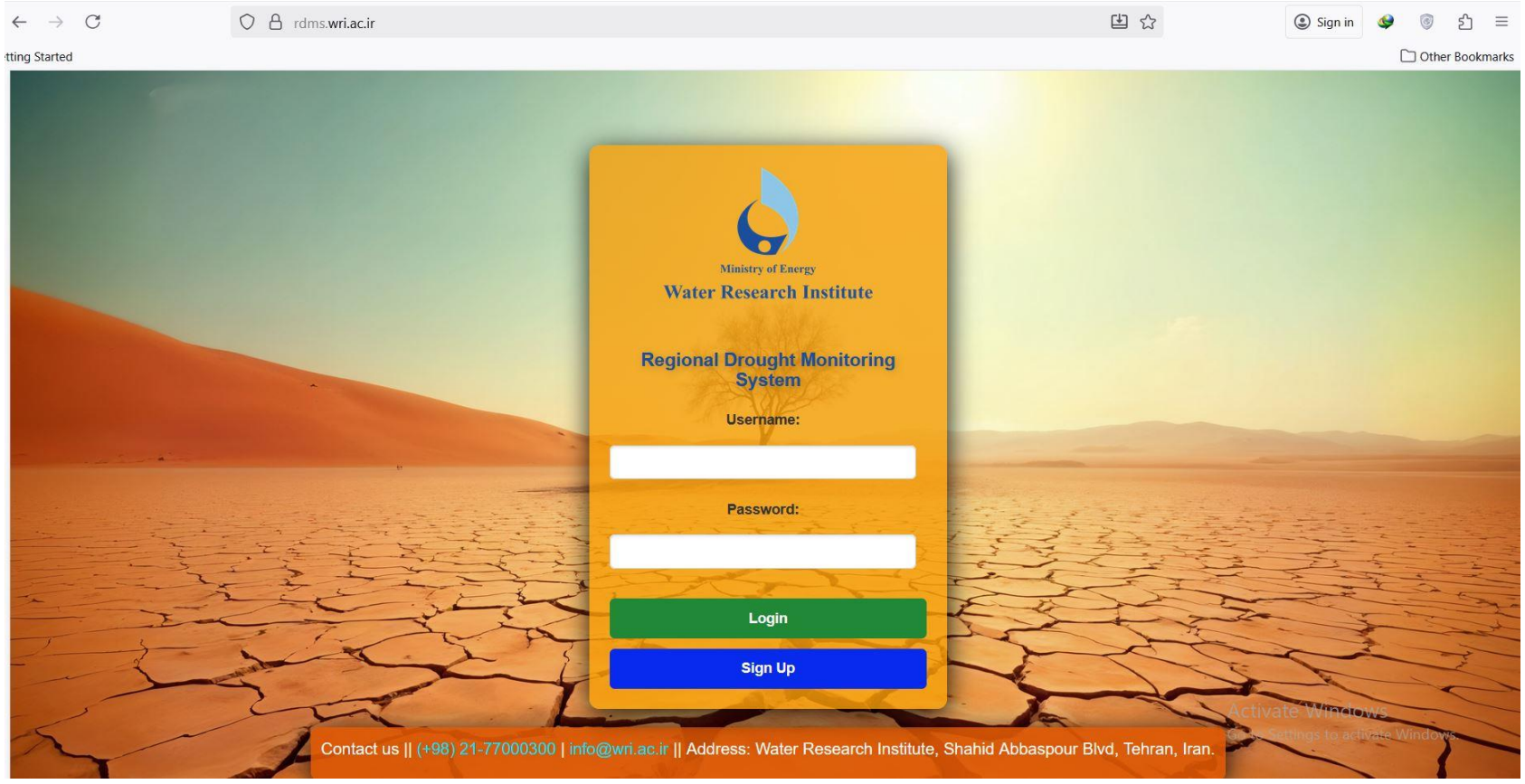
A Regional Drought Monitoring System (RDMS) to implement IDM

- **Drought Indices**

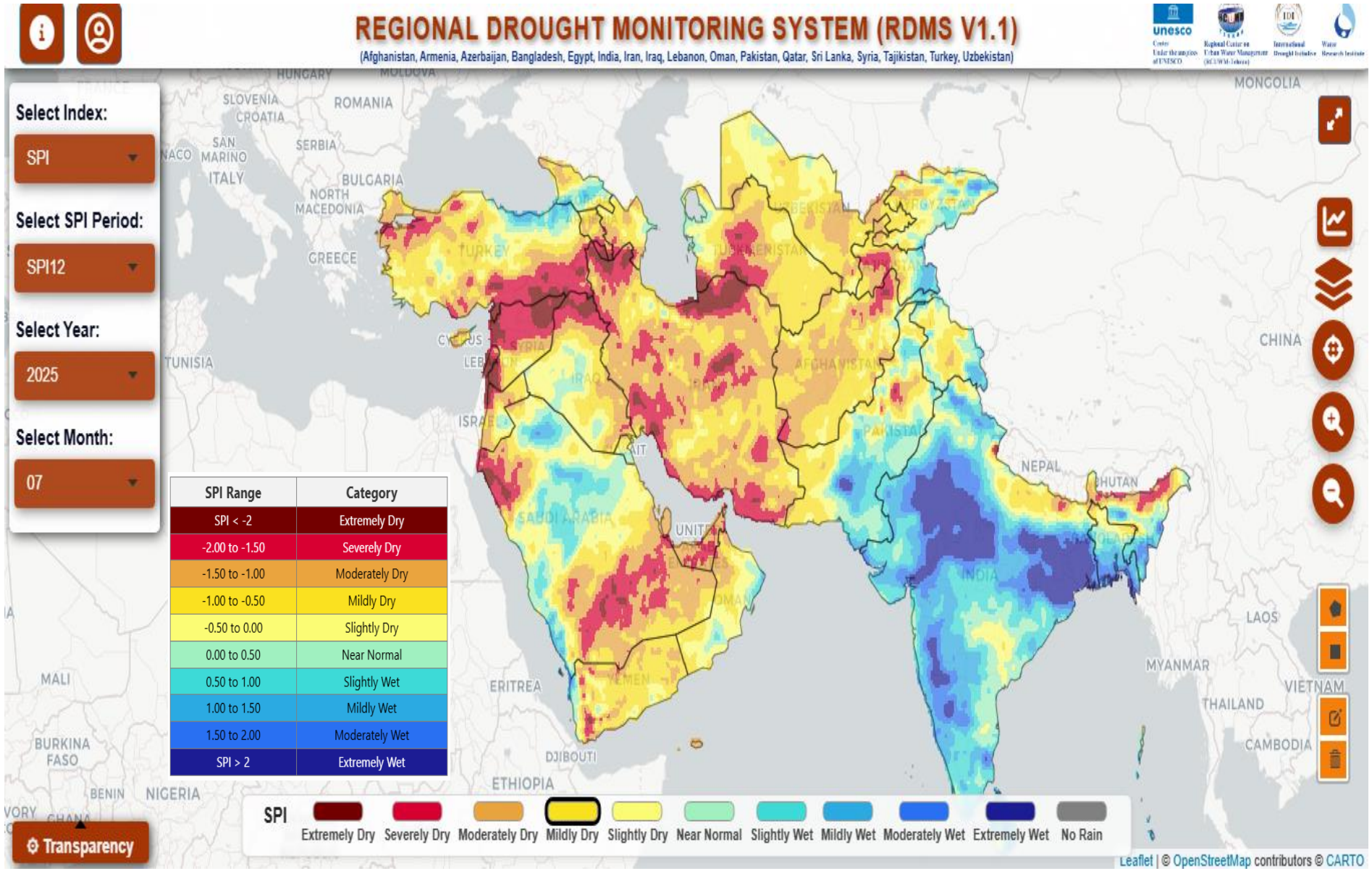


A Regional Drought Monitoring System (RDMS) to implement IDM

- Address: rdms.wri.ac.ir
- Web-based GIS system
- Input Data: ERA5, Fifth generation of ECMWF atmospheric reanalysis of the global climate
- Drought Index: Standardized Precipitation Index (SPI) – Phase 1
- Time Scales: 1, 3, 6, 9, 12, 24 months
- Statistical period: 1980-2025
- This system enable users to analyze both short-term and long-term drought patterns.



A Regional Drought Monitoring System (RDMS) to implement IDM



IDM: Renew of IDI

- **International Drought Initiative (IDI)** under the auspices of UNESCO has been established in 2010. IDI Secretariat is based in the RCUWM-Tehran.
- Constructing a regional data hub
- Monitoring, impact assessment and drought mitigation
  - Drought characterization and monitoring
  - Impact assessment (qualitative and quantitative evaluation)
  - Defining the measures taken to mitigate each drought
- Completing and constructing drought risk management

IDI
International Drought Initiative

IDM: Ongoing Projects

Activity	Co-organizers	Contribution	Remarks
Regional Training Workshop on "**Implementation of IDM: Challenges and Solutions**"	RCUWM, IDMP		Concept Note
Compile a book entitled "**Integrated Flood and Drought Management focusing on Advanced Technologies in the RCUWM Governing Board Member States**"	RCUWM, IDMP		Concept Note
A Regional Drought Monitoring System (RDMS) to Implement IDM-Phase 1	RCUWM	Iran	In progress

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Conclusion

Research

Training and Capacity Building

Publication

Dr. Naser Dehghanian

Conclusion

Plan	Activity	Contribution(s)
1 Groundwater	Regional Training Workshop on "Groundwater Governance in GB Member States: Challenges and Solutions", 2026.	---
	Smart Management System for Water and Electricity – Phase 1	Iran and …
2 IFM	Regional Training Workshop on "Flood and Sediment Management in line with IFM: Challenges and Solutions"	Iran
	Compile a book entitled "Guidelines for Adaptive River Management in Drylands"	Iran
	Develop regional systems for 1- Flood monitoring and warning and 2- Reservoir inflow forecasting – Phase 1	Iran and …
4 Climate Change	Workshop on Climate Change and Regional Adaptation	Iran
	Compile a book entitled "Climate Change Adaptation Approaches and Experiences in the RCUWM Governing Board Member States"	Iran
5 IDM	Regional Training Workshop on "Implementation of IDM: Challenges and Solutions"	…
	Compile a book entitled "Integrated Flood and Drought Management focusing on Advanced Technologies in the RCUWM Governing Board Member States"	All GB members
	A Regional Drought Monitoring System (RDMS) to Implement IDM - Phase 1	Iran and …