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KEY TO WATER SECURITY AND SUSTAINABILITY
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Groundwater access in local communities in the Lower Mekong Region: A case of Khon Kaen, Thailand

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Introduction

- **Groundwater** is widely withdrawn for **socio-economic development** (Ferchichi et al., 2020; Muenratch et al., 2021, 2022a; UNESCO, 2022).
- Regionally, groundwater has been currently used to **support human activities and the environment in the Lower Mekong Region (LMR)** (Dam et al., 2016; Muenratch et al., 2022a; Ngoc et al., 2015).
- Several communities in this region have been affected by **water shortages**, particularly in the dry season (Ngoc et al., 2015).
- Thus, groundwater is a major water source **to mitigate drought risks** in the communities (Cooperman et al., 2022; Langridge & Van Schmidt, 2020; Mussá et al., 2015).

Fig.1 GW use in the agricultural sector in Khon Kaen

Fig.2 Drinking water production in Khon Kaen

Introduction

- However, **inequity in groundwater access** is a key issue in this region (Hofmann, 2022; Lebel et al., 2022; Ngoc et al., 2015).
- **The competition of groundwater use** is still a challenge for groundwater management in LMR (Muenratch et al., 2022a; Ngoc et al., 2015).
- **Some groups of users are not inclusive** of the use of invisible resources (i.e. marginalized and vulnerable groups) (Ezbakhe et al., 2019; Lebel et al., 2022).
- Hence, it is necessary **to understand appropriate measures to facilitate groundwater access to ensure equitable groundwater use** including marginalized and vulnerable groups (Conti et al., 2016; Hoffman, 2022; Kooy et al., 2018).

Fig.3 GW Public supply

The objectives of the study

To examine the association between measures facilitating to access groundwater and the roles of groundwater organizations in Khon Kaen.

Methods

- The questionnaires were distributed to 338 groundwater users in Khon Kaen.
- The GW users are from Agriculture, Business and Domestic households.
- Descriptive statistics were used to explain general information about GW users in the communities.
- The Chi-square test was used to examine the association between GW measures and GW organizations including access to GW supply.

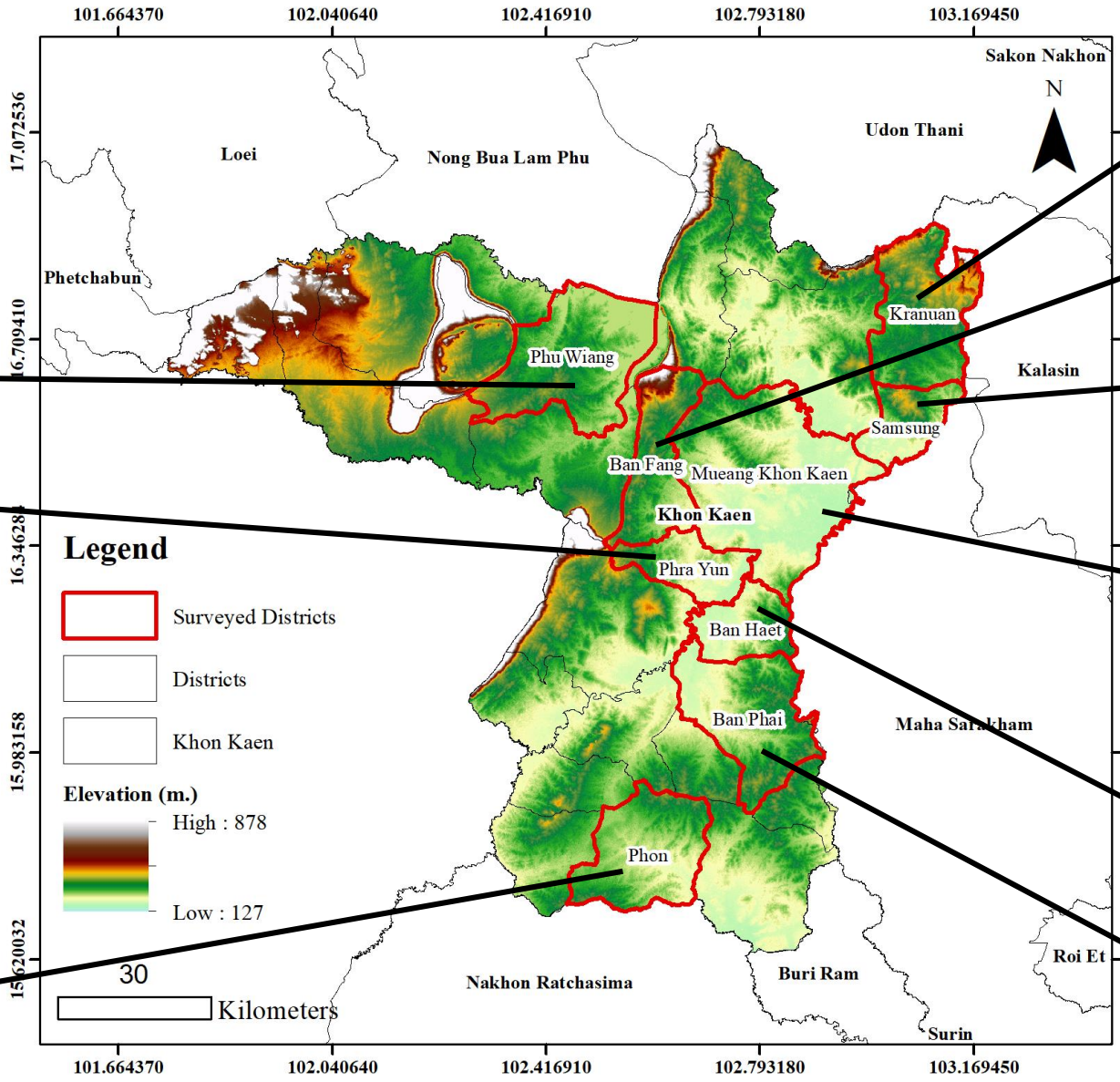
Fig.4 Field Survey in Khon Kaen

Study area

- Population Growth
- Economic Development
- Rapid Urbanization
- Drought-prone area
- High abstraction of GW
- Water use competition

Sampling Size

Types of sector	Pop size	Sample size
1) Agriculture	666	110
2) Business	883	126
3) Domestic use	485	102
Total	N = 2,034	n = 338



1 — 25.1% from Phon

2 — 24.3% from Mueang Khon Kaen

3 — 18% from Ban Fang

4 — 14.5% from Phu Wiang

5 — 10.7% from Ban Haet

6 — 3.8% from Sam Sung

7 — 2.7% from Kranuan

8 — 0.6% from Phra Yun

9 — 0.3% from Ban Phai

Fig. 5 GW users are randomly selected from 9 districts in Khon Kaen, Thailand

Results (i) Descriptive statistics: *General Information*

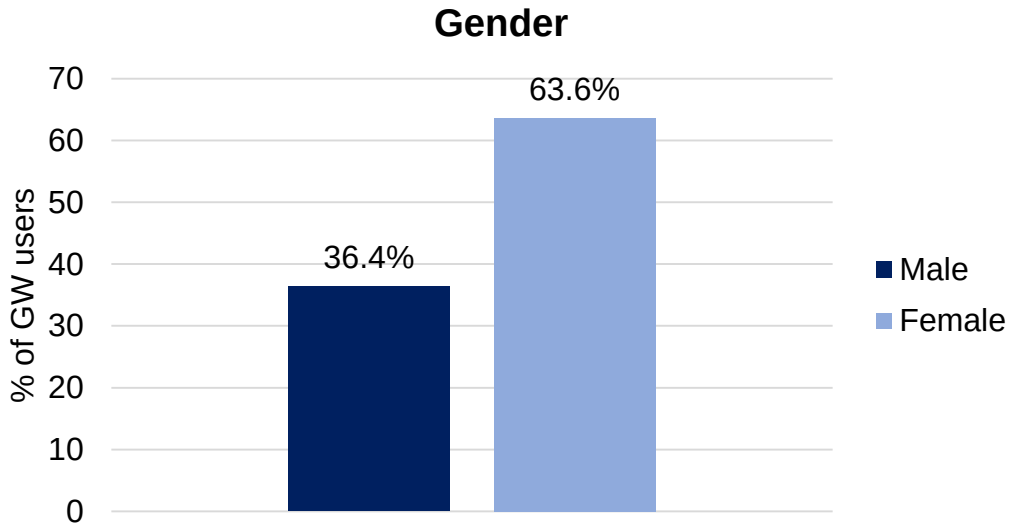


Fig.6 Gender of GW users

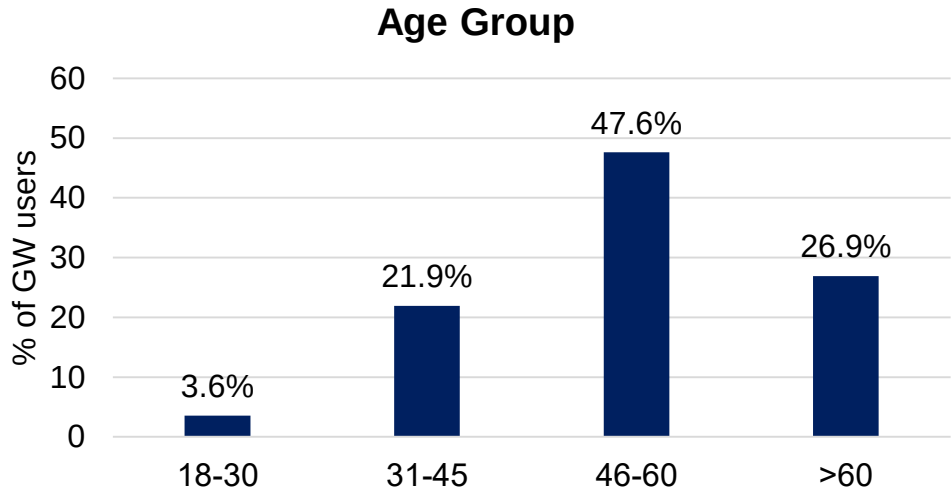


Fig.7 Age groups of GW users

*Average Age = 53 years old

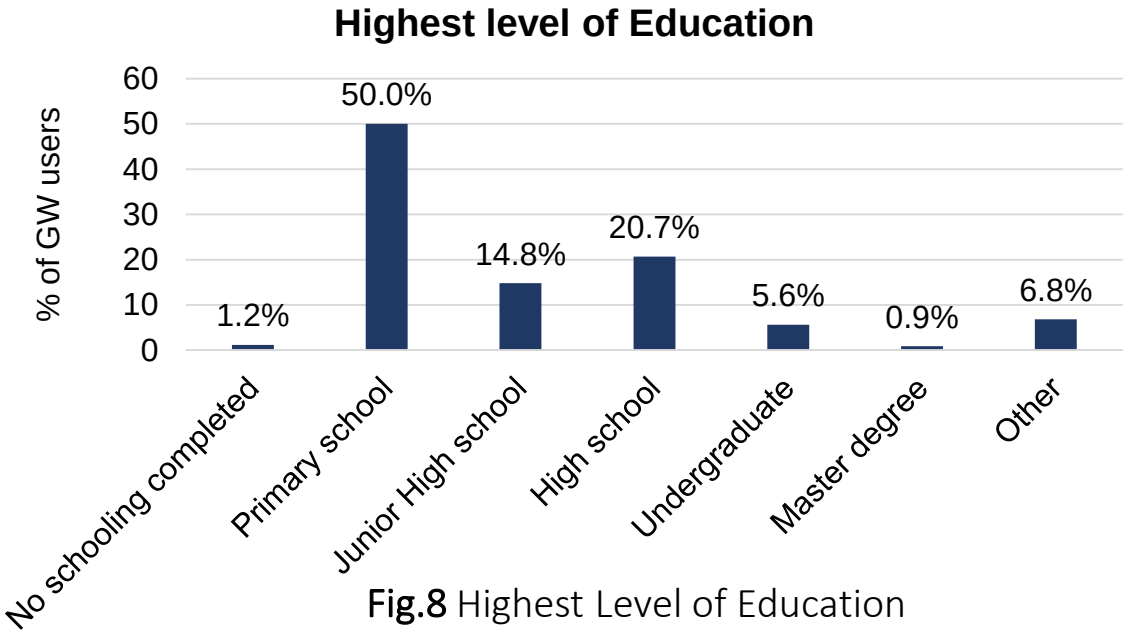


Fig.8 Highest Level of Education

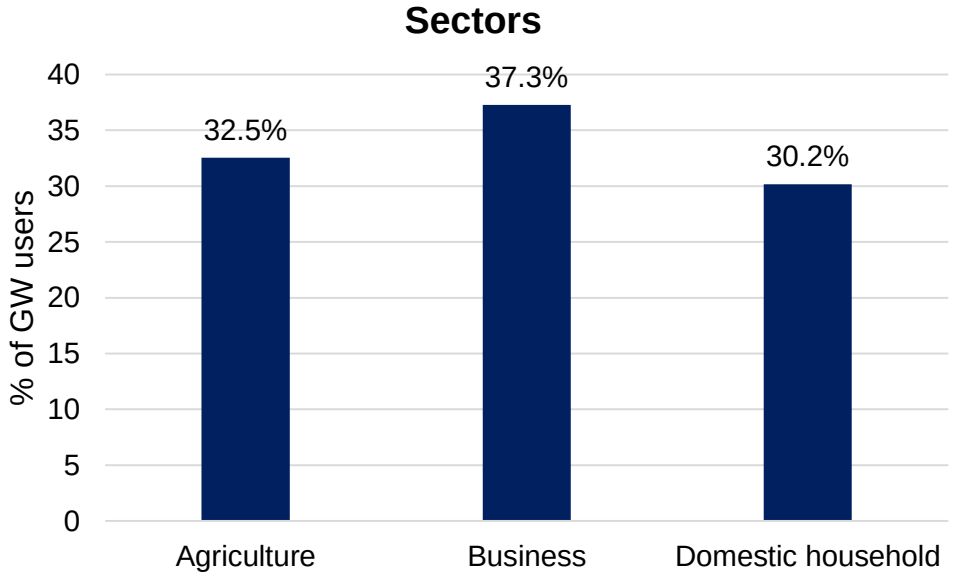


Fig.9 Sectors

Results (i) Descriptive statistics: *Access to Water*

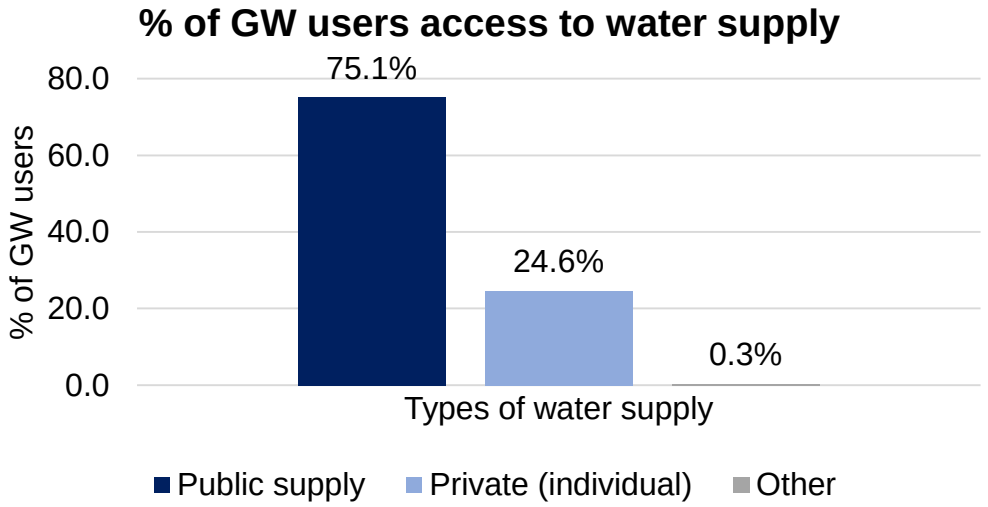


Fig.10 Access to GW supply

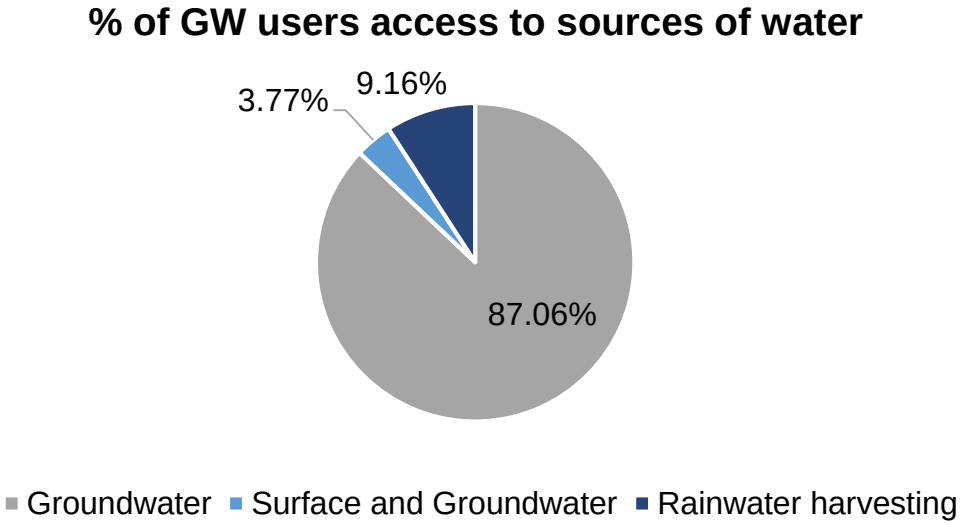
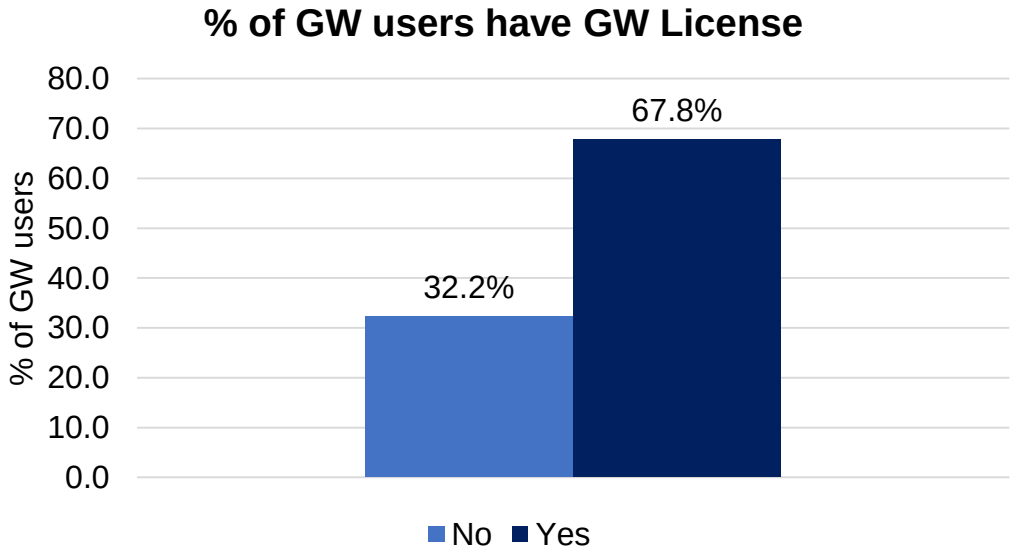


Fig.11 Access to GW supply



*N=338

Fig.12 GW License

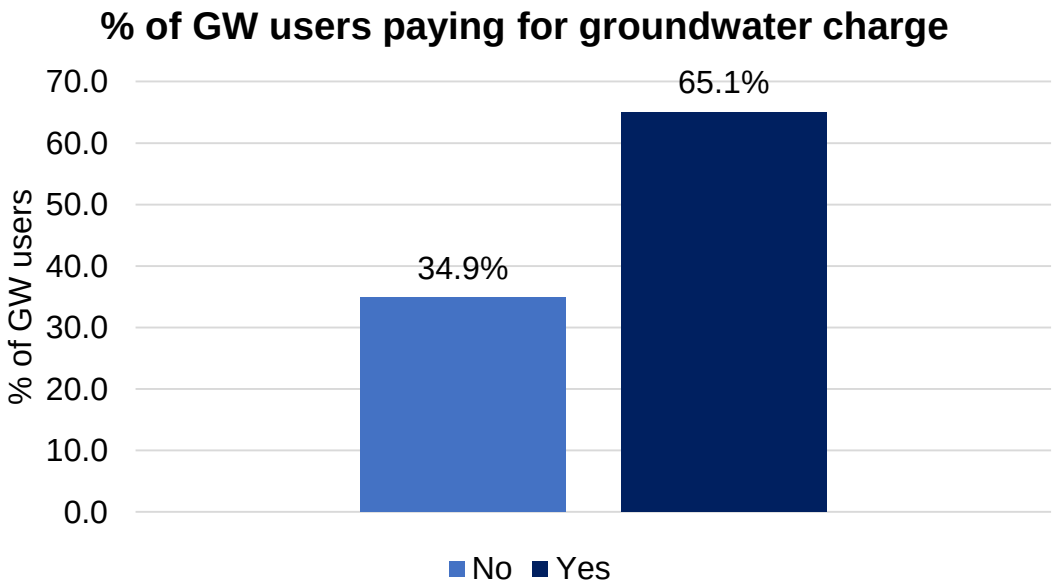


Fig.13 GW charge

Results (i) Descriptive statistics: *Additional payments*

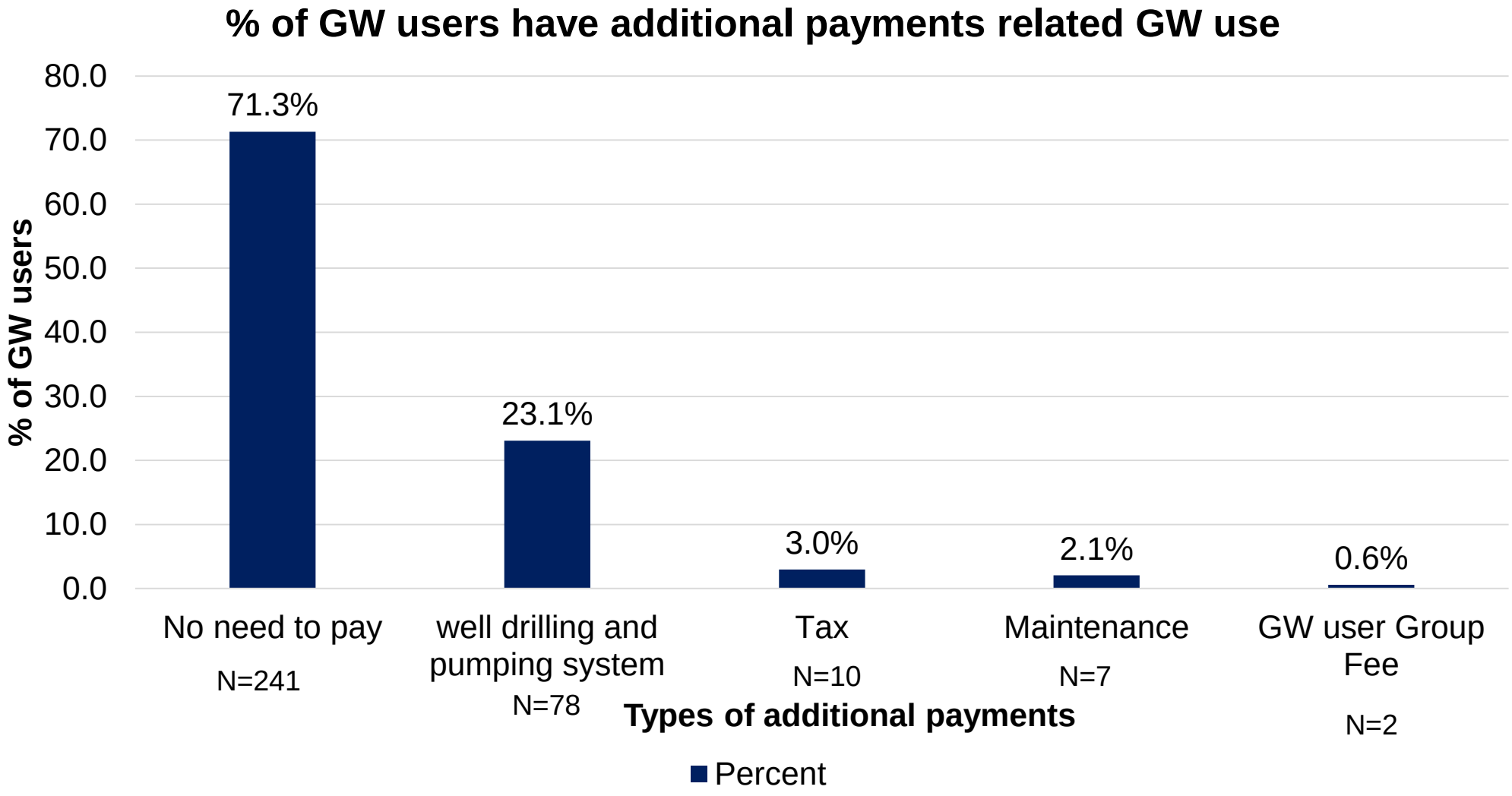


Fig.14 Additional payments related to GW use

*Average additional payments (N=85) = THB 30,902.95 or $ 856.21

Results (i) Descriptive statistics: *GW use among sectors*

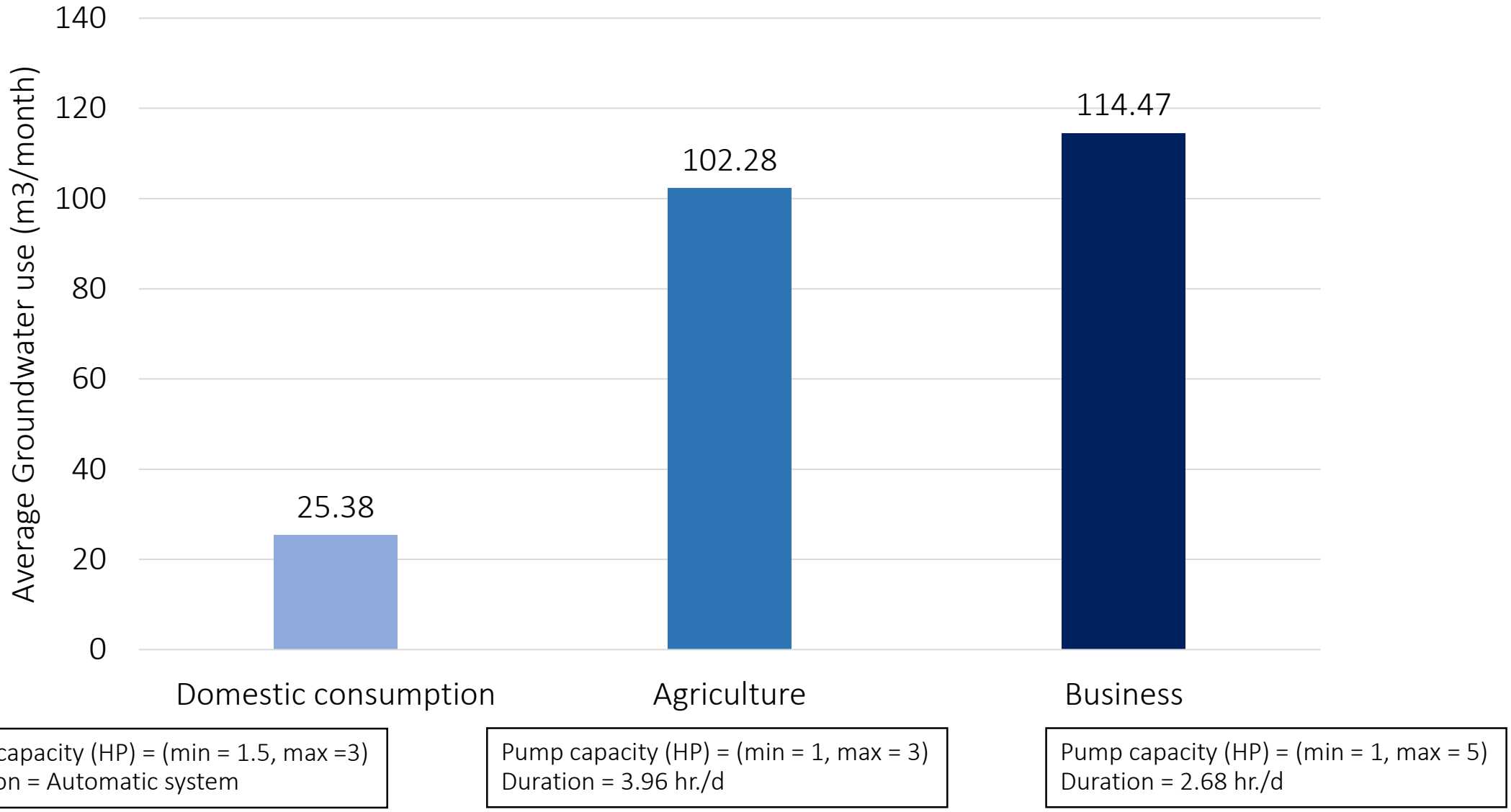


Fig.15 Average GW use among Sectors in Khon Kaen

*N=338

Results (i) Descriptive statistics:

Perception of GW users to GW organizations

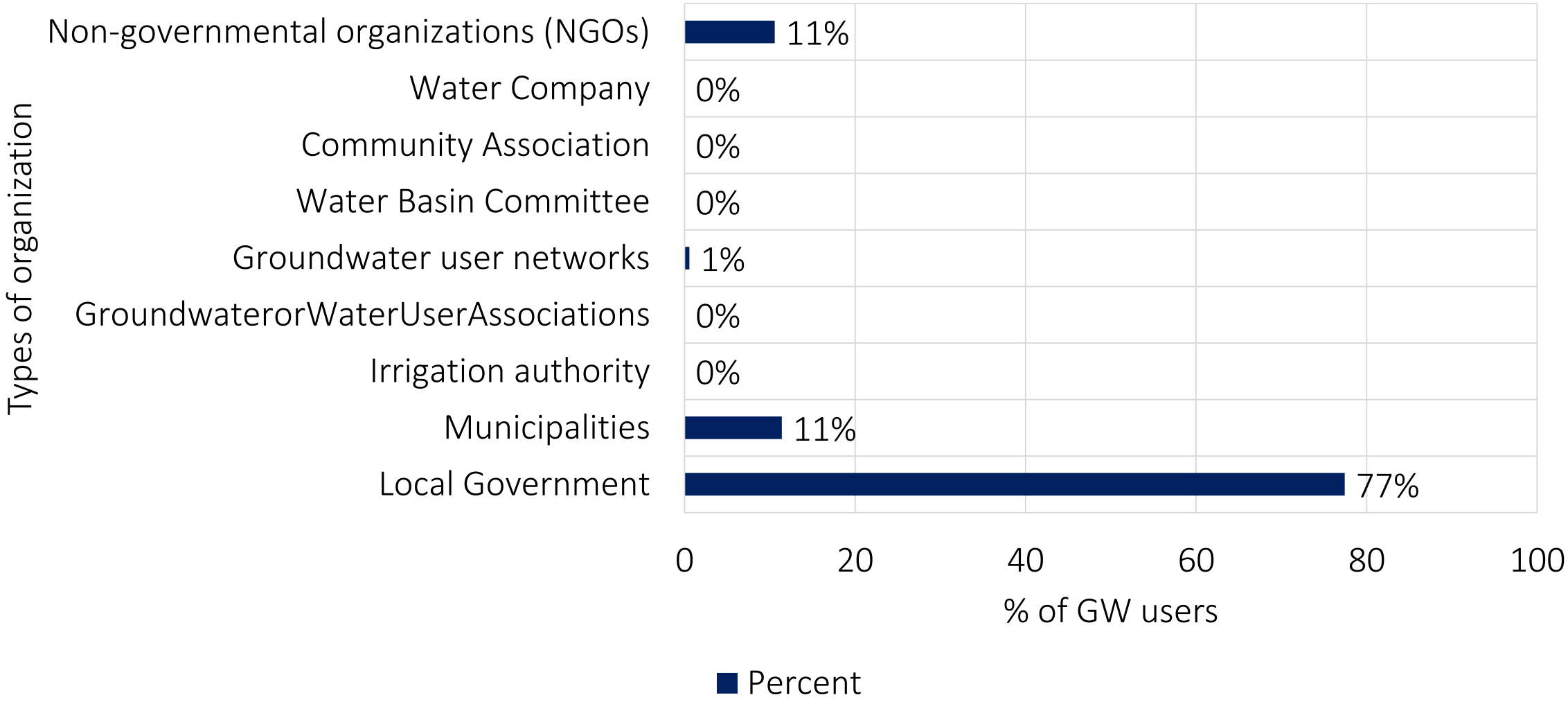


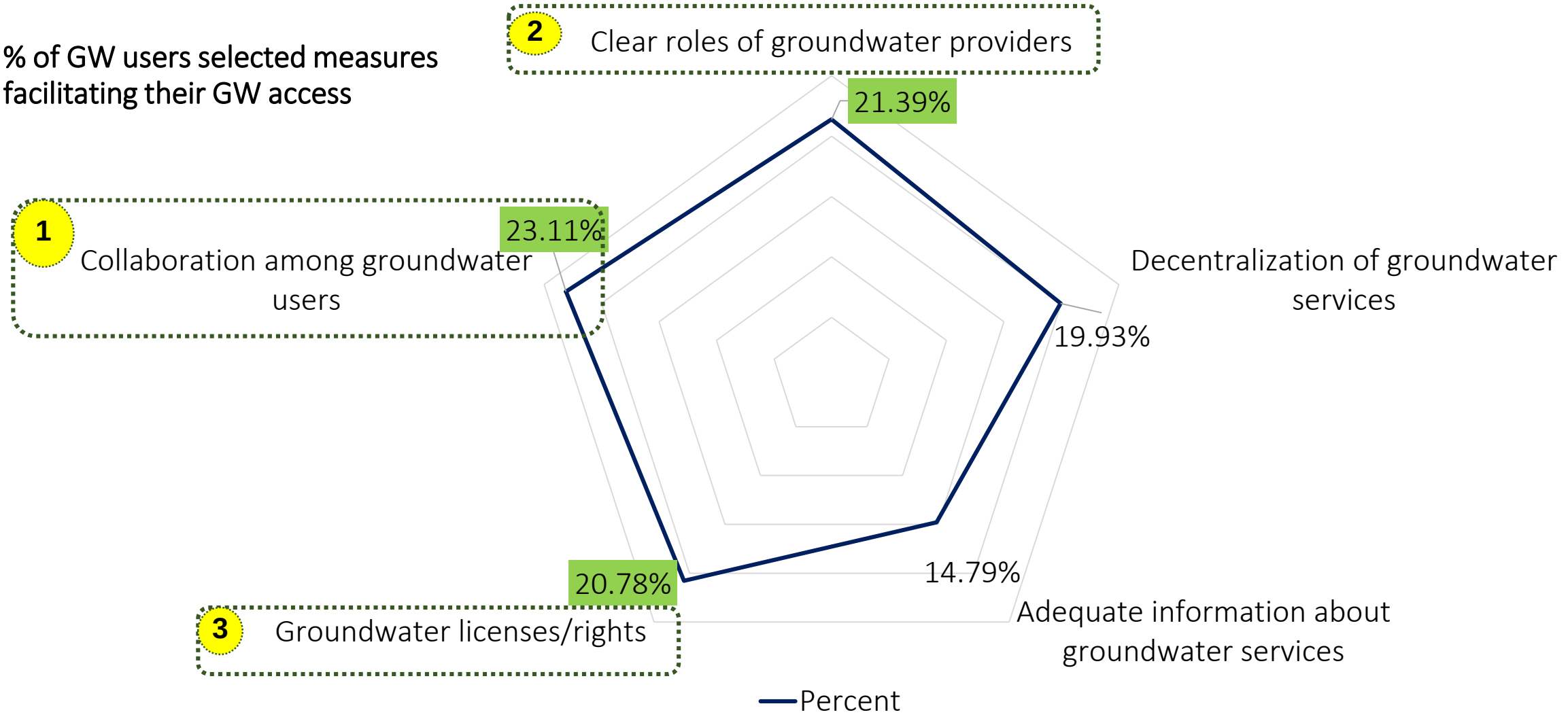
Fig.16 Perception of GW users to GW organizations

*N=338

Results (i) Descriptive statistics:

Measures facilitated groundwater access

% of GW users selected measures facilitating their GW access



*N=338

Fig.17 Measures facilitated groundwater access

Results (ii) Chi-square test: *Frequency Table*

Table 1 Frequency of variables

GW Measures		GW organizations						Access to GW	
		Local Government		Municipalities		Non-governmental organizations (NGOs)		Public supply	
		No	Yes	No	Yes	No	Yes	No	Yes
Clear roles of groundwater providers	No	33	129	151	11	150	12	50	112
	Yes	27	148	145	30	149	26	34	141
Decentralization of groundwater services	No	31	144	161	14	165	10	59	116
	Yes	29	134	136	27	135	28	25	138
Adequate information about groundwater services	No	40	177	196	21	192	25	47	170
	Yes	20	101	101	20	108	13	37	84
Groundwater licenses/rights	No	30	138	157	11	162	6	54	114
	Yes	30	140	140	30	138	32	30	140
Collaboration among groundwater users	No	24	125	138	11	135	14	66	83
	Yes	36	153	159	30	165	24	18	171

*N=338

Results

(ii) Chi-square test

Table 2 Chi-square results

		GW organizations			Access to GW
GW Measures		Local Government	Municipalities	Non-governmental organizations (NGOs)	Public supply
Clear roles of groundwater providers	Chi-square	1.404	8.438	4.667	5.879
	df	1	1	1	1
	P-value	0.236	.004*	.031*	.015*
Decentralization of groundwater services	Chi-square	0.000	5.808	11.114	15.261
	df	1	1	1	1
	P-value	0.985	.016*	.001*	.000*
Adequate information about groundwater services	Chi-square	0.193	3.421	0.047	3.309
	df	1	1	1	1
	P-value	0.660	0.064	0.828	0.069
Groundwater licenses/rights	Chi-square	0.003	9.766	19.698	9.507
	df	1	1	1	1
	P-value	0.960	.002*	.000*	.002*
Collaboration among groundwater users	Chi-square	0.493	5.635	0.911	53.938
	df	1	1	1	1
	P-value	0.482	.018*	0.340	.000*

*N=338

Summary of the findings

- Most of the respondents are female (63.6%), 46-60 years old (47.6%), and the highest level of education is a primary school (50%).
- Groundwater is the main source of water (87.06%) while most people have access to public supply in communities (75.1%).
- The findings reveal that
  I. **Clear roles of groundwater providers** are associated with municipalities (X^2 = 8.44, df=1, p = 0.004) and NGOs (X^2 = 4.67, df=1, p = 0.03). / Access to Public supply (X^2 = 5.88, df=1, p = 0.015).
  II. **Decentralization of groundwater services** are associated with municipalities (X^2 = 5.808, df=1, p = 0.0016) and NGOs (X^2 = 11.114, df=1, p = 0.001). / Access to Public supply (X^2 = 15.26, df=1, p < 0.001).
  III. **Groundwater licenses/rights** are associated with municipalities (X^2 = 9.76, df=1, p = 0.002) and NGOs (X^2 = 19.698, df=1, p < 0.001). / Access to Public supply (X^2 = 9.507, df=1, p = 0.002).
  IV. **Collaboration among groundwater users** are associated with municipalities (X^2 = 5.635, df=1, p = 0.018). / Access to Public supply (X^2 = 53.94, df=1, p < 0.001).

Discussion and Conclusion

- The findings reflect that **municipalities and NGOs are associated with proposed groundwater measures in Khon Kaen.**
  - Similarly, Hofmann (2022) found that municipal teams and NGOs have also been involved in establishing standalone water supply schemes to provide a sustainable and affordable service in Tanzania.

- The findings suggest that **cross-sectoral collaboration** is essential to facilitate GW access and sustainable use.

- Additionally, GW users suggested that **collaboration among groundwater users** should be prioritized to facilitate access to groundwater in their communities.

- **GW Users or Stakeholders Collaboration** is the key way to reduce serious GW issues at the local scale (Megdal et al., 2017). However, building collaboration requires extensive dialogue, significant time and commitment of all participants (Conrad et al., 2018).

Discussion and Conclusion

- **Clear roles of groundwater providers and Groundwater licenses/rights** are important to consider to be GW measures to access GW in the communities (Molle & Closas, 2020; Muenratch et al., 2022a; Nussbaumer et al., 2016).

- **Challenges** - Although there have been currently calling for more inclusive governance and a role for groundwater users, GW governance has still relied on fragmented policy tools and state-run strategies > State-centered groundwater governance is largely ineffective (Molle & Closas, 2019).

- **Thus, collaborative strategies among key actors** are necessary to strengthen groundwater governance (Molle & Closas, 2019; Muenratch et al., 2022a,b).

- Understanding **community perception** is the primary step toward improving Groundwater governance (Cooperman et al., 2022). Thus, the findings will be useful for policymakers, policy practitioners and groundwater users to collaborate in groundwater management at the community level (Conrad et al., 2018; Megdal et al., 2017; Molle & Closas, 2019).

Discussion and Conclusion

- Policymakers can apply the findings in the policy-making process **to identify the appropriate policy practitioners**, **design local policies** and **consider types of groundwater supply** for allocating groundwater and support GW management at the community level (Cooperman et al., 2022).

- In the case of **Tanzania** – ***Lack of Public GW supply***
  - Hofmann (2022) argued that **the limited public water supply** has further enabled the informal private water vending business to flourish, with a significant increase in private boreholes over the last fifteen years.

- Further, these findings can contribute to the Sustainable Development Goals (SDG6) – water and sanitation, **to ensure equitable access to groundwater among groups of people** including marginalized and vulnerable groups (Conti et al., 2016; Hofmann, 2022; Kooy et al., 2018).

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Thank you for your attention.

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