Situation of Arsenic Pollution in Cambodia and the Removal Systems in Communities

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Content

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I. Introduction

- This presentation is made based on the master thesis in the graduate school of IDEC (International Development and Cooperation), Hiroshima University Department of Development Technology.
- Water Quality Analysis using ICP-AES was supported by Sogo-mizu Institute.

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II. Arsenic Risk in Cambodia

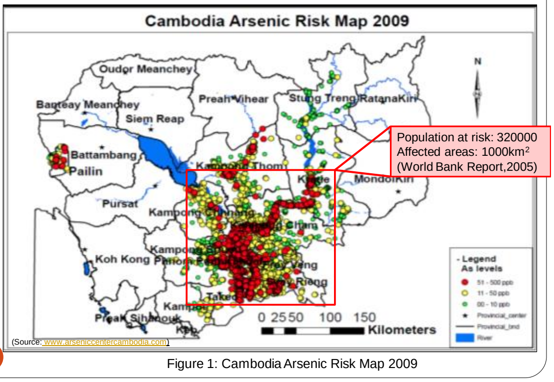

Figure 1: Cambodia Arsenic Risk Map 2009

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II. Arsenic Risk in Cambodia

- This high arsenic concentration detected in groundwater have been found responsible for health problems ranging from skin disorders to cancer (World Bank Policy Report, 2005) .
- The problem has increased greatly with the growing use of tube wells for water supply and irrigation, especially in rural areas of Cambodia, around more than 50% of groundwater used for drinking water source (census 2008).

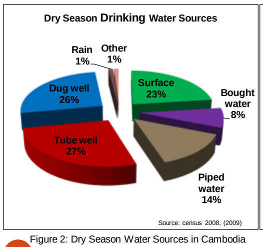

Figure 2: Dry Season Water Sources in Cambodia

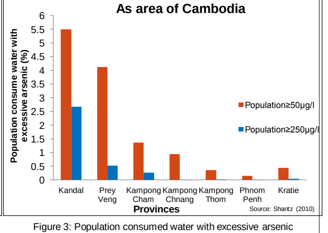

Figure 3: Population consumed water with excessive arsenic

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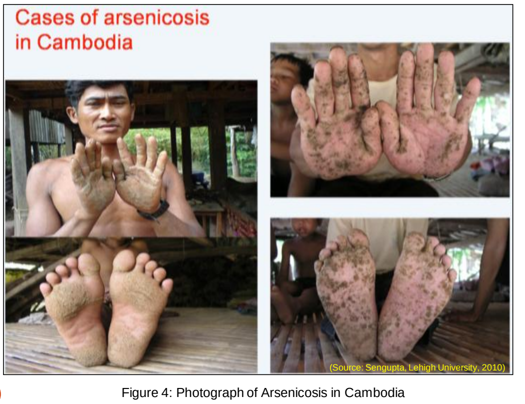

Figure 4: Photograph of Arsenicosis in Cambodia

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III. Arsenic Removal System installed in Cambodia

Arsenic Removal Systems installed in 4 Provinces

Name of Systems	Kandal	Prey Veng	Kampong Cham	Kratie	Total
ITC	04	02	0	0	06
RUPP	0	03	0	0	03
Lien Aid	02	0	0	0	02
Japanese Group	05	03	08	0	16
Napa	0	0	0	01	01
Total	11(39.3%)	08(28.6%)	08(28.6%)	01(3.6%)	28

Source: www.arseniccentercambodia.com

Objective:

- To identify the effectiveness of ARSs installed in Cambodia.

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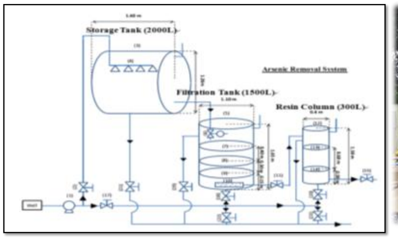
1. SARSAC (ITC): Adsorption Technology



1. SARSAC (ITC) Adsorption Technology

- SARSAC was installed by collaboration between the Institute Technology of Cambodia (ITC) and Lehigh University, USA.
- These systems have been applied in model of the community-based arsenic removal through a sustainable business model(Water 21, 2012).
- This system was applied by adsorbent technology using and re-generable adsorbent media (hybrid arsenic-selective absorbent or hybrid anion exchange or resin HIAX) with sand filter.

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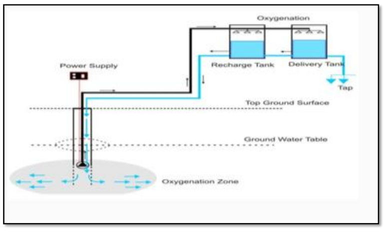
2. SAR (RUPP): Oxidation Technology



2. SAR (RUPP) Oxidation Technology

- SAR was installed in collaboration between Queen's University Belfast (QUB) and Royal University of Phnom Penh (RUPP) for technological improvement in managing groundwater resources in arsenic affected areas in Cambodia.
- The technology involves a simple and easily to remove arsenic and other heavy metals from groundwater using oxidation controlled by aerial oxygen and bioremediation process that happen inside the aquifer, without production of sludge & not using any chemicals at all (SAR Technology, 2011).
- In subterranean arsenic removal (SAR), aerated groundwater is recharged back into the aquifer for oxidation zone making, which can trap iron and arsenic on the soil particles through adsorption process. The oxidation zone created by aerated water boosts the activity of the arsenic-oxidizing microorganisms, which can oxidize arsenic from +3 to +5 states.

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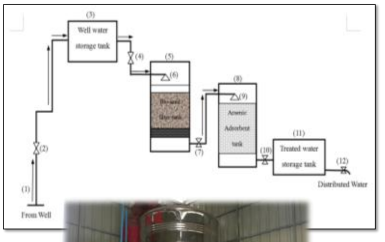
3. Lien Aid: Adsorption Technology



4. Lien Aid Adsorption Technology

- This system was installed by Lien Aid non-government organization that is one of the organizations responsible for providing the safe drinking water supply to Cambodia people.
- This system was designed by adsorbent technology with adsorbent media combined with bio-sand filter and Chlorine powder.

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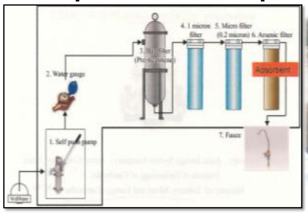
4. Japanese : Adsorption Technology



5. Japanese Adsorption Technology

- This system was installed by collaborative project between Japan and Cambodia, supported by NEDO, from June 2010 till February 2012 (Kang et al., 2014), through the collaboration between Institute of Technology of Cambodia (ITC) and Ministry of Industry, Mines and Energy (MIME).
- The patented AMORPHOUS IRON-(HYDR) OXIDES technology have been developed for this systems, wherein which its adsorbent was developed at Kochi University, Japan, is AMORPHOUS IRON-(HYDR) OXIDES (Kang et al., 2014).

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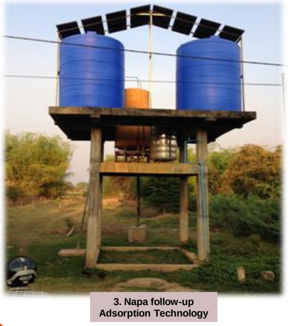
5. Napa follow-up: Adsorption Technology



3. Napa follow-up Adsorption Technology

- This system was installed by ITC in collaboration with Ministry of Water Resource and Meteorology (MoWRM) and MAFF under NAPA Follow-up project.
- This system was carried out by solar power to pump water from tube well to store in tower tanks and equipped with filter tank to improve physical water quality before distribution.
- It distribute to 50 households via pipes for drinking and cooking. The price of water is 1000 riel ($25cent) per cubic meter.

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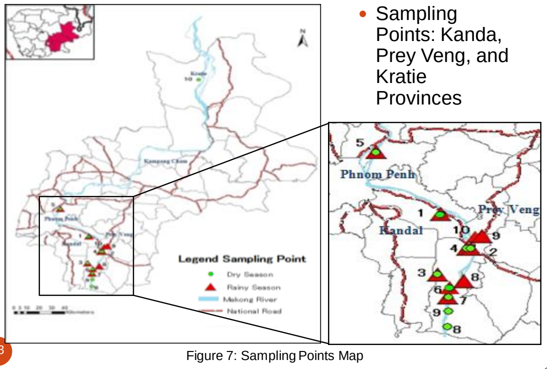
IV. Field Survey and Water Quality Analysis

Study areas



- Sampling Points: Kanda, Prey Veng, and Kratie Provinces

Figure 7: Sampling Points Map

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IV. Field Survey and Water Quality Analysis

- **Field Survey to know the current status of ARSs**
  - Field Visit to understand the existing condition.
  - Sampling from 25 ARSs locations for Water Quality Analysis Data.
  - Interview with 12 Stakeholders from different organizations.
  - Questionnaire Survey with 150 affected people were conducted to know the perception and involvement of affected people for ARSs.

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Results of Water Quality Analysis

Analyzed by Sogo-mizu Institute using ICP-AES

Table: As concentration (μg/l)in Pre and Post-treatment water in Rainy and Dry season

	Rainy Season		Dry Season		
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	
Provinces	**As (μg/l)**	**As (μg/l)**	**As (μg/l)**	**As (μg/l)**	**Name of System**
WHO Guideline		10		10	
National Cambodia Standard		50		50	
Kandal					
1	3	<1	3	10	SARSAC (ITC)
2	40	<1	21	1	SARSAC (ITC)
3	270	<1	270	3	SARSAC (ITC)
4	290	15	340	380	Lien Aid
5	150	3	210	10	Lien Aid
Prey Veng					
6	21	23	78	100	SAR(RUPP)
7	450	450	560	500	SAR(RUPP)
R8	1000	1100			SAR(RUPP)
R9	75	76			Japanese System
R10	160	45			Japanese System
D8	Unavailable sampling		52	<1	SARSAC (ITC)
D9			620	9	SARSAC (ITC)
Kratie					
D10			300	58	Napa System
Maximum	**1000**	**1100**	**620**	**500**	
Minimum	**3**	**<1**	**3**	**<1**	

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V. Results

Current Status of ARSs installed in Cambodia

1. SARSAC(ITC) 2. SAR (RUPP) 3. Napa 4. Lien Aid System 5. Japanese System

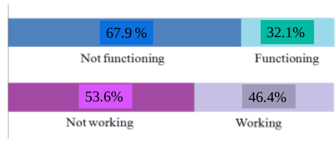

Figure 9:Current Status of ARSs installed in Cambodia

- According to water quality result showed that 9 of 28 (32.1%)ARSs are functioning, 19 of 28 (67.9%) are non-functioning. It assumed that most of ARSs are not effective.
- The field investigation revealed out of 28 ARSs, 13 (46.4%) are working and 15(53.6%) are not working. It indicated that the current status of ARSs were not sustainable.
- Both results suggested ARS implementation as arsenic mitigation option were not successful in Cambodia.

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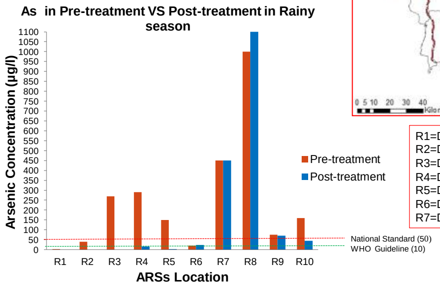
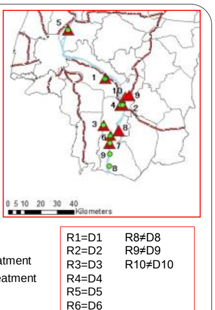
V. Results

Water quality analysis





R1=D1 R8≠D8
R2=D2 R9≠D9
R3=D3 R10≠D10
R4=D4
R5=D5
R6=D6
R7=D7

Figure 10: As in Pre VS Post-treatment in Rainy season

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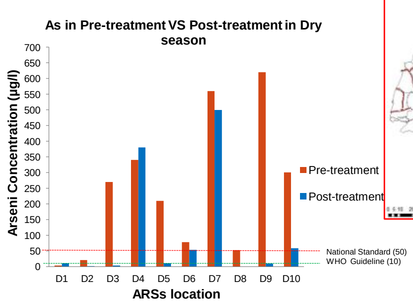
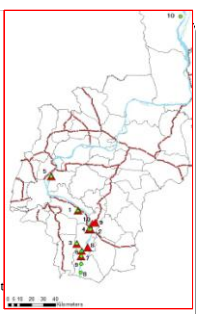
V. Results

Water quality analysis





R1=D1 R8≠D8
R2=D2 R9≠D9
R3=D3 R10≠D10
R4=D4
R5=D5
R6=D6
R7=D7

Figure 11: As in Pre VS Post-treatment in Dry season

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V. Results

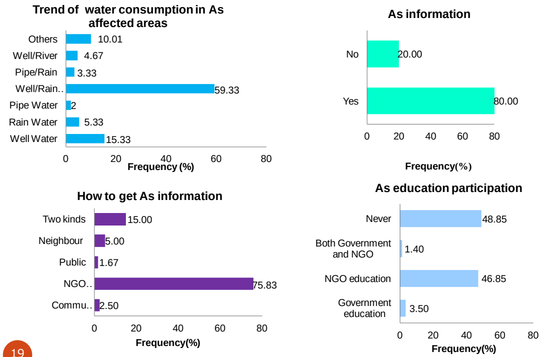

Figure 12: People's involvement on As information

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V. Results

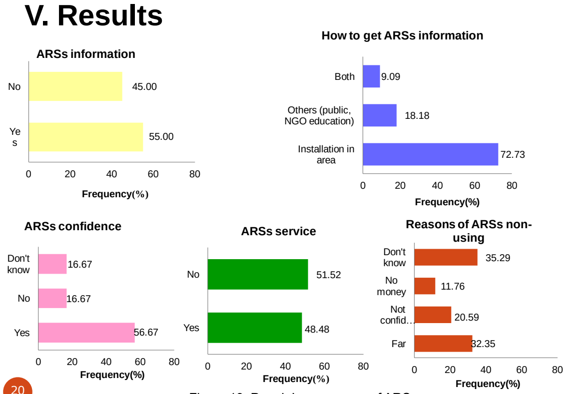

Figure 13: People's awareness of ARSs

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V. Results of Interview and Questionnaire

- **Lack of Management by installers**: Management is key term for successful and sustainable project.
- **Lack of Collaboration**: It's very necessary to cooperate between the responsible government (MRD) and project managers.
- **Lack of Communication and Education for affected people**
- **Lack of Finance for maintenance and water quality monitoring**
- **Lack of Participation for maintenance and using system**

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VI. Conclusion and Recommendation

- Based on field survey and analytical results:
  - Successful case = 32% (working and functioning)
  - Unsuccessful case= 68% (54% not working,14%not satisfactory)
- Data meeting Standard (available data are 10)

	Rainy season	Dry season
WHO Guideline (10µg/l)	40%	60%
National Standard (50µg/l)	70%	60%

- Based on field survey, the ineffectiveness and non-sustainability of ARSs implemented in Cambodia are not totally caused by technical aspect. The interviewed and questionnaire survey results also showed that these problems occurring because of the lacking of management, collaboration community's involvement and also financial aspects that caused the non-sustainability of ARSs.
- Through this study, SARSAC(ITC) were identified with the best successful system for community accepting because it was applied in business model and simple operation.

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VI. Conclusion and Recommendation

- These results suggested that the most important aspect for sustainable ARSs implementing is to bring the awareness and applicable information of arsenic issue and mitigation among the communities to involve the arsenic mitigation activities.
- It is therefore necessary to participate from Stakeholders in terms of the management, collaboration and finance aspects by improvement and enforcement; and from affected communities in term of involvement by enough receiving information.

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Thank you for your kind attention

Your questions and comments are welcomed

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