GROUNDWATER IN CU LAO CHAM ISLAND

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ABSTRACT

Situated in the north east of Dai river mouth, Cu Lao Cham is the biggest island among group of islands offshore Quang Nam province. Inhabitants live mainly in the South west coast of island and make up some fishing-hamlets. Cu Lao Cham island with its original forest, many geotopes such as waterfall, beautiful beaches are creating potential to develop tourism.

Researching on water resource of Cu Lao Cham island shows that: 1 - island is not rich in fresh water. Groundwater source depends on weathering crust and forest cover; 2 - island water quality in current is good for drinking and other development activities; 3 - afforestation and building water reservoir are optimal solutions in water source and quality protection now.

Studying water quality is important significance to orient planning and socio - economic development in island.

Content of report include two problems: 1 - Influence factors on quality and source of groundwater; 2 - groundwater quality in island; 3 - Some of proposing solutions for protection of water source and quality in island.

Keywords: geotope, groundwater, quality, resource, scarp, weathering crust

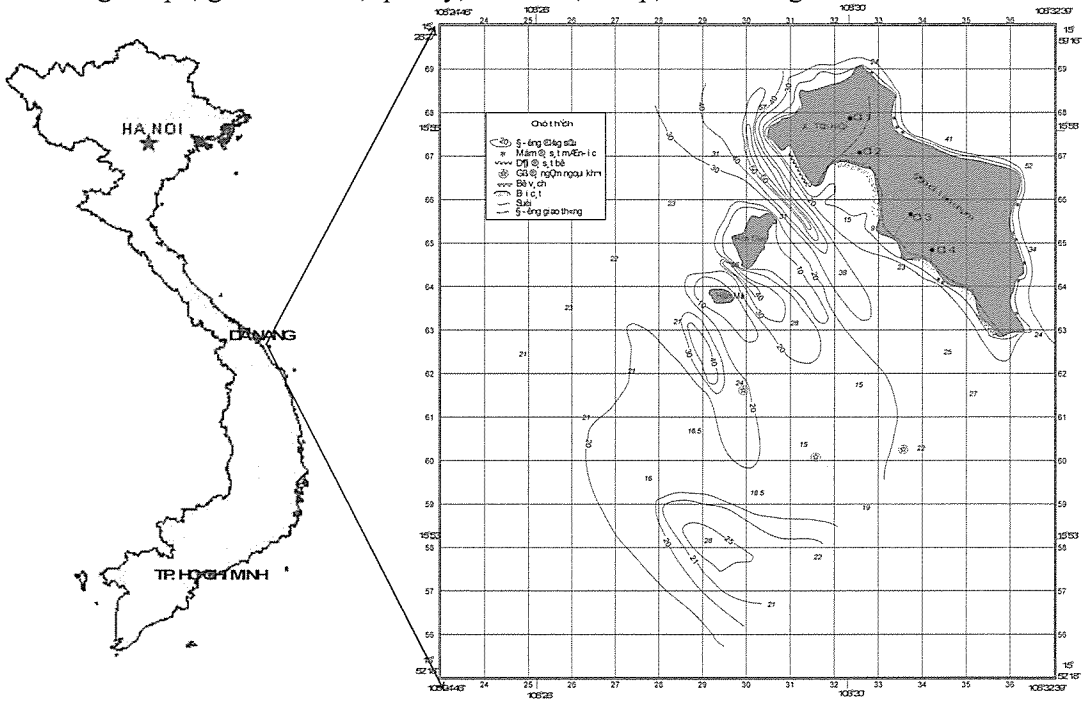

Fig 1. Location of study area

INTRODUCTION

Cu Lao Cham is an attractive tourism island where was called Paradise island in 1960s. Nowadays, Cu Lao Cham is also a natural reserve, lying about 30km off the coast of Quang Nam province, with population of 3000, total area is 1317ha. According to the statistical data, there are 2618 tourist journeys visited the island.

In company with population increasing and tourism promoting of island, fresh water requirement is considerably increasing. So, theme of groundwater exploitation and quality deserve careful study. In order to solve that theme, the study group carried out research on influence factors on groundwater and its quality. The result of study will help to find out the groundwater source and quality for living and tourism.

METHODS

Fieldwork

In order to study geological and geomorphological characteristics of Cu Lao Cham Island, research group has been on fieldwork. Geological characteristics of island were studied as: original rock formations, weathering crust, drainage network... Characteristics of phytology and geomorphology were also studied.

Water samples were taken from 4 streams where is groundwater goes out in dry season. They were measured pH, temperature on fieldwork and kept in good condition for analyzing concentration of heavy metals.

Analyzing and data processing

Each water samples were analyzed for definition of concentration of Cu, Pb, Zn, As, Cd, Hg

- Concentration of Pb, Cd in water is defined by flame-less AAS method.
- Concentration of As in water is defined by hydro-flame AAS method.
- Concentration of Cu, Zn in water is defined by C_2H_2 - flame AAS method.
- Concentration of Hg in water is defined by cool evaporated AAS method.

Vietnamese Environmental Quality Standards and WHO Water quality standards for drinking were used for assessment of island groundwater quality.

Geological, geomorphological, phytological characteristics were integrated to find out the influence factors on groundwater resource.

Influence factors on groundwater resource

Natural factors

Cu Lao Cham island consist of melanocratic biotite granite and lencocratic granite, belonging to Hai Van complex (T_3n *hv*). This granite was compressed intensively and controlled by two fault systems: Northwest - southeast and North East - South West. All of those characteristics make up the specific relief, weathering crust and soil of islands.

On the topographic side, more than 3/4 island area is mountain zone with relief gentle slope in the South Western. The scarp of relief is developed only via the North East. That's why the drainage network of island is distributed in the South West. Streams all are short and destitute of flow in dry season. Surface water has related directly to groundwater. In dry season, groundwater is the main source applying water for surface water. So, groundwater is very important for life in dry season on island

Cu Lao Cham island is characterized by weathering crust with variety of thickness. Vegetation cover holds an important role in weathering process. The place, where vegetational cover is bare, has a thin weathering crust, exposed with rocks. The place, where vegetational cover is verdant luxuriant, has a very thick weathering crust. The weathering crust plays important role for forming and keeping water in island.

About 60 - 70% area of Cu Lao Cham island was covered by vegetation. Almost is tropical forest. This forest gives island not only nice scenery and biodiversity, but also an important water reserve.

So, it is possible to believe that groundwater source is mainly depending on the thickness of weathering crust and vegetational cover. Where, vegetational cover is verdant luxuriant and weathering crust is thick, is rich of groundwater.

Characteristics of water bearing horizon

Water bearing horizon in Cu Lao Cham Island is composed of weathering product, proluvian and alluvian. These formations play the leading role in forming and keeping water.

Weathering crust here is product of Haivan complex, which is characterized by kaolinite, quarzt, and biotite. Water richness of weathering crust is presented variety. The place with a thin weathering crust is lack of water. This phenomenon is met in Dong Chua basin and others in island. Because of verdant forest, south east slope of Dong Chua basin surface always is wet even in dry season. On the contrary, the North West slope of Dong Chua, where is bare, is dry in dry season.

Apart from weathering crust, proluvian and aluvian in island have capacity of water. However, these formations exist in basins and distribute above sea level about 8 meters. Most of streams in island flow into the sea.

On other side, there are 4 streams in Cu Lao Cham island, as: Ong Tho, Tinh, Bai Bim, Bai Huong. These streams are variety from 750m to 1200m in length. At the beginning of June, these streams all are dry. It means that water supplying for drinking and other developed activities in island is serious problems in dry season. At the upstream of Tinh and Bai Bim streams, two dams were built to make a water reservoir. This water reservoir could supply 60litter/day person, it means total of fresh water supplying is 175m^3/day (not including water supplying for the Army in island). In tourist season, fresh water is mainly exploited from groundwater.

In general, Cu Lao Cham island is lack of freshwater. In future, groundwater is main source to supply to developed activities in the island. So, sustainable development in exploitation and using groundwater is serious problem here. Also, exploitation groundwater suitable with characteristics of water bearing horizon is considerable.

Groundwater quality

Water in the island is characterized by no smelt, no taste and fresh. It has temperature from 22 - 26°C and pH from 6.03 to 8.15, being neutral to weakly alkaline water. In order to estimate water quality in the island, we have taken 4 water samples from four streams in island (Fig.1) in dry season. All samples were analyzed to define the concentration of heavy metal. Analysis results are presented in table 1.

Table 1. Concentration of heavy metals in samples (mg/l)

No	Samples	Hg	Pb	Cd	As	Cu	Zn
1	CL1	0.0001	0.006	0.002	0.001	0.001	0.025
2	CL2	<0.0001	<0.001	0.001	0.003	0.017	0.030
3	CL3	<0.0001	0.002	0.001	0.001	0.017	0.035
4	CL4	<0.0001	0.001	<0.001	0.003	0.0025	0.019
TCVN-5944-1995		0.001	0.05	0.01	0.05	1.0	5.0
WHO standards		0.001	0.01	0.003	0.01	2	3.0

Concentration of almost heavy metals (Hg, Pb, Cd, As, Cu, Zn) is lower than allowed levels in comparison with Vietnamese Environmental Quality Standards (TCVN-5944-1995). Parameters of pH and temperature of Cu Lao Cham island groundwater is also lower than allowed levels.

In comparison with allowed levels in water quality standards for drinking of World Health Organization, concentration of heavy metals is also lower than allowed levels. As for Cd, concentration in groundwater is approximate allowed level.

However, some data from fieldwork show that groundwater from some wells is initially contaminated by organic matters from domestic waste and micro-organism. Waste treatment for protection water quality is considerable problems.

Anyways, the quality of groundwater in Cu Lao Cham island in current is suitable for using in drinking and other developed activities.

Proposing solution

Basing on result of research on groundwater resource in Cu Lao Cham island, study group propose some solutions for protection of groundwater source and quality, following as:

- Afforestation on bare land to step up weathering process in order to make a thick weathering crust and keep water.
- Building water reservoir in island for using in dry season
- Good realization of waste collection and treatment in island, especially domestic waste in order to avoid contaminating water source.
- Training and education of environmental and fresh water protection for local community in island.
- Equipment water tank for households in island.

These are possible optimal solutions for keeping fresh water in current for inhabitants in Cu Lao Cham island. However, sustainable development of island groundwater investigation and exploitation is facing problem in future.

CONCLUSION

1. Characteristics of geology and geomorphology and forest cover play the important role for forming and keeping water in the island.
2. Weathering crust, proluvian and aluvian that are geological bodies play role of filtration and bearing water
3. Concentration of heavy metals in water is lower than allowed levels in comparison with Vietnamese Environmental Quality Standards (TCVN-5944-1995) for drinking water. The island groundwater in current is good for domestic using and other development activities.
4. Afforestation and building water reservoir are optimal solutions for water source and quality protection in Cu Lao Cham island now.

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