The seasonal variation of As and Pb in groundwater in Ban Khai District, Rayong province, Thailand

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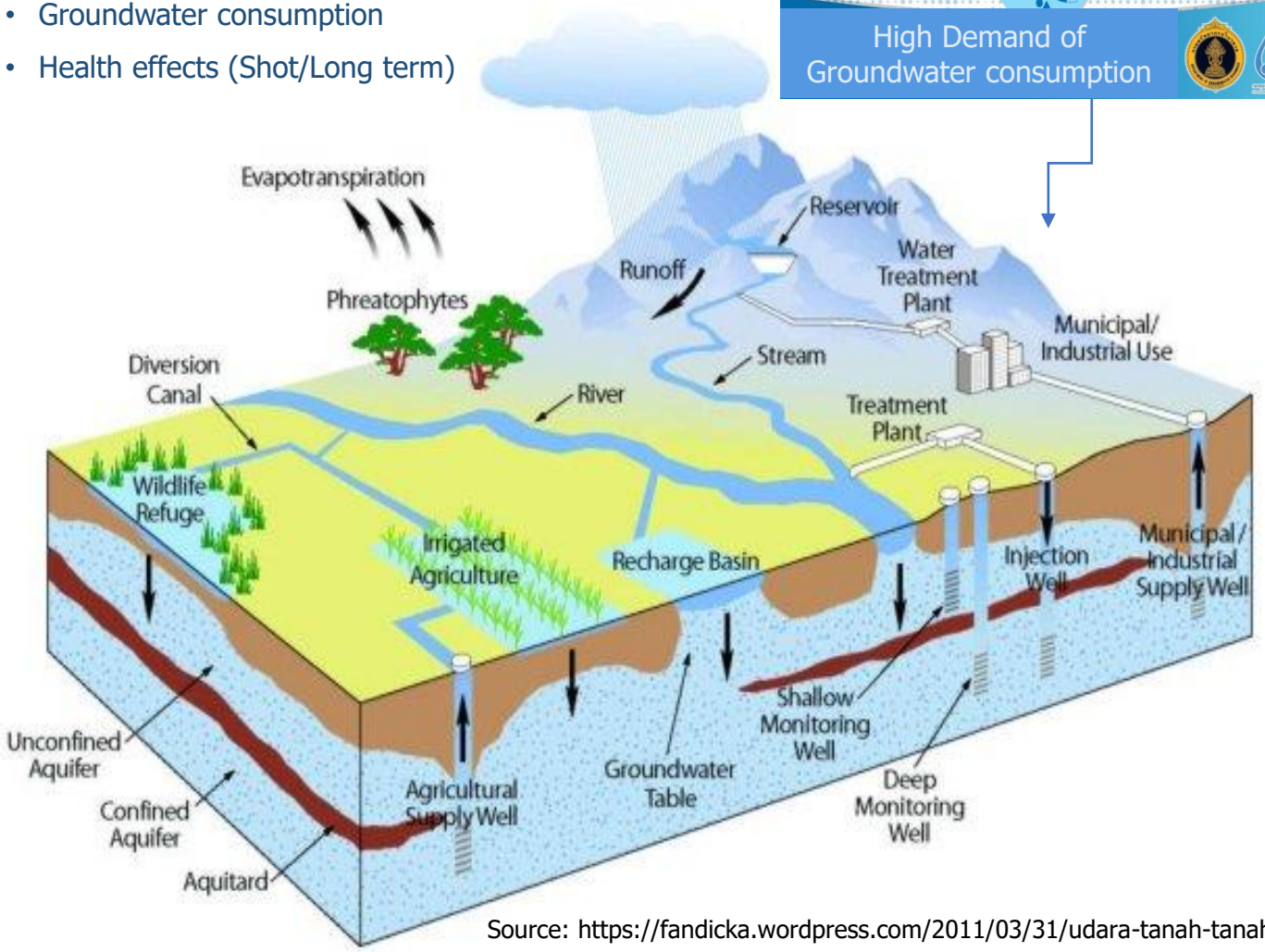
Miss Wiyada Nilkarnjanakul

Introduction

- Topography/ Land uses
- Hydro chemical changing and contamination
- Groundwater consumption
- Health effects (Shot/Long term)



Source: https://fandicka.wordpress.com/2011/03/31/udara-tanah-tanah/

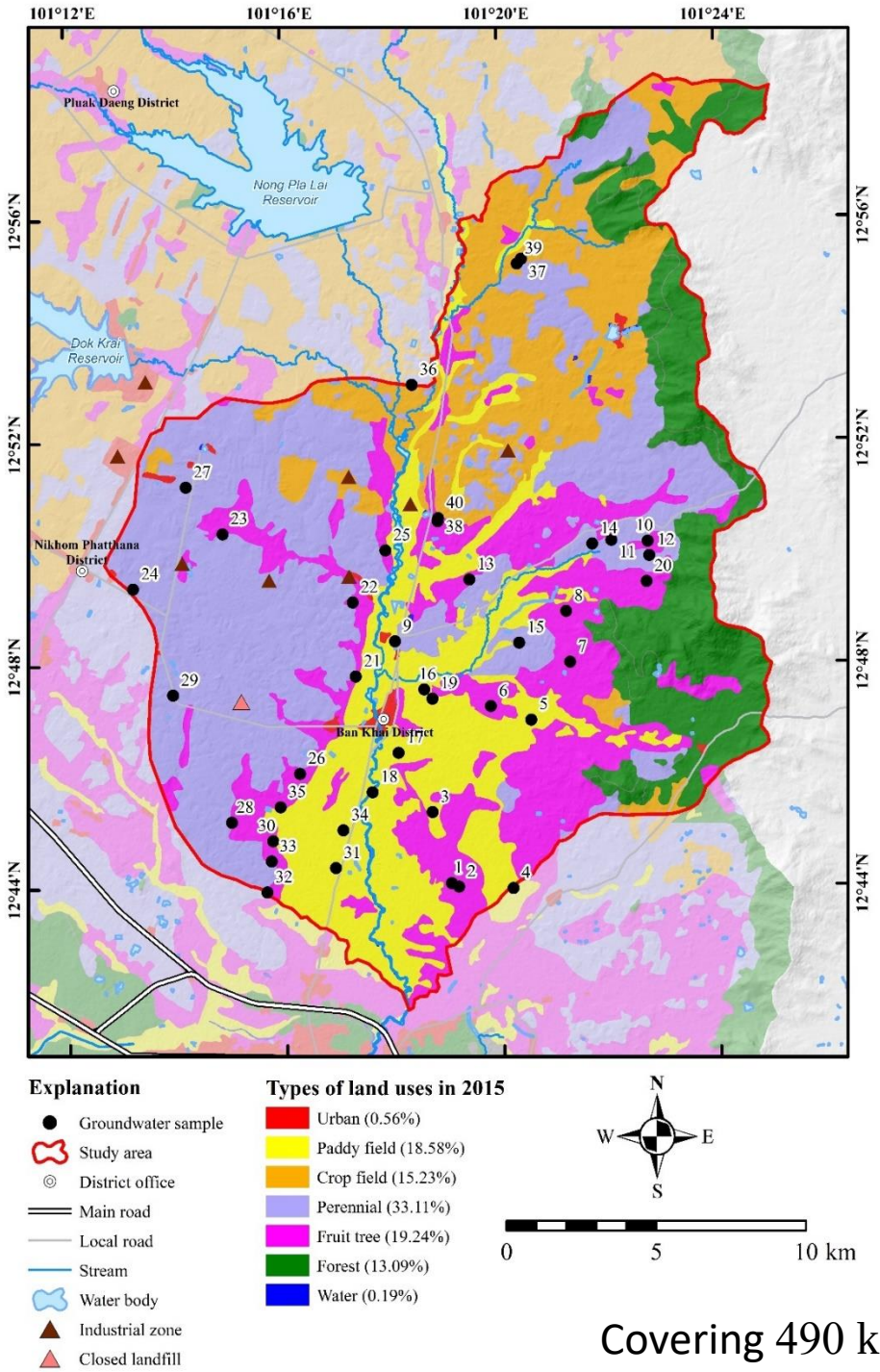
Study area

Research objectives

I) To determine the physicochemical properties such as pH, EC, DO, ORP in groundwater

II) To compare the concentrations of Pb and As speciation in groundwater and their spatial distribution between wet and dry season in Ban Khai district

Study area



Covering 490 km^2

The topography ranges in altitude from 10 to 136 meters above mean sea level

The deposits comprise sand, silt, clay and gravel, which originates from granite.

The geological formations include sedimentary rocks and Triassic granite such as biotite, tourmaline and granodiorite granite.

Source: Land Development Department, 2015

Methodology

Sample collection

40 groundwater samples/season
(March and August 2019)

Physical information

- Topography
- Land use
- Meteorology
- Depth of groundwater well

Chemical analysis

- Hydrochemical properties (pH, EC, DO, ORP)
- Pb concentration
- As speciation (Total As, As^{3+}, As^{5+})

Spatial distribution









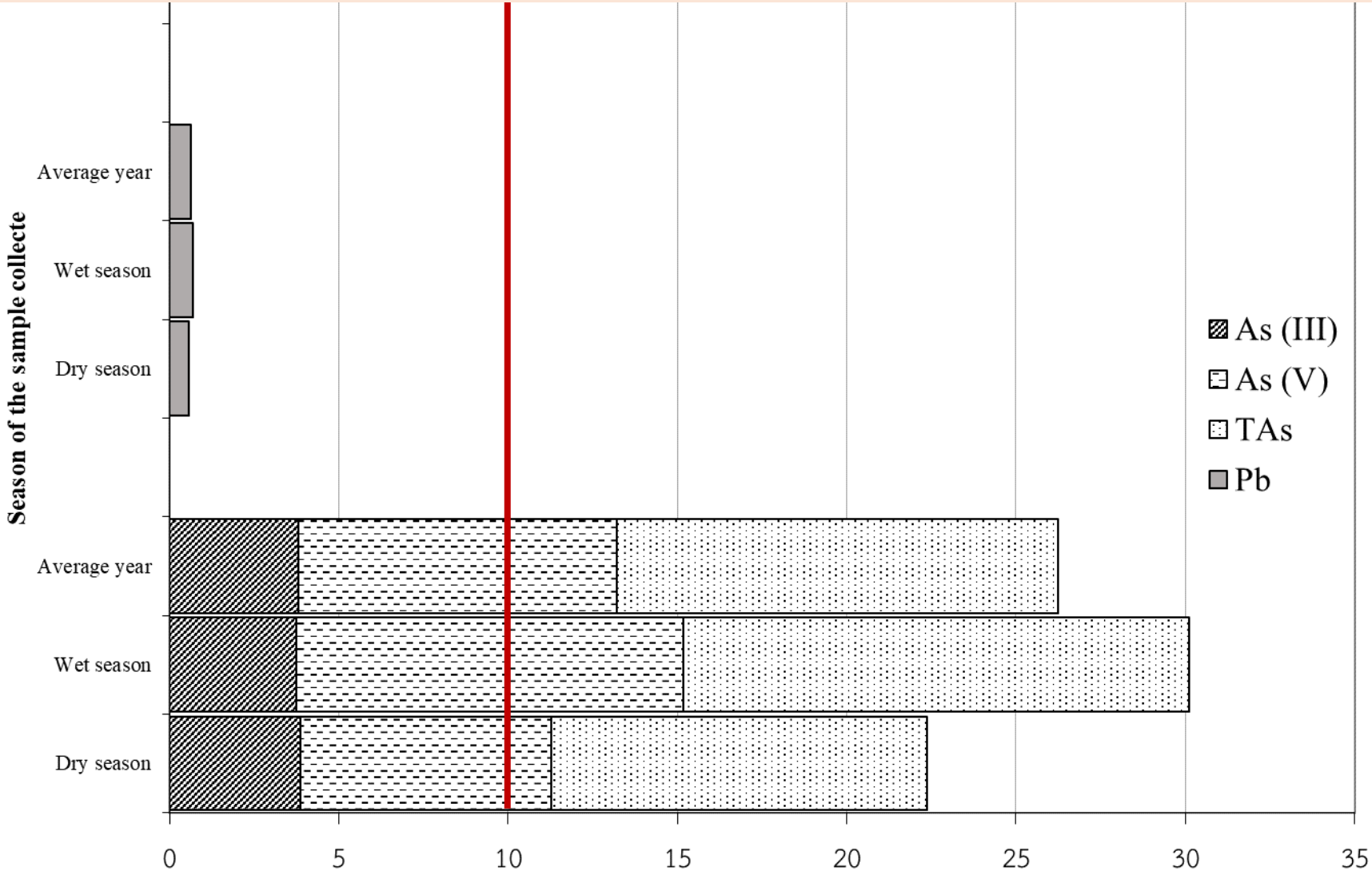

Result and discussion

- ❑ Groundwater properties
- ❑ Heavy metal concentrations and their spatial distributions

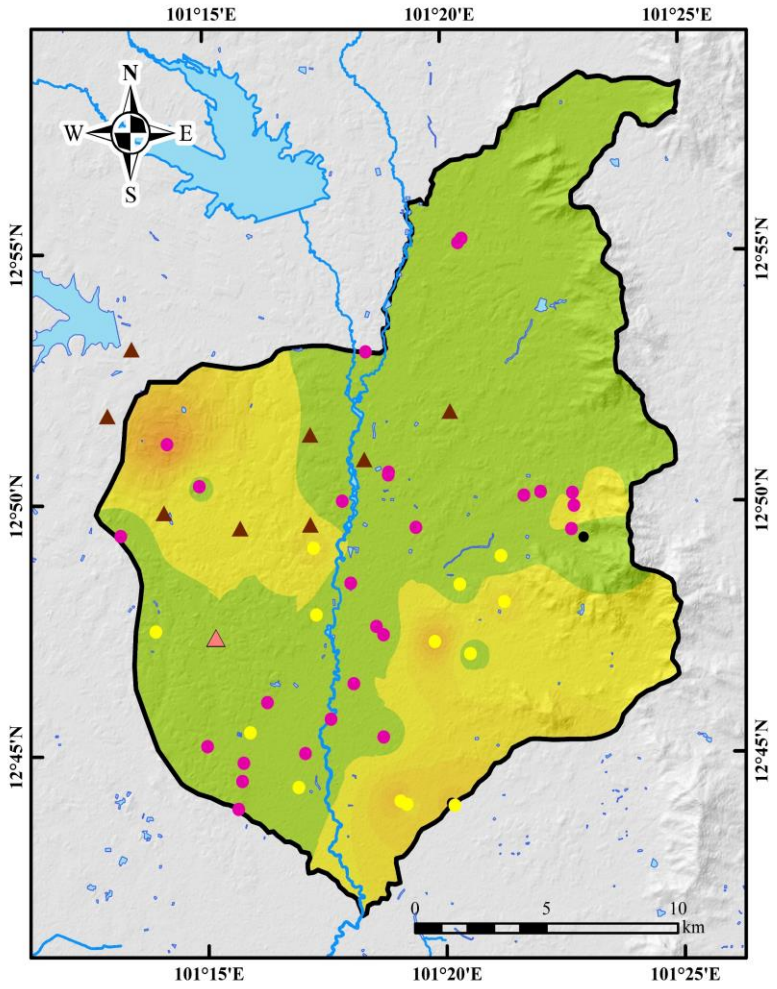
Physicochemical properties between the dry and wet seasons

		pH	DO	EC	ORP
	unit	-	mg/L	µS/cm	mV
Dry season	Median	6.69	6.08	218.00	231.70
	Min	5.25	2.28	21.5	-140.1
	Max	8.82	7.82	553	383.9
Wet season	Median	7.09	5.95	248.00	216.55
	Min	5.37	1.52	1.97	-128.70
	Max	8.55	7.84	576.0	347.20
Average season	Median	6.85	6.02	245.00	222.80
	Min	5.25	1.52	1.97	-140.1
	Max	8.82	7.84	576.0	383.9
WHO guideline		6.5-8.5	-	-	-

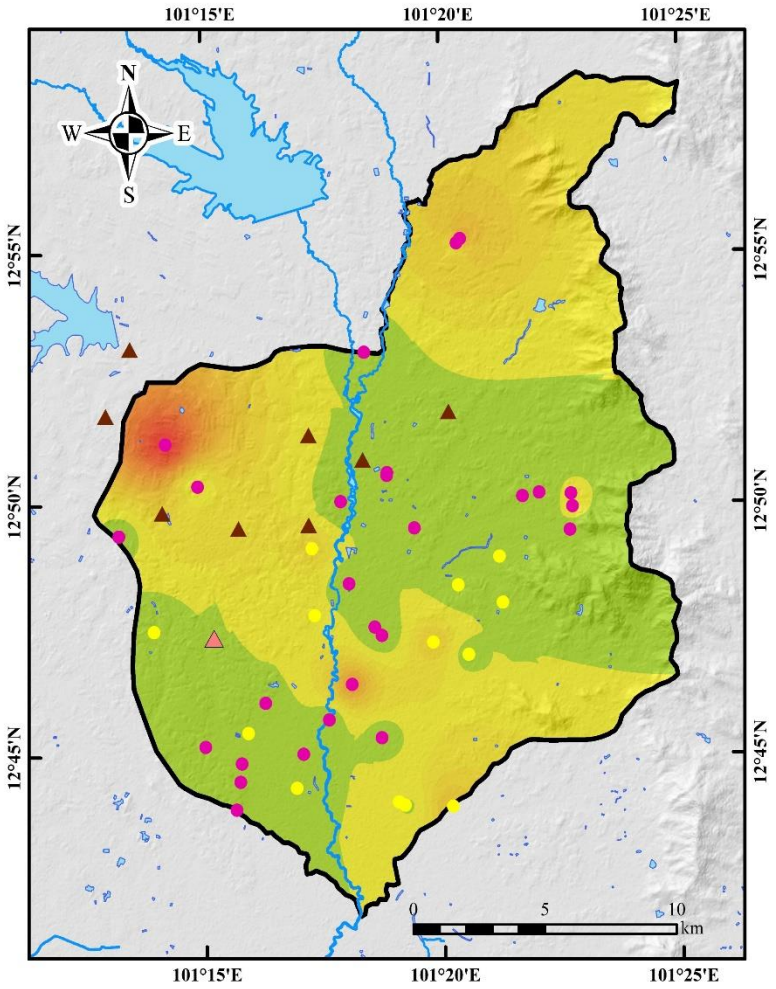
As and Pb concentrations in groundwater wells in the dry and wet seasons (unit: µg/L)



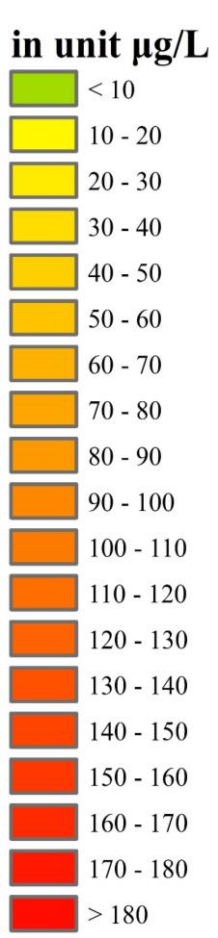
Spatial distribution of As concentration

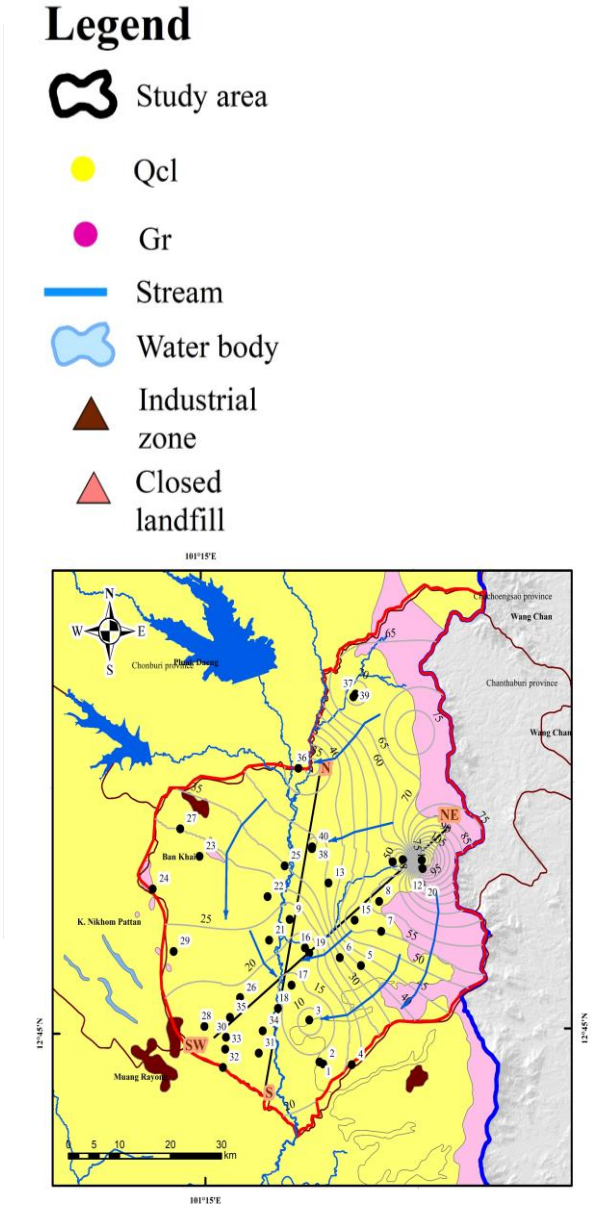


Dry season

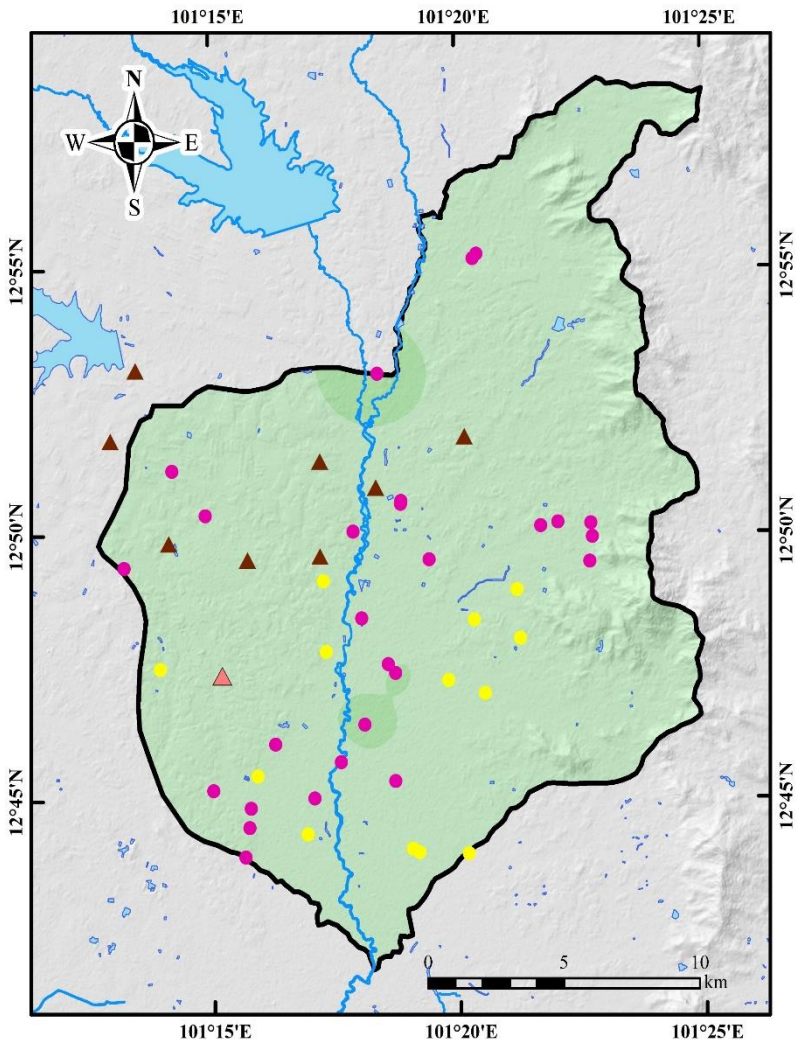


Wet season

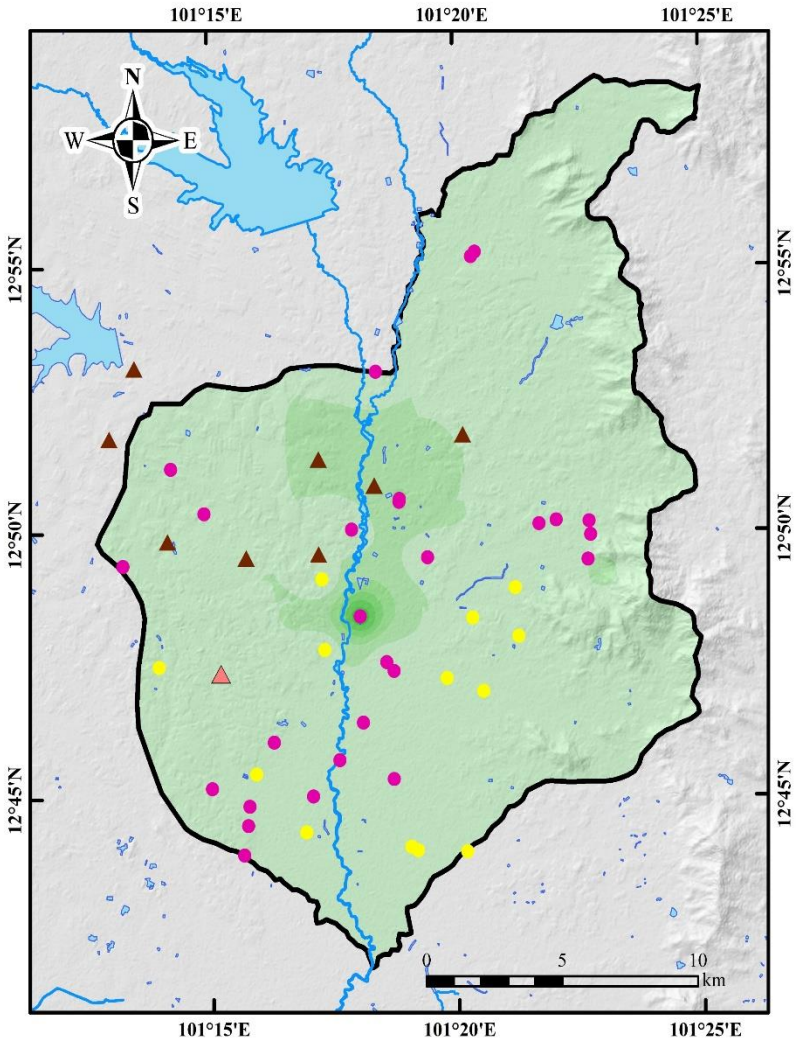




Spatial distribution of Pb concentration



Dry season



Wet season

Conclusion and Recommendation

>>Accounting for 22% of 80 samples were exceeded the WHO guidelines of 10 μg/L while Pb concentration in all the wells were below.

>>High As and Pb concentrations mainly found in wet season.

>>The As and Pb distribution map were not present differences between the two seasons.

Providing an additional alternative water supply or an effective treatment method in order to reduce the health risk from long-term groundwater consumption is an important for these residents in the area.

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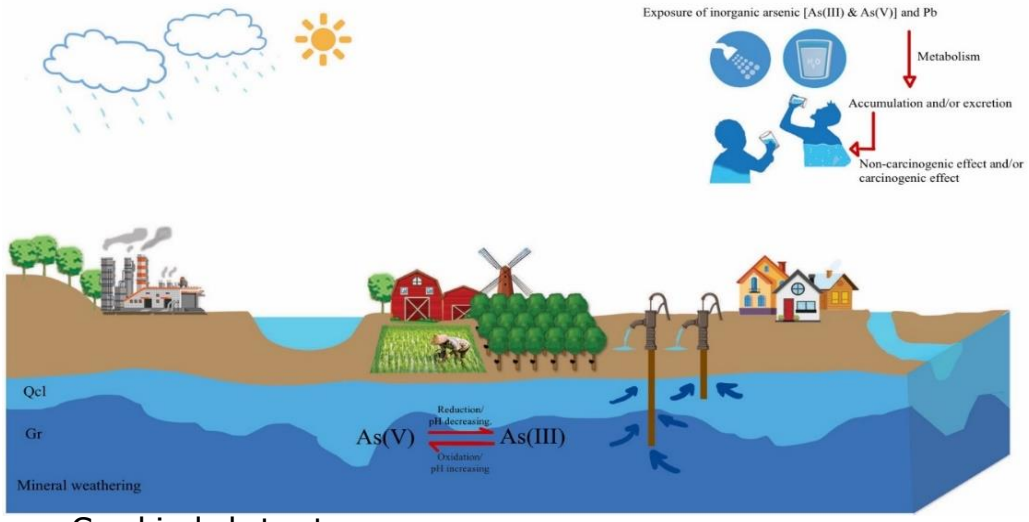

Graphical abstract

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Spatial distribution and health risk assessment of As and Pb contamination in the groundwater of Rayong Province, Thailand

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ABSTRACT

This study investigates the presence of arsenic (As) and lead (Pb) in groundwater and their spatial distribution in Ban Khai District, Rayong Province, Thailand. Forty groundwater samples were collected at different locations in the dry and wet seasons during March and August of 2019, respectively. The hydrochemical facies illustrate that the major groundwater types in both seasons mainly consisted of Ca–Na–HCO_3, Ca–HCO_3–Cl and Na–HCO_3 types. The concentration of As ranged from <0.300 to 183.00 μg/L, accounting for 22% (18 of 80 samples), exceeding the WHO guidelines of 10 μg/L. The spatial distribution of As was distinctly predominant as a hot spot in some areas during the wet season. The wells may have been contaminated from human activity and thus constituted a point source in the adjacent area. For Pb, its concentration in all the wells were not exceeded 10 μg/L of the WHO guidelines, appearing as a background concentration in this area. Most of the wells were shown to be in an oxidation state, supporting As^V mobility. Moreover, the area also had a nearly neutral pH that promoted As^V desorption, while the presence of undissolved Pb in the aquifers tended to increase. Furthermore, chemical applications to agricultural processes could release the As composition into the groundwater. The health risk resulting from oral consumption was at a higher risk level than dermal contact. The non-carcinogenic risk affecting the adult population exceeded the threshold level by approximately 27.5% of the wells, while for the children group, the risk level was within the limit. Total cancer risk (TCR) of adult residents exceeded the acceptable risk level (1×10^{-6}) in all wells, causing carcinogenic health effects. Therefore, health surveillance is important in monitoring the toxic effects on the local residents who use groundwater from these contaminated wells. Furthermore, a sanitation service and an alternative treatment of the water supply will be needed, especially in wells with high As levels.

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