

**THA 2022** International Conference on  
**Moving Towards a Sustainable Water and  
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# Development of Framework to Evaluate Current State of Groundwater Governance under Urbanization and Climate Change

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# Presentation Outline

I. Background

II. Objective and Rationale

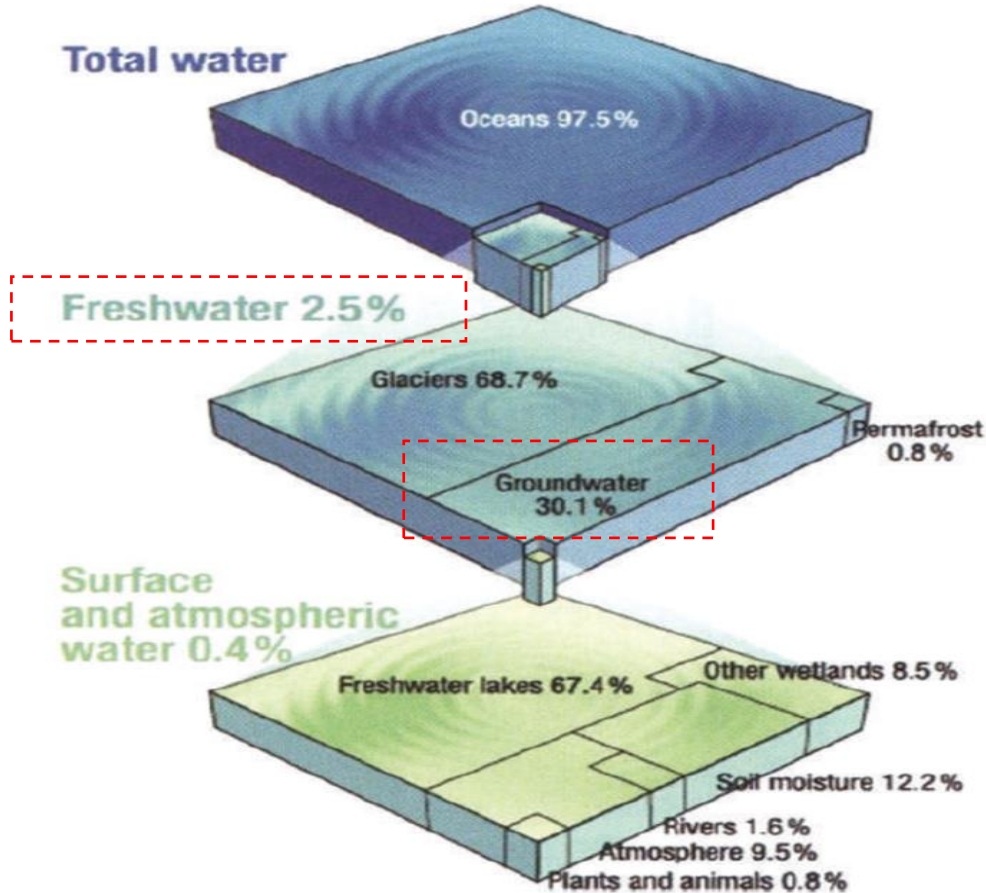
III. Materials and Methods

IV. Results and Discussion

V. Conclusions

# Background

## World's Water - Global Distribution



(Source: IGRAC, 2011 as cited in Margat & Gun, 2013)

## Multiple Stresses to Groundwater

- Rapid Population Growth and Urbanization
- Industrialization
- Climate Change
- Tourism Development
- Transboundary Effect

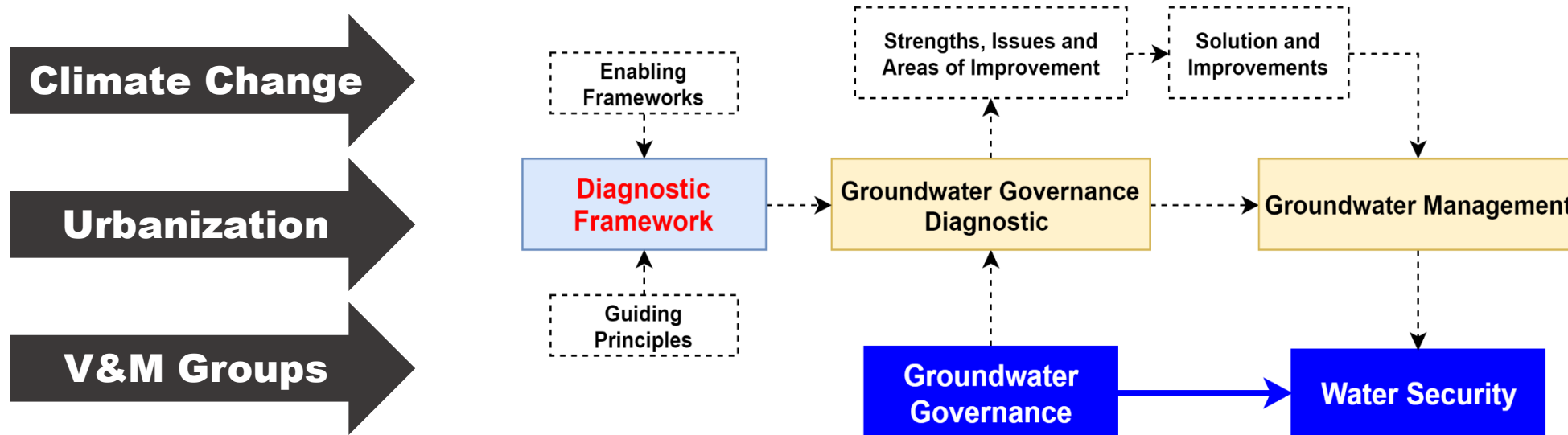
## Groundwater Management Issues

- Groundwater Table Depletion/ Increase
- Land Subsidence
- Groundwater Contamination/ Pollution
- Saltwater Intrusion
- Social and Right based Conflicts

## Background (contd.)

- Volume of groundwater extraction has raised by fourfold in past 50 years and the trend is likely to persist in the future (FAO, 2016).
- Governing and managing groundwater resources is repeatedly ignored and underrated in the rapidly urbanizing cities.
- Understanding groundwater governance is a soft approaches for managing and addressing the water crisis challenges (de Chaisemartin et al., 2017).

# Objective & Rationale



- Assists in stocktaking of the governance situation (provisions and gaps: actors, regulatory framework, policies, information).
- Facilitates government, planners, managers and related actors in decision-making and initiate urgent call for action.

# Materials for Development of Framework

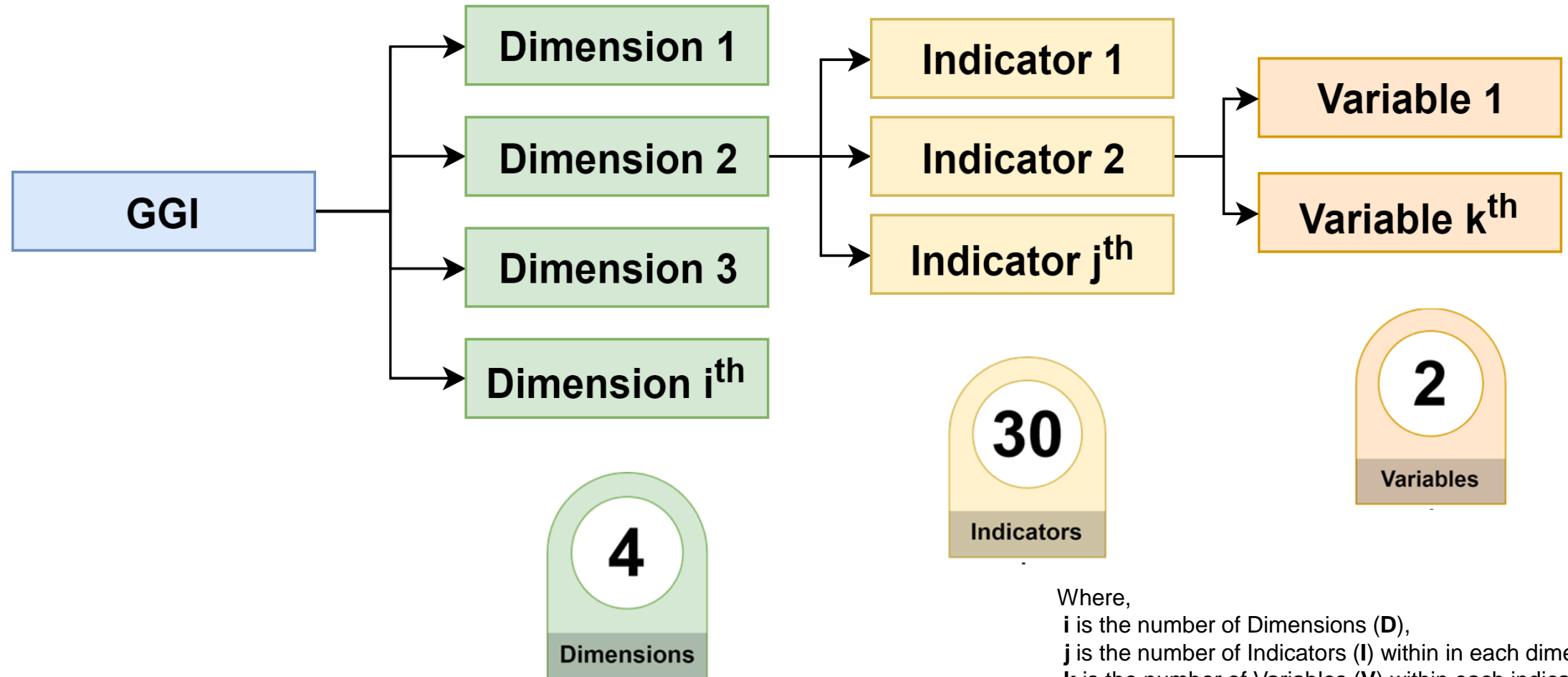
S.N	Name of Publication	Publication Year	Publication Type	Publisher
1	Gender-responsive indicators for water assessment, monitoring and reporting	2019	Report	World Water Assessment Programme ( <b>WWAP</b> ), <b>UNESCO</b>
2	Advances in Groundwater Governance	2018	Book	CRC Press (Taylor and Francis Group)
3	Freshwater Governance for the 21st Century : Global Issues in Water Policy 6	2017	Book	Springer
4	Gender equality and inclusion in water resources management	2017	Report	Global Water Partnership ( <b>GWP</b> )
5	Global Diagnostic on Groundwater Governance	2016	Report	Food and Agriculture Organization ( <b>FAO</b> )
6	Global Framework for Action to achieve the Vision on Groundwater Governance	2016	Report	Food and Agriculture Organization ( <b>FAO</b> )
7	Shared global vision for Groundwater Governance 2030 : A call-for-action	2016	Report	Food and Agriculture Organization ( <b>FAO</b> )
8	Progress on Level of Water Stress : Global baseline for SDG indicator 6.4.2	2016	Report	Food and Agriculture Organization ( <b>FAO</b> )
9	Key Interventions to Improve Local Groundwater Governance	2015	Report	Water Research Commission ( <b>WRC</b> )
10	Why Gender Matters in IWRM: A tutorial for water managers	2014	Report	International Network for Capacity Building in Integrated Water Resources Management (Cap-Net)- <b>UNDP</b> & Gender and Water Alliance ( <b>GWA</b> )
11	Groundwater governance : conceptual framework for assessment of provisions and needs	2010	Report	GW MATE, <b>World Bank</b>

## Research Application

S.N	Name of Publication	Citation
1	Groundwater-resource governance: Are governments and stakeholders responding to the challenge?	Foster & Garduño, 2012
2	A critical assessment of groundwater governance in Tunisia	Frija et al., 2014
3	Global governance principles for the sustainable development of groundwater resources	Kirstin & Gupta, 2015
4	Stakeholder Engagement for Inclusive Water Governance: "Practicing What We Preach" with the OECD Water Governance Initiative	Akhmouch & Clavreul, 2016
5	Groundwater Governance in the Azores Archipelago (Portugal): Valuing and Protecting a Strategic Resource in Small Islands	Cruz & Soares, 2018
6	Groundwater governance in Bangladesh: Established practices and recent trends	Bhattacharjee et al., 2019

# Results and Discussion

## ➤ Structure of Framework



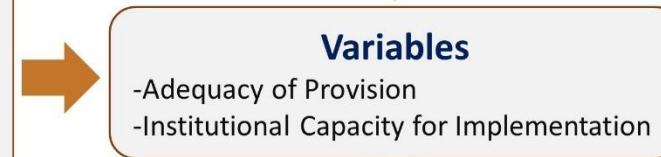
Where,  
 $i$  is the number of Dimensions (**D**),  
 $j$  is the number of Indicators (**I**) within in each dimensions  
 $k$  is the number of Variables (**V**) within each indicators  
**GGI** is the Groundwater Governance Index.



# Results and Discussion: Developed Framework



Rating	
0	Non-Existent
1	Incipient
2	Acceptable
3	Optimum



## Aggregation Equations

$$I_{xy} = \frac{V_1 + V_2}{2}$$

$$D_x = \frac{\sum_{y=1}^n W_y * I_{xy}}{\sum_{k=1}^n W_y}$$

$$GGI = \frac{\sum_{x=1}^n W_x * D_x}{\sum_{x=1}^n W_x}$$

### Sources (Indicators and Rating)

-Foster et al., 2010 (GW-MATE)  
-Miletto et al., 2019 (UNESCO)  
-UNESCO-IHP, 2011

### Threshold

0  
0.01 - ≤ 1  
1.01 - ≤ 2  
2.01 - ≤ 3

### State of Groundwater Governance

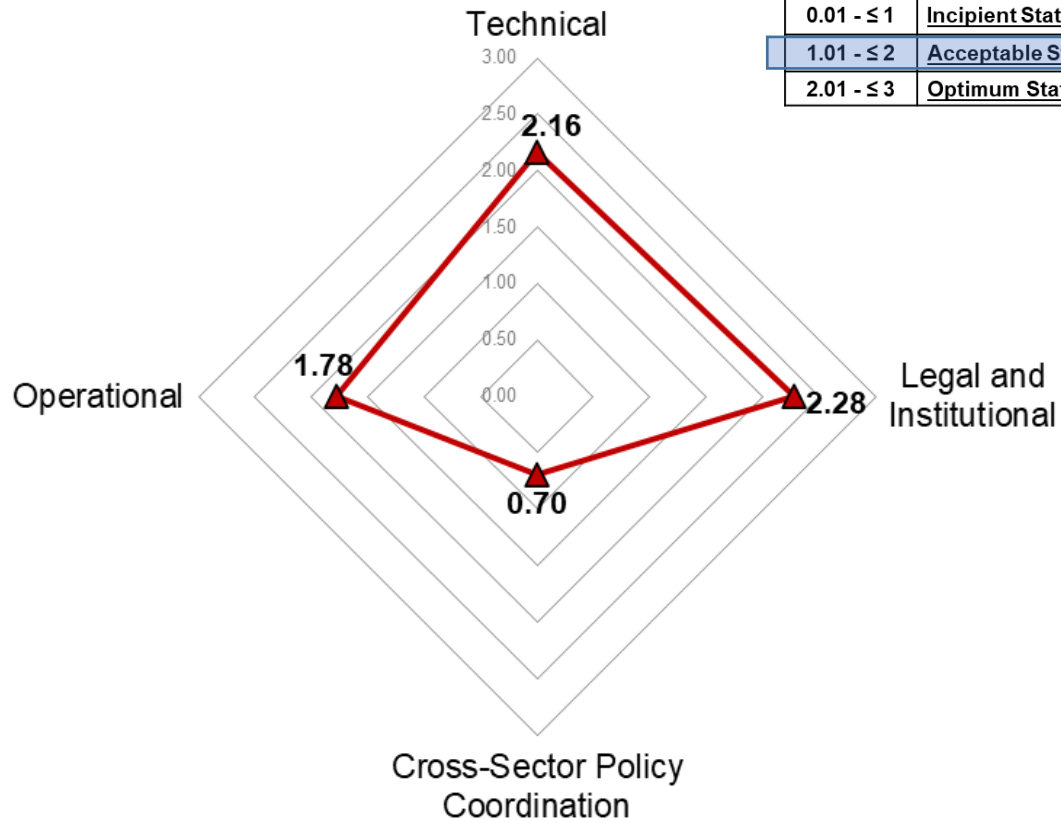
Non-Existent  
Incipient  
Acceptable  
Optimum



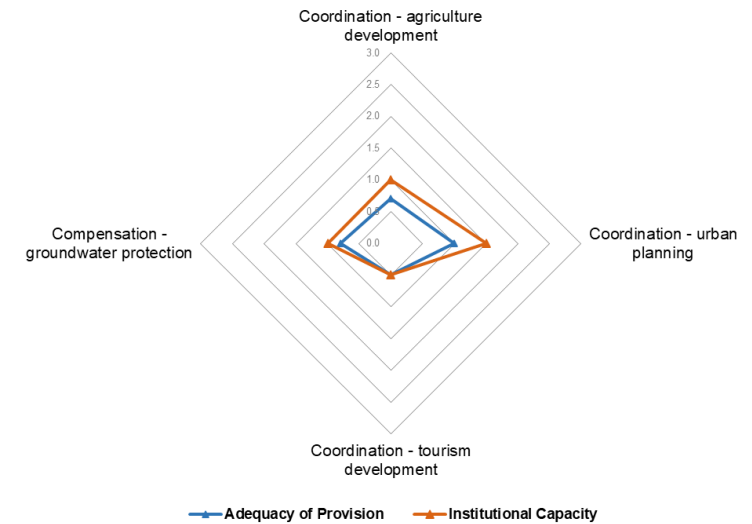
# Sample: Application of Framework

**Ground Water Governance  
Index (GGI) = 1.73**

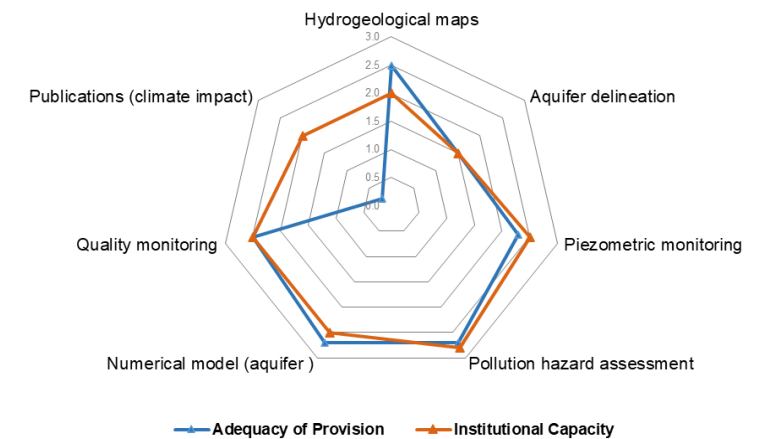
Threshold	State of Governance
0	<u>Non-Existent State</u> of Groundwater Governance
0.01 - ≤ 1	<u>Incipient State</u> of Groundwater Governance
1.01 - ≤ 2	<u>Acceptable State</u> of Groundwater Governance
2.01 - ≤ 3	<u>Optimum State</u> of Groundwater Governance



**Cross-Sector Policy Coordination Dimension**



**Technical Dimension**



# Results and Discussion (contd.)

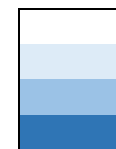
## ➤ Multi-Aspect Analysis

Component	Actors	Legal Frameworks	Policies and Plans	Information and Knowledge
Dimension				
Technical				
Legal and Institutional				
Cross-Sector Policy Coordination				
Operational				

Relevancy

Very Low

Very High



### Indicator-Based Analysis

- Groundwater Extraction Aspect
- Groundwater Quality Aspect
- Climate change and Urbanization Aspect
- Social Inclusion (Vulnerable & Marginalized) and Rights Related Aspect

# Conclusions

- The framework consists of 4 dimensions, 30 indicators and 2 variables.
- The GGI value ranges from 0-3 (i.e., non-existence state to optimal state of governance) and delivers the current state of groundwater governance.
- The framework shall be useful in appraising (multiple aspects) provisions and needs in groundwater governance and shall be handy in taking urgent call to action leaving no one behind.

# Thank you very much!

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