

Roles of multi-stakeholders in sustainable groundwater management towards SDG6. A Case of Khon Kaen, Thailand

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Abstract

The rapid economic development is driven by The First National Economic and Social Development Plan from 1962 until now. Thus, Khon Kaen's economy is significantly expanded and led to the emergence of new businesses. Meanwhile, groundwater is much withdrawn by the business sector resulting in the downward trend of groundwater level. In addition, there is a lack of capacity assessment among stakeholders to manage invisible resources in their community. Heterogeneous stakeholders' involvement is needed to support groundwater management to achieve sustainable development goals (SDGs). The study aims to investigate the roles of multi-stakeholders at the local level to contribute to sustainable groundwater management in Khon Kaen. We identified stakeholders and the capacity of multi-stakeholders to manage groundwater resources in the community toward the targets of SDG6 (water and sanitation). The stakeholder identification is applied to identify the key stakeholders and online questionnaires. The finding shows many groups of stakeholders have high interest and high power for groundwater management in Thailand (most of them are state actors). Meanwhile, high interest and low power groups include various groundwater users (marginalized and vulnerable groups). Low interest and high power of stakeholder groups are policymakers and donors while low interest and low power of stakeholder groups are civil society and media. The capacity assessment of multi-stakeholders will be shown in the study. The multi-stakeholder roles and capacity assessment could support the capacity building program to strengthen local groundwater governance toward SDG6 targets and contribute to the groundwater policy at the national level as well as transboundary aquifer management.

Keywords- Groundwater management; Stakeholders; SDG6; Khon Kaen

1. Introduction

Groundwater is the key supporter of socio-economic development, livelihood and water insecurity. Since groundwater is also a significant resource for local people, groundwater management should be extended to the local level (Mauroner et al., 2021). Nevertheless, both national and local governance needs to be designed urgently to cope with the multi-level groundwater issues (Faysse et al., 2011; Jerbi et al., 2018). The rapid economic development is driven by The First National Economic and Social Development Plan since 1962. Khon Kaen's economy is significantly expanded and led to the emergence of new businesses. Groundwater is much withdrawn by the business sector while groundwater level is a downward trend. In Thailand, it is found that there is a lack of stakeholder engagement in groundwater management and previous researches 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).

Stakeholder engagement is the key element of good groundwater governance (Closas & Villholt, 2019). The rise of awareness on groundwater use among stakeholders is necessary to alter their behavior related to groundwater resources. This approach will enhance the acceptance among stakeholders to adapt the behavior to uncertain situations of groundwater dynamics (van der Gun, 2021). A stakeholder is a person or entity (e.g., water authorities, non-governmental organizations (NGOs), or community members) with an interest or concern in the issues. Stakeholder participation can add saliency, credibility, and legitimacy to scientific assessments, which may lead to more effective and adaptable water management decisions (Cash et al., 2003; Elshall et al., 2020; Heink et al., 2015). Therefore, if there is a lack of local participation by various stakeholders, any measures related to groundwater management tend to collapse (Mumma, 2011).

Since there is a lack of capacity assessment among stakeholders to manage invisible resources in their community, the stakeholder involvement is needed to support groundwater management by contributing the capacity-building in water-related activities in groundwater governance to respond to sustainable development goals (SDGs). In addition, it may support the participation of local communities in improving water management (UN, 2020). Consequently, we aim to investigate the roles of multi-stakeholders at the local level to contribute to sustainable groundwater management in Khon Kaen. The study may contribute to the multi-stakeholder partnerships which can unlock the potential to adapt new solutions toward SDG6 to ensure more effective progress on sustainable development.

2. Study area

Khon Kaen faces an increase in water demand since the population growth and business expansion including the industries related to agro-based and food processes which required more irrigated water (Artlert & Chaleeraktragoon, 2013). Meanwhile, the UbolRatana Dam also requires a large volume of water to generate electricity (Thilakarathne & Sridhar, 2017). The competition of water use is to be intensified and have several impacts on Khon Kaen metropolitan area in the future. Whereas climate change is occurring, Khon Kaen encounters low effectiveness of urbanization management (Beringer & Kaewsuk, 2018). The absorbed surfaces and natural floodways in the city have declined since the lack of land use planning in the past (Ito et al., 2016). 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 services and the garment industry, attracting an influx of migrants from the surrounding rural areas.

3. Methodology

3.1 Stakeholder identification

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 identification 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.

3.2 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.

4. Results

4.1 Groundwater Stakeholders

Stakeholders refer to institutions, organizations or groups that have some interest in a particular sector in the issues. Groundwater stakeholders are people who have a significant interest in the groundwater resources of a specified aquifer. Meanwhile, they use groundwater resources in their activities that could cause or prevent groundwater pollution, and they are regarded with groundwater resources and environmental management (Garduño et al., 2010). The stakeholders in

the groundwater context can be scientists or experts, policymakers, users (farmers, industrial users, service users, etc.) (Mitchell & Mezas., 2012; Zellner, 2008), indigenous people, environmental interests and rural landholders (Knappe & Pahl-Wostl, 2011). Stakeholder participation can be engaged in several levels (i.e., individual wells, aquifer systems, river basin and national level). If stakeholders can access to plan groundwater management at all levels, it can contribute to effective groundwater management, conservation and protection significantly (Garduño et al., 2010).

Groundwater stakeholders can be considered to private authorities or some organizations which are related indirectly. For instance, drilling contractors, surface irrigation providers, drainage and flood management authorities, sand and gravel mining operators, land use planning authorities, watershed management, educational establishments, professional associations and journalists or mass media (Garduño et al., 2010). Groundwater management cannot be achieved if it is focused only on the technical perspective. Thus, it should include groundwater users and develop a variety of instruments to regulate groundwater use and effective aquifer management (Gupta and Babel, 2005).

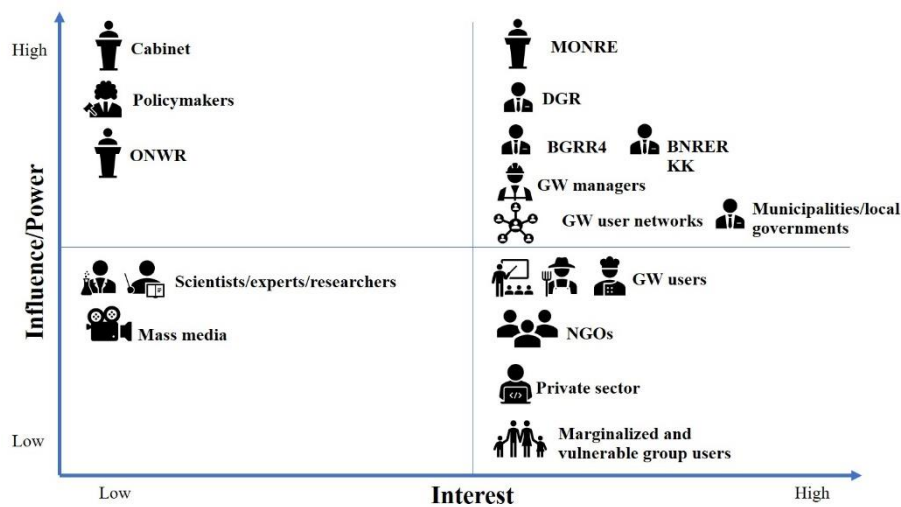


Fig. 1 Stakeholder Matrix

Fig. 1 represents the stakeholder matrix to understand the influence or power, and interest among groups of groundwater stakeholders. The stakeholder identification is classified to the main categories;

4.1.1 High influence and high-interest stakeholders

Groundwater policies, plans and regulations were taken by the sub-institutions that control and manage groundwater resources (i.e., Ministry of Natural Resources and Environment (MONRE), Department of Groundwater Resources (DGR), Bureau of Groundwater Resources Regional 4 (BGRR4) and Bureau of Natural Resources and Environment Regional (BNRER). The actions have been affecting many sub-groups of groundwater stakeholders in both direct and indirect ways according to the hierarchy of authorities. Registered (agricultural, business and domestic users) and non-registered (marginalized and vulnerable users) groundwater users may also be affected by the actions in terms of positive and negative impacts (i.e. poor people cannot access good quality of groundwater since lack of water supply by PWA in the slum community) (Mark, 2019). Moreover, groundwater resources and the environment are also affected by users in terms of groundwater depletion and land subsidence which are the dominant effects of groundwater issues in Thailand (Ngoc et al., 2015).

The MONRE transferred the mandate of groundwater resources management to the DGR. Therefore, DGR has much power to take control and manage groundwater resources directly. Meanwhile, BGRR4 is a bureau of groundwater resources regional 4 (Khon Kaen) which is a department that governs the groundwater resources at the local level. The provinces which BGRR4 cover are Khon Kaen, Kalasin, Maha Sarakam, Leoi and Nong Bua Lam Pu. Khon Kaen is a pilot province that local government authorities and municipalities can implement in some missions to manage and control groundwater at the local level. Thus, local government authorities and municipalities 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 in a case of well's size is smaller than 100 mm. or the quantity of use is less than 10 m³/day.) (DGR, 2020).

In addition, groundwater managers are the actors who help to solve groundwater in the hydrological aspect. They took some findings or consulted with scientists to manage groundwater in terms of technical aspects. Coelho et al. (2019) indicated that 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. Initially, DGR has started to create networks of groundwater users in 2020. The activity aims to create knowledge and experience about groundwater resources among groundwater users, especially agricultural users (DGR, 2020). In 2021, there are several laws related to water resources announced by ONWR. The recent law is the Water User Associations. The law aims to strengthen the participation among water users to cooperate with water resources in each river basin. WUA can suggest, inform and give opinions that relate to water resources management in the water basin to water basin committees. The law may support the specific groundwater user's associations. Meanwhile, groundwater user networks have also been empowered to comanage groundwater resources at the local level. Moreover, DGR prepared the activities to enhance the awareness of users in terms of groundwater knowledge and development among various sectors through the strengthening of understanding the laws and regulations related to groundwater resources. The activities can empower the community to overcome the challenges at the local level.

4.1.2 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) has 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). The government has established the main organization that controls water management policy which conforms to the sixth strategy of the national water resources management strategies. The vision of the organization is "To be the main organization that systematically regulates and manages the policies of integrated national water resources management (ONWR, 2021).

4.1.3 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. Donors or financial supporters 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).

4.1.4 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 researches 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 BBRG4 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 the various roles in the groundwater governance in Khon Kaen.

4.2 Stakeholder capacity to address the groundwater challenges toward SDG6

Most stakeholders are private companies (23.1%), municipalities (15.4%), domestic household users (12.8%) and communities (12.8%). The average age of stakeholders is 28 years old, female (76.7%), and the highest level of education is bachelor degree (55.8%). Furthermore, the level of capacity to address the groundwater challenges toward SDG6, the average score of the capacity to address SDG6 and compare the average score of capacity among stakeholder groups are described;

4.2.1 Percentage of stakeholders responded to the capacity to address the groundwater challenges toward SDG6

Overall, Fig.2 shows that the stakeholders assess “probably yes” (score = 4) to all groundwater challenges to contribute to the SDG6 targets: 48.60% of respondents selected the challenge of conflicts among groundwater stakeholders toward SDG 6.B community participation. Furthermore, 27% of them assess “Definitely yes” (score = 5) to the challenge of groundwater depletion while 5.40% of stakeholders selected “Definitely not” (score = 1) are groundwater pollution, groundwater depletion, groundwater policies and marginalized and vulnerable groups inclusive.

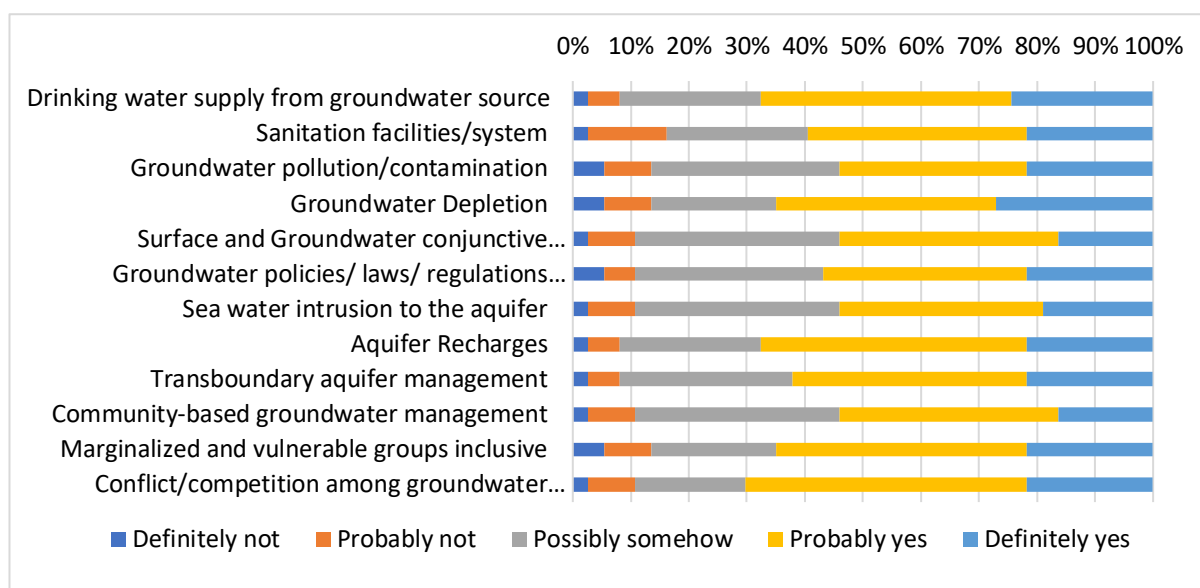


Fig. 2 Percentage of stakeholders responded to the capacity to address the groundwater challenges toward SDG6

4.2.2 The level of stakeholders' capacity to address groundwater challenges toward SDG6

Fig. 3 illustrates that the multi-stakeholders can address the challenge of conflicts among groundwater stakeholders toward SDG 6.B community participation (mean score = 3.82). Furthermore, the stakeholders can address the challenge of drinking water supply from groundwater sources toward SDG 6.1 – water access for all (mean score = 3.79). Groundwater pollution or contamination, Surface and Groundwater conjunctive management, Groundwater policies, laws, regulations improvement and Community-based groundwater management (mean score = 3.56).

4.2.3 Comparison of mean score of stakeholders' capacities

Table 1 shows there is a significant difference of score mean of stakeholder capacity between groups; Aquifer Recharges ($F=2.50$, p -value = 0.025) and Seawater intrusion to the aquifer ($F=2.29$, p -value = 0.037). The groundwater challenges related to SDG6 target 6.6 – aquifer protection.

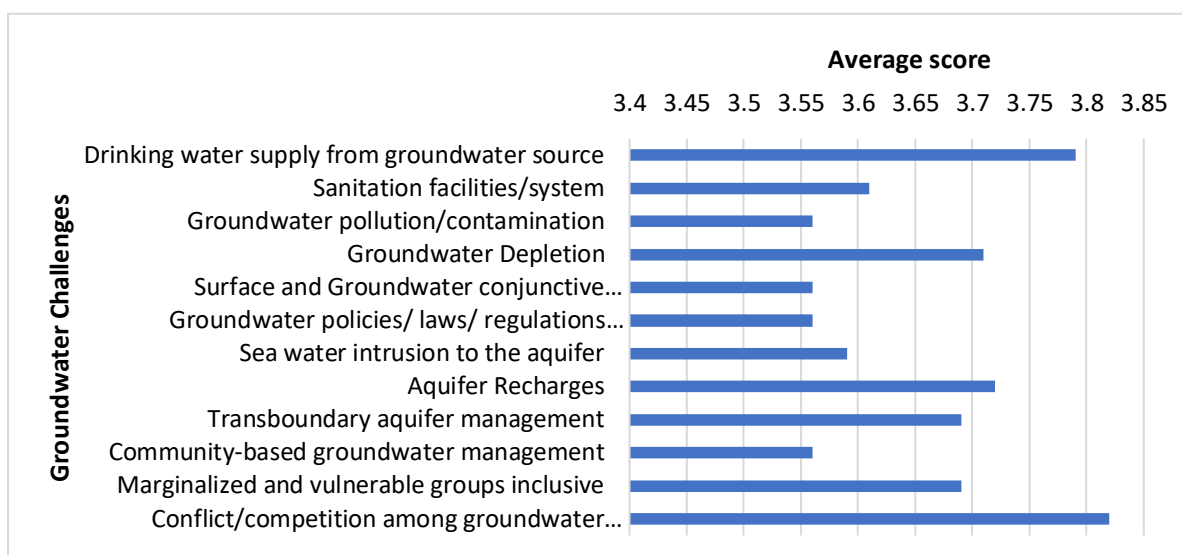


Fig. 3 The level of stakeholders' capacity to address groundwater challenges toward SDG6

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

5. Discussion and conclusion

Stakeholder 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 up 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.

The findings show overall stakeholders assess their capacity in the score level (4) represented to 'possibly'. Multi-stakeholders accepted and preferred to address the groundwater challenges in the community. In addition, 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.

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.

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.

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