

Roles of multi-stakeholders in sustainable groundwater management towards SDG6.

A Case of Khon Kaen, Thailand

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Introduction

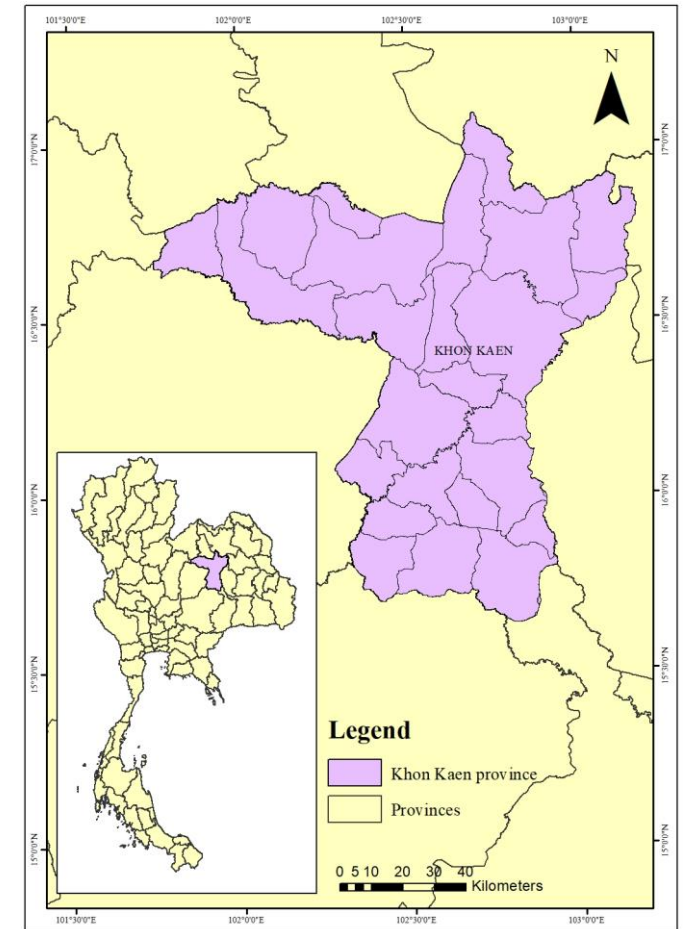
- Groundwater is the key supporter of socio-economic development, livelihood and water insecurity for local people (Mauroner et al., 2021).
- The rapid economic development led to the emergence of new businesses.
- Stakeholder engagement is the key element of good groundwater governance (Closas & Villholt, 2019).
- However, there is a lack of stakeholder engagement in groundwater management and previous research only focused on the state actors, official organizations and experts appraised groundwater governance at the national level (see, Cheyasit et al., 2019; Sarami Froushani et al., 2021).
- The awareness of groundwater use among stakeholders is necessary to alter their behaviour related to groundwater resources.
- Since there is a lack of capacity assessment among stakeholders to manage groundwater in their community, multi-stakeholder involvement is needed to support groundwater management to respond to the sustainable development goals (SDGs)
 - Contributing the capacity-building in water-related activities in groundwater governance.
 - Supporting the participation of local communities in improving water management (UN, 2020).

The objectives of the study

- To investigate the roles of multi-stakeholders at the local level to contribute to sustainable groundwater management in Khon Kaen.

Study area

- Khon Kaen faces the water challenges -> an increase in water demand (Artlert & Chaleeraktrakoon, 2013).
 - Population growth
 - Economic development (the industries related to agro-based and food processes) which required more irrigated water.
 - The Ubol Ratana Dam also requires a large volume of water to generate electricity (Thilakarathne & Sridhar, 2017).
 - The competition of water use will be intensified and have several impacts on Khon Kaen metropolitan area in the future.
- Since the economic development pushed by government policies, Khon Kaen's economy substantially expanded, and led to the emergence of new businesses, such as hired transportation, hotels, restaurants, bars, wholesale and retail trade services and the garment industry, attracting migrants from the surrounding rural areas.



Study area: Khon Kaen province, Thailand

Methodology

1. Stakeholder analysis

- The secondary data were gathered and analyzed based on the existing studies (i.e. Chanyaluk, 2020; DGR, 2020; Garduño et al., 2010; OECD, 2018; Paenmonkul, 2020, etc.).
- A stakeholder analysis was applied to identify who are the beneficiaries and disadvantages in groundwater issues.
- The step starts with a stakeholder matrix which is identified from the official reports, researches, media and documentaries to illustrate who is related to groundwater issues in Khon Kaen.
- The method aims to clarify the influence and interest among key stakeholders. The procedure will provide the basis of groundwater stakeholder information to identify the roles in groundwater issues.

2. Stakeholder's capacity assessment

- The primary data is collected from the online questionnaires to assess the stakeholder capacity in groundwater management toward SDG6.
- Descriptive Statistics are used to analyze the level of stakeholders' capacity to address the challenges of groundwater management toward SDG6 (i.e. mean and percentage).
- One-way ANOVA is used to compare the mean score of capacity among stakeholder groups.

Results

1. Groundwater Stakeholder

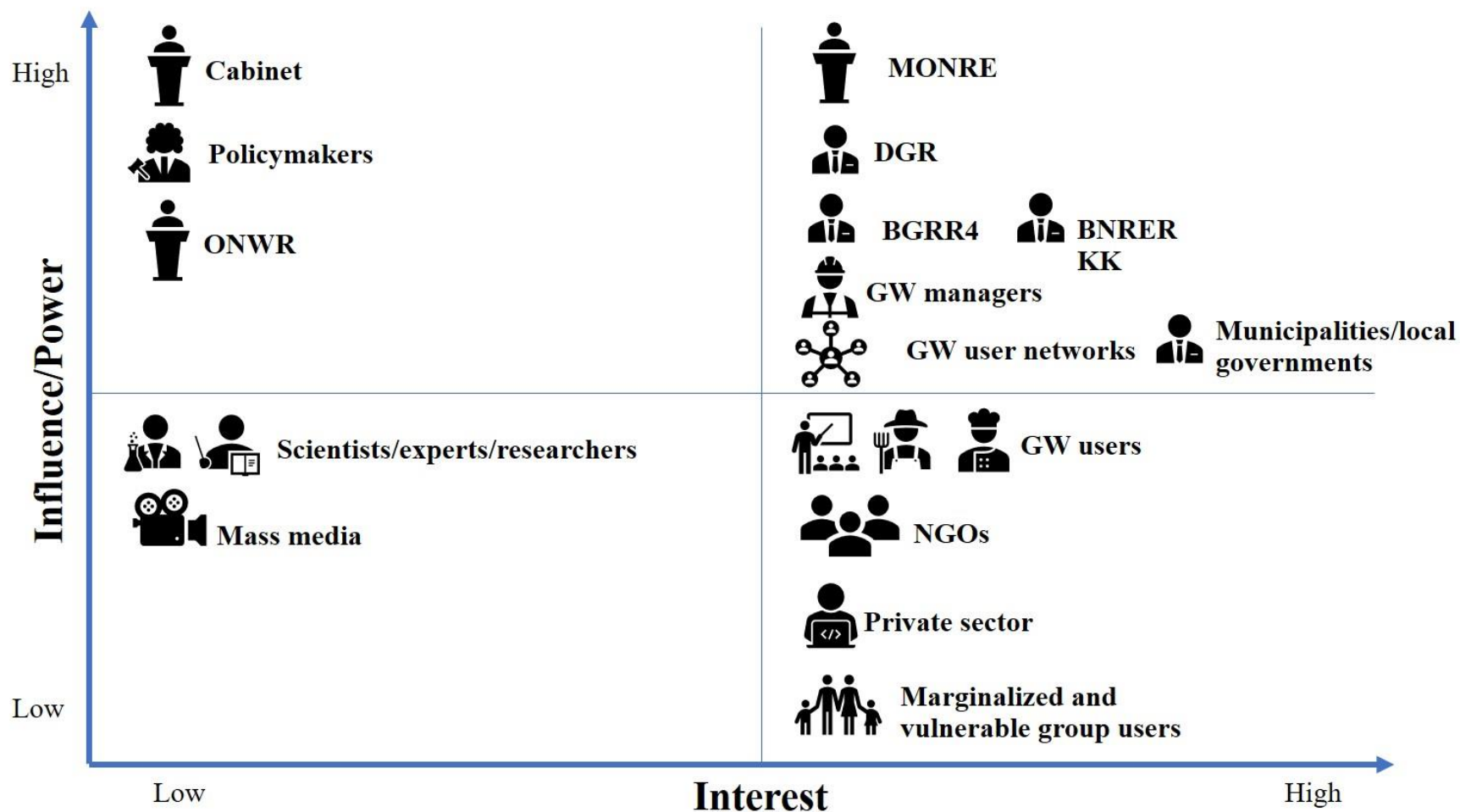


Fig. 1 Stakeholder Matrix

Results

1. Groundwater Stakeholder

1.1 High influence and high-interest stakeholders: Groundwater policies, plans and regulations were taken by the sub-institutions that control and manage groundwater resources;

- **Ministry of Natural Resources and Environment (MONRE)**
- **Department of Groundwater Resources (DGR)**
- **Bureau of Groundwater Resources Regional 4 (BGRR4)**
- **Bureau of Natural Resources and Environment Regional Khon Kaen (BNRER)**
- **Groundwater managers** are the actors who help to solve groundwater in the hydrological aspect. The task of water monitoring has become a key action to provide significant information to water users and to reduce over expenses caused by increases in water uses among different human activities (Coelho et al., 2019).
- **Groundwater user networks** are also one of the actors who has been interested recently since they have more power than individual users in terms of bargaining the power of users to governments.
- **Local governments and municipalities** can implement in some missions to manage and control groundwater at the local level. Thus, they can provide services for the groundwater users in some ways (i.e., people in pilot areas can ask for groundwater license in the provinces which is dominated by local departments transferred by DGR).

Results

1. Groundwater Stakeholder

1.2 High influence and low-interest stakeholders

- **The Prime minister and cabinet** have a role to consider and enforce the policies according to the cabinet's agreement.
- **The National Water Resources Committee (NWRC)** is a policymaker of water management, and the Office of National Water Resources (ONWR) adopts policies from NWRC to operate the functions of water management at the national level.
- **ONWR** has a role to propose the water policies in Thailand including holistic water management (Phanthaphech and Chittaladakorn, 2021). The organization is under the Prime Minister's office of Thailand (ONWR, 2021).

Results

1. Groundwater Stakeholder

1.3 Low influence and high-interest stakeholders

- **Groundwater users** play a key role in terms of groundwater abstraction to support their activities (i.e. domestic drinking in their households, agricultural production as well as business purpose.)
- The main activities are based on the regulations under the Groundwater Act which determined the main three purposes of groundwater use in the license application.
- Another group of users are **the marginalized and vulnerable groups** who reside in the slum communities along the railways in Khon Kaen municipality. These groups have been affected since the residence is illegal. There is no public water supply investment and these users did not have the money to pay for water meter installation provided by Provincial Water Authority (PWA). They had to buy water from the company and drill the private well to use water temporarily (Mark, 2019).
- In case of conflicts among groundwater users, **local NGOs** have a role to support equal access for the vulnerable and marginalized group while environmental NGOs are interested in protecting aquifers and groundwater tables in sustainability.
- There is a lack of financial supports from Donors or financial supporters. They need to sustain and conserve groundwater by supporting aquifer recharge. They support budgets to public and private sectors in terms of research funding and financial to NGOs (Garduño et al., 2010).

Results

1. Groundwater Stakeholder

1.4 Low influence and low-interest stakeholders

- **Mass media** has a role to inform the news about groundwater resources. However, there is a lack of power of mass media to raise the awareness of groundwater users and other groups of stakeholders to manage groundwater at the local level.
- **Scientists or researchers** have a role to solve problems related to groundwater resources. (i.e. Groundwater institution under Khon Kaen university). The roles of the institution are developing databases and conducting research related to groundwater. Moreover, extending networks with universities, research institutes as well as related authorities to conduct research and funding. They can influence DGR and BGRR4 by cooperating in terms of research and experiments to find innovations and better ways to improve the situation in such areas.
- Therefore, DGR and BGRR4 should support and facilitate scientists in both inside and outside organizations.
- However, some groups of groundwater stakeholders are still invisible and behind the water sector since the lack of studying groundwater stakeholders at the local level. Therefore, the research aims to explore more groundwater stakeholders to balance the issues of groundwater resources. The findings of stakeholder identification can be the preliminary data to understand the key stakeholders who play various roles in the groundwater governance in Khon Kaen.

Results

2. Stakeholder capacity to address the groundwater challenges toward SDG6

Groundwater Stakeholders

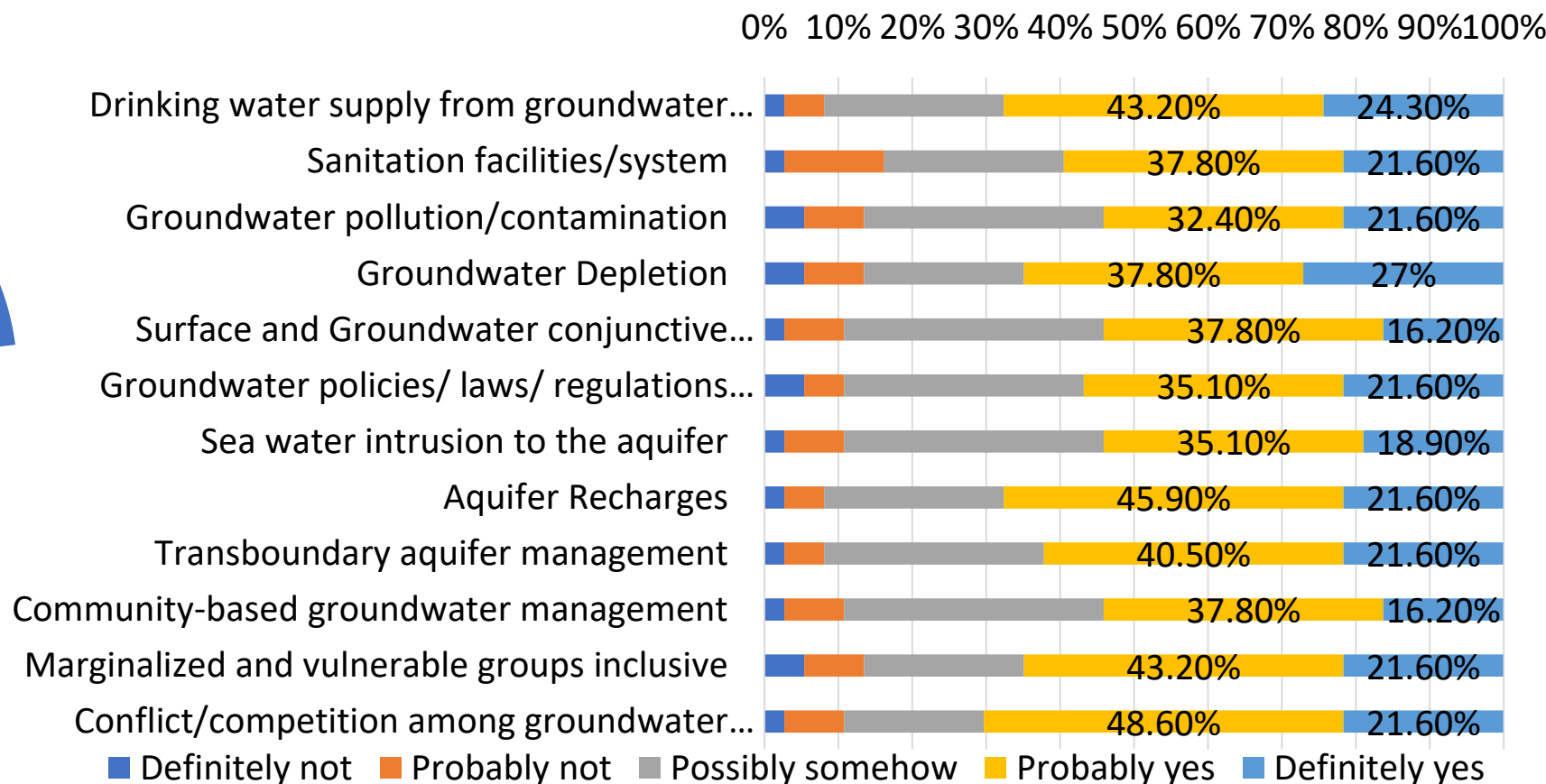
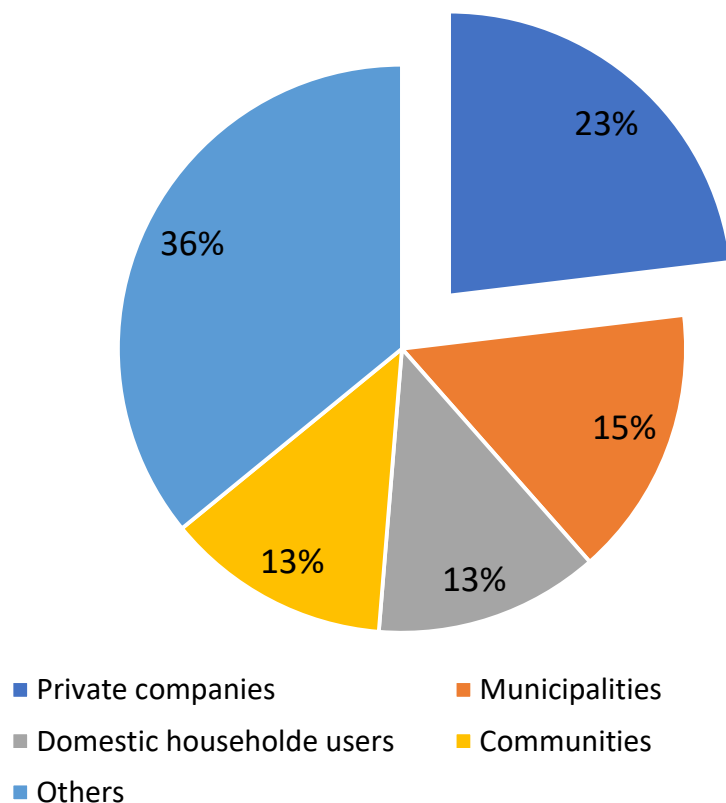


Fig. 2 Percentage of stakeholders responded to the capacity to address the groundwater challenges toward SDG6

Results

2. Stakeholder capacity to address the groundwater challenges toward SDG6

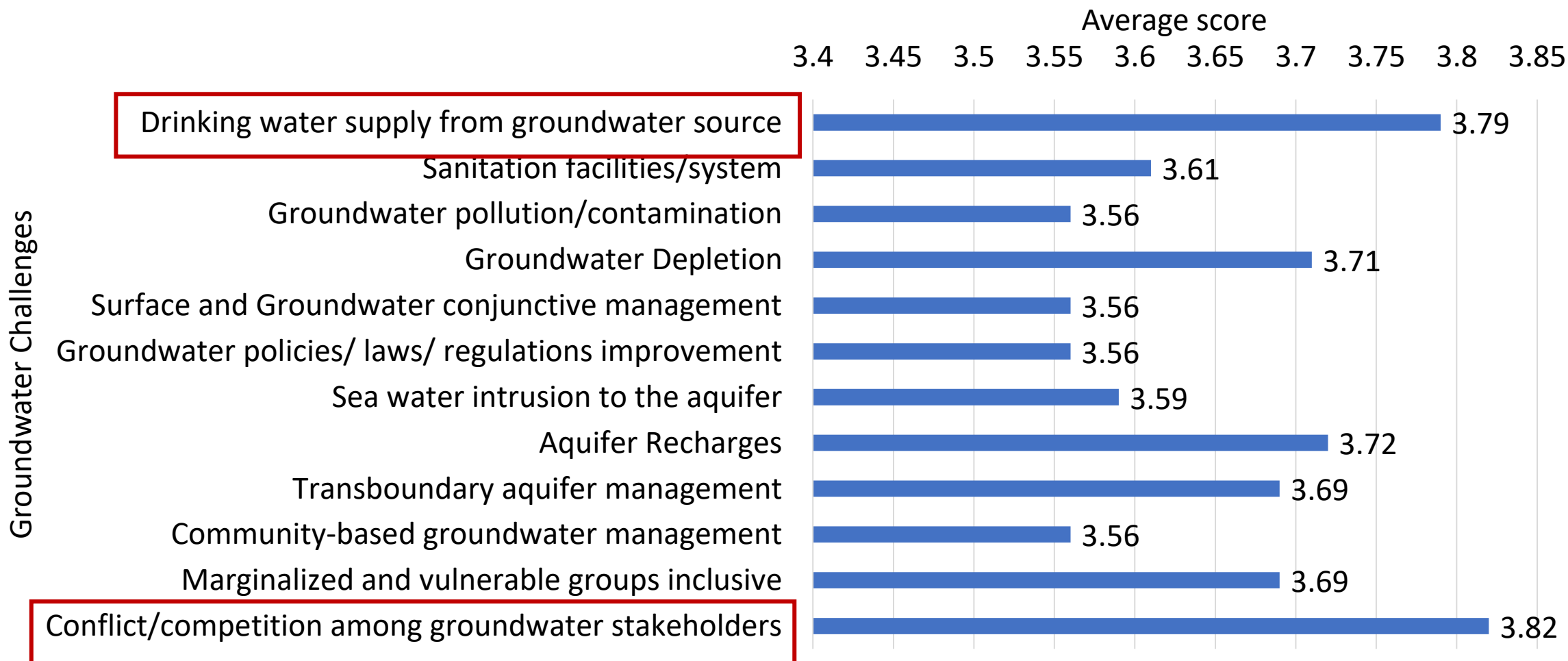


Fig. 3 The level of stakeholders' capacity to address groundwater challenges toward SDG6

Results

2. Stakeholder capacity to address the groundwater challenges toward SDG6

Table 1 ANOVA results of stakeholder capacity to address groundwater challenges

SDG6 targets	Groundwater Challenges	Sum of Squares	df	Mean Square	F	P-value
6.1 Access to drinking water for all.	Drinking water supply from groundwater source	6.87	12	0.57	0.54	0.87
6.2 Access to sanitation and hygiene for all.	Sanitation facilities/system	11.29	12	0.94	0.82	0.63
6.3 Improve water quality	Groundwater pollution/contamination	14.52	12	1.21	1.08	0.41
6.4 Ensure sustainable withdrawals	Groundwater Depletion	17.16	12	1.43	1.29	0.28
6.5 Implement integrated water resources management (IWRM)	Surface and Groundwater conjunctive management	9.99	12	0.83	0.92	0.54
	Groundwater policies/ laws/ regulations improvement	9.01	12	0.75	0.56	0.85
6.6 Aquifer protection	Seawater intrusion to the aquifer	18.21	12	1.52	2.29*	0.04
	Aquifer Recharges	19.23	12	1.60	2.50*	0.03
6.A International cooperation	Transboundary aquifer management	12.75	12	1.06	1.28	0.29
6.B Participation of local communities	Community-based groundwater management	12.09	12	1.01	1.22	0.32
	Marginalized and vulnerable groups inclusive	17.31	12	1.44	1.39	0.23
	Conflict/competition among groundwater stakeholders	11.69	12	0.97	1.05	0.44

- There is a significant difference of score mean of stakeholder capacity for at least one of the stakeholder groups: **Aquifer Recharges** (F=2.50, p-value = 0.03) and **Seawater intrusion to the aquifer** (F=2.29, p-value = 0.04).
- The groundwater challenges related to SDG6 target 6.6 – aquifer protection.

Discussion and conclusion

1. Stakeholder identification

- SH identification illustrates who are the key stakeholders, and the power and interest of each group in groundwater management.
- Key actors who manage closely (High power – high interest) (i.e., DGR, BGRR4, BNRER and MONRE) should integrate the level of capacity in terms of stakeholder participation in the policymaking process.
- Also, they should address the challenges which stakeholders can address (i.e., conflicts among groundwater stakeholders and drinking water supply from groundwater sources).
 - The findings may help to boost the capacity in groundwater management. Karatzas et al. (2021) highlighted that it can increase governance capacity by **addressing people's skills in jointly decision-making and engaging stakeholders through participation.**

Discussion and conclusion

2. Stakeholder capacity to address the groundwater challenges toward SDG6

- The findings show overall stakeholders assess their capacity in the score level (4).
- Multi-stakeholders accepted and preferred to address the groundwater challenges in the community.
- The challenge of **conflicts among groundwater stakeholders and drinking water supply** from groundwater sources are the dominant high average preferences among stakeholders.
 - The findings suggest that there should be **supported measures to stakeholders** in terms of stakeholder participation or consultation to formulate policies related to conflict resolution and knowledge dissemination or training about clean drinking water supply in communities.
- However, groundwater pollution and contamination, surface and groundwater conjunctive management, groundwater policies, laws, regulations improvement and community-based groundwater management are the lowest preferences among stakeholders.
 - The findings suggest that groundwater authorities should implement **the policies related to these challenges to respond to the capacity building of the groundwater stakeholders**. It may help to overcome the groundwater challenges in which there is a low capacity of the stakeholders.

Discussion and conclusion

2. Stakeholder capacity to address the groundwater challenges toward SDG6

- Aquifer Recharges and seawater intrusion to the aquifer were the difference in mean score among stakeholder groups.
 - The findings may imply that **the governments should consider the policy related to raising awareness among stakeholders to understand the impacts on groundwater resources** (i.e. seawater intrusion) and knowledge about aquifer recharge to make stakeholders understand the beneficiaries of addressing groundwater challenges.
- **Understanding the stakeholders' capacity** to address groundwater challenges toward SDG6 can **contribute to the roles of broader stakeholder participation** in terms of local **groundwater management strategies**, and bringing all significant groundwater issues into the decision-making process for the groundwater regulatory or policy cycle (Foster, 2008) to support sustainable groundwater management in multi-level of groundwater governance.

Thank you for your attention.