Collaborative research on improvement of water supply in rural communities of Thailand: Khoksi and Nong Toom Sub-district, Khon Kaen Province

Yoshinobu Ishibashi
Former Professor, Faculty of Public Health,
Khon Kaen University

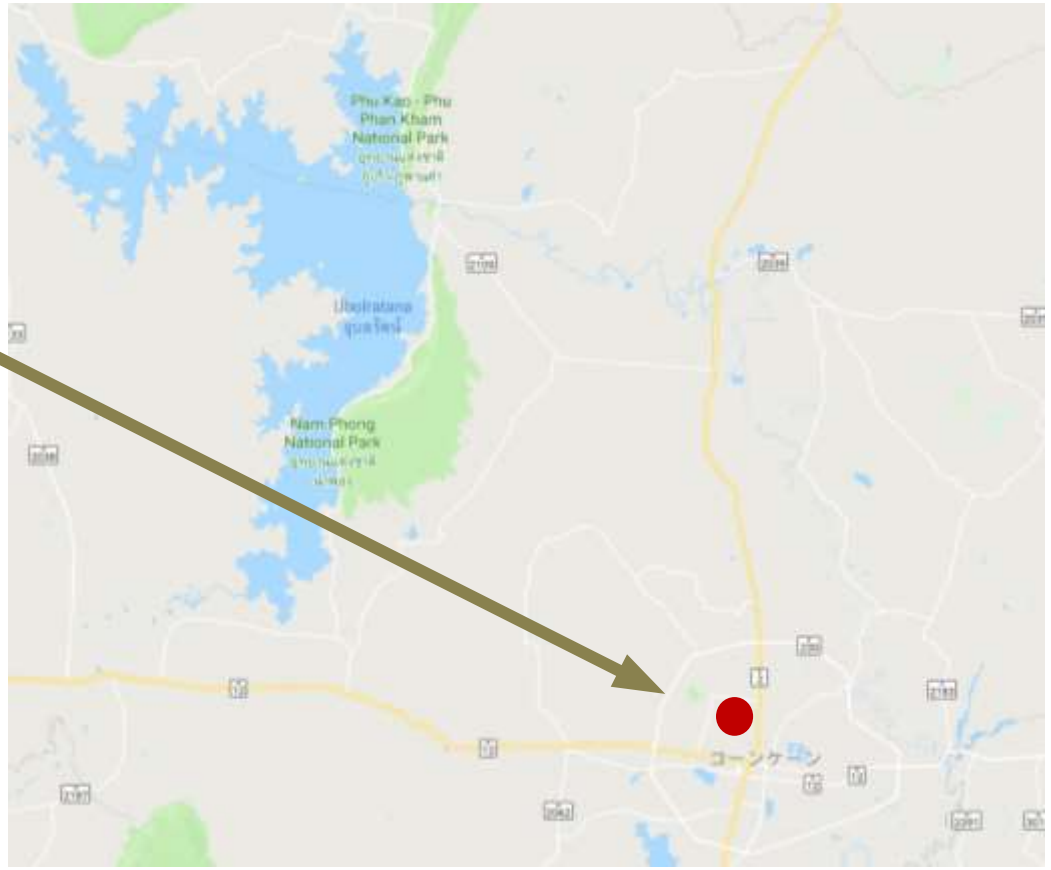
October 16, 2020

Today's topic

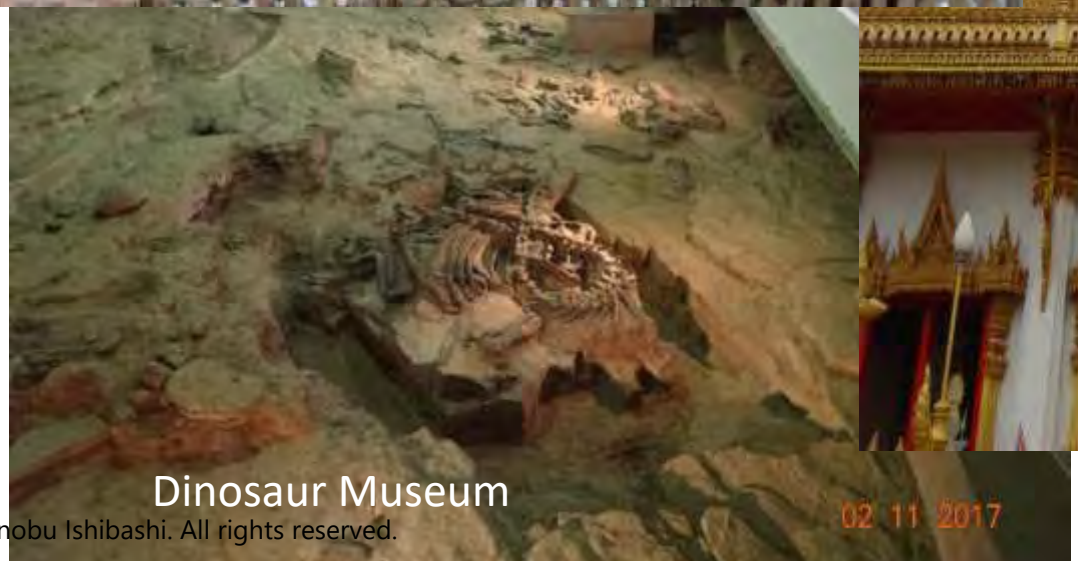
(About Khon Kaen University's Faculty of Public Health)

1. **Introduction**
    - **1.1 Background and purpose of the project**
    - **1.2 Facts about community water supply**
2. **MOU conclusion and project establishment**
3. **Details of the project**
4. **Training**
5. **Interruption due to new coronavirus**
6. **Resumption of activities**
7. **Challenges for the future**
8. **Conclusion**

About Khon Kaen University's Faculty of Public Health



450 km northeast of Bangkok　　1 hour flight



Dinosaur Museum

Wat Nong Wang

Graduate School of Public Health

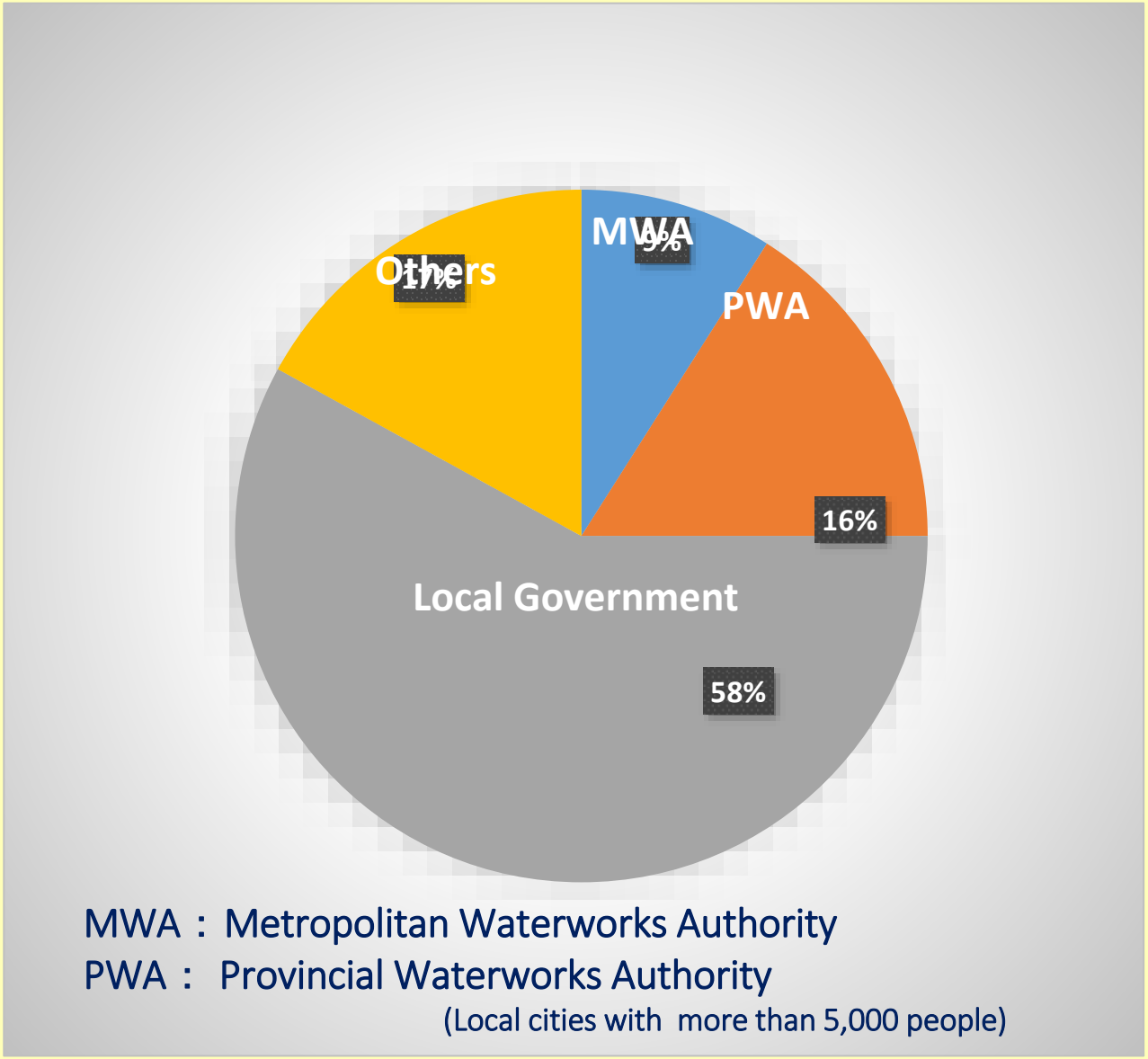
Major in Environmental Health, Occupational Health and Safety

Major in Epidemiology and Biostatistics

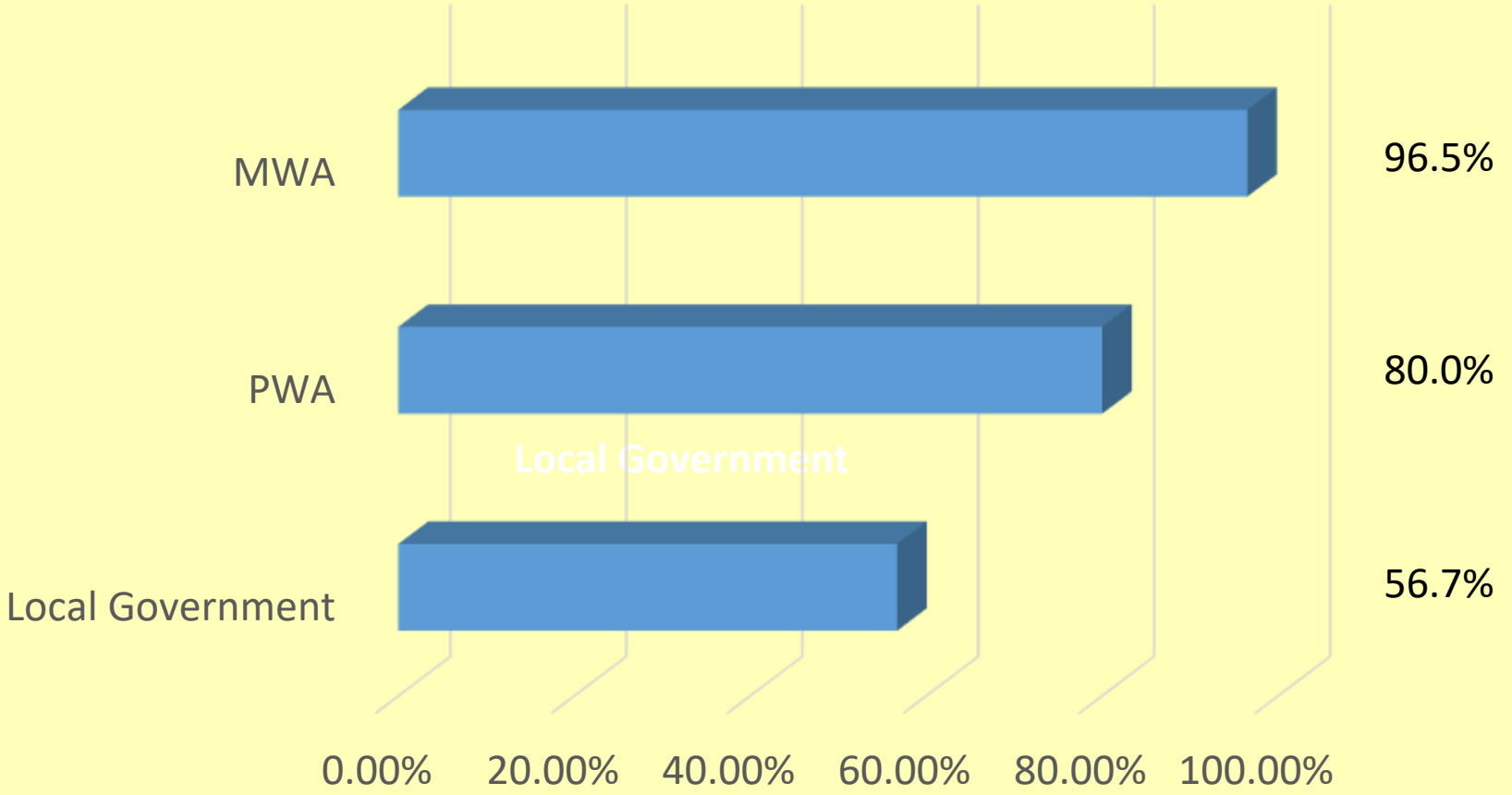
Major in Public Health Administration Health Promotion Nutrition

1. Introduction

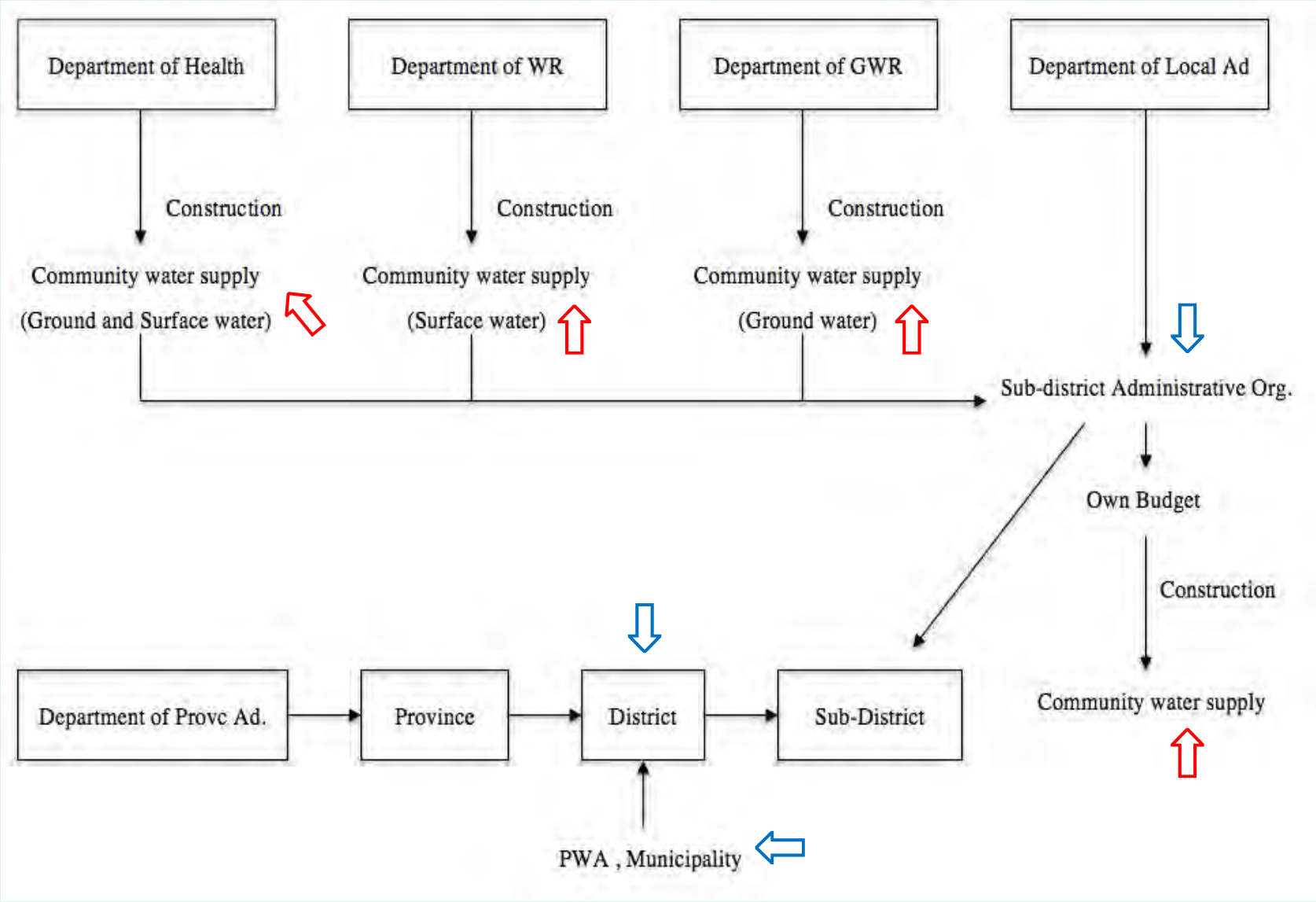
1.1 Background and purpose of the project



Jurisdiction of Thailand's water supply



Satisfaction by Thai water jurisdiction



Community Water Supply の管轄図　（当初の頃）

History of community water supply (village water supply)

1990 Thai Ministry of Health instructed community to improve water supply

1997 Enactment of decentralization law

1999 Enactment of laws to plan decentralization

Community water supply is also involved in these

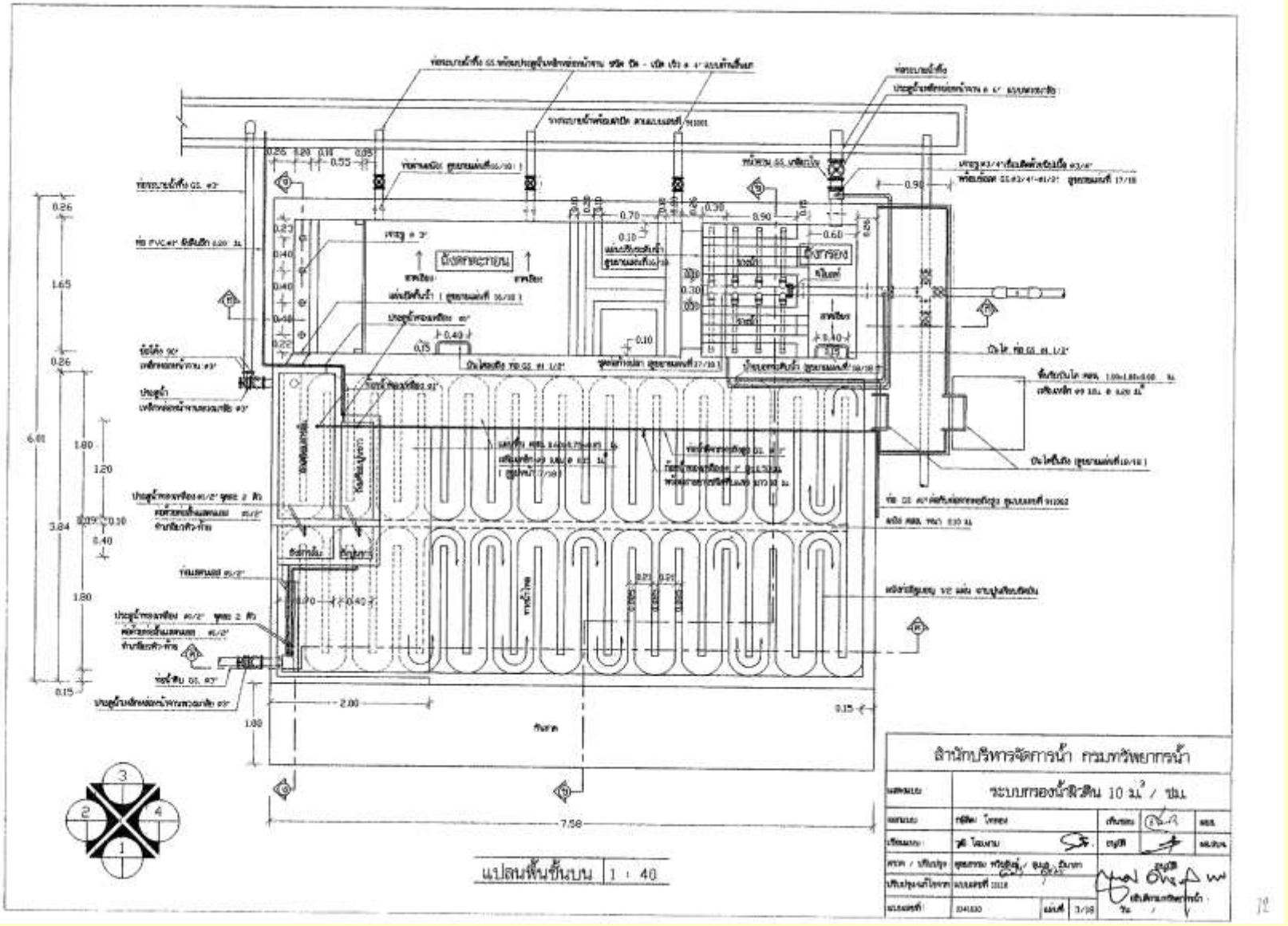
2005 Enforcement of village water supply laws and committee rules

The groundwork for community water supply improvement

Community water supply system

Raw water (1) ⟶ coagulo-sedimentation(2) ⟶ disinfection(3) ⟶ clear water tank(4) ⟶ elevated tank(5) ⟶ gravitational supply(6)

Outline of water purification plant

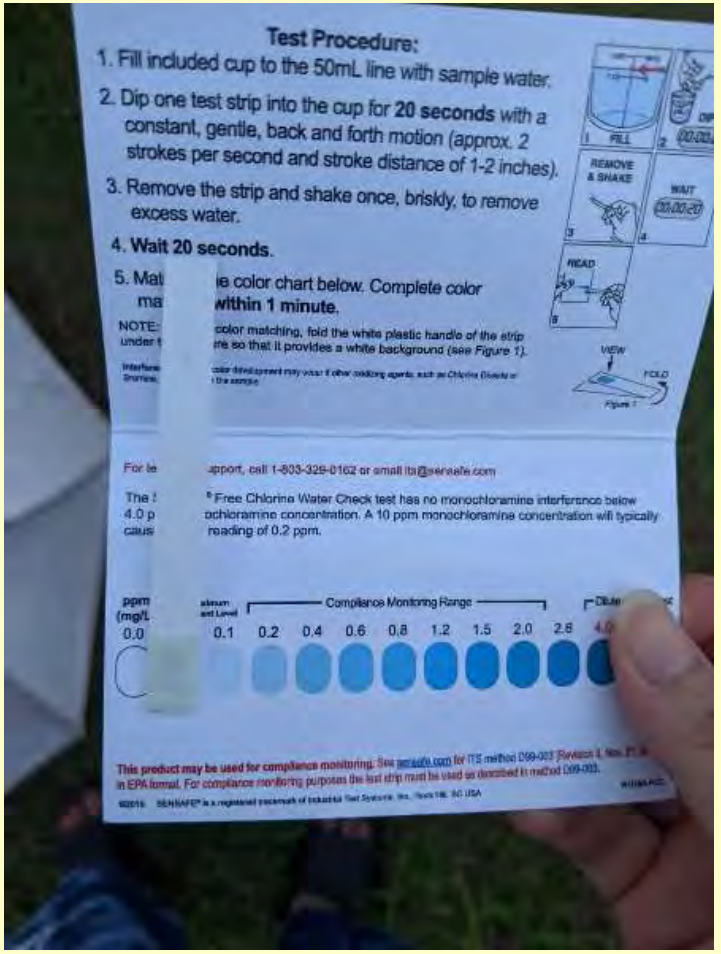


1.2 Facts about community water supply

Water quality items that do not meet Thai water standards

		Total number 30
Water quality item	Number that does not meet the standard	Percent
Turbidity	7	22.3
Color	11	36.7
TDS	1	3.3
Chloride	2	6.7
Sulfide	2	6.7
pH	6	20
Total coliform bacteria (TCB)	20	66.7
Fecal coliform bacteria (FCB)	20	66.7
Fe	4	13.3
Mn	4	13.3
Fluoride	1	3.3
Pb	2	6.7
Zn	1	3.3
As	1	3.3

Source:: REO10



No residual chlorine detected with tap water

Full of trash

Baffling type flocculation basin with no flow, overflow, and algae attachment

Impossible coagulation operation to pour raw water directly

Improbable coagulation operation 2

It's strange that flocs are formed

Aluminum Ammonium Sulfate

Calcium hypochlorite

Water leakage

A website showing the information about the Khon Kaen region shows a video of villagers' requests and complaints about water supply.

Regarding water quality of tap water;

- 70% of villagers do not get good quality tap water
- Yellowish coloration and very high turbidity
- Trouble with earthy odor

Dissatisfaction that villagers do not deal with petition to the local government

Currently, managers who should properly manage a water purification plant in a village do not understand the theory of water purification or the proper operations, and treat water using only experience.

Against this background, we realize that it is necessary for managers to learn the correct water purification theory and to train the operation know-how.

This situation has become a major motivation and purpose for the project establishment.

Consideration for water source

The water source of Khoksi is Loeng Lake
Therefore, it is necessary to pay attention to the water source.

Cows, buffaloes, horses, etc. graze on the shores of the lake
Unpredictable load of nutrients flowing in with rainfall

Pig houses and poultry houses are scattered nearby
The wastewater in each barn is treated and does not flow directly into the lake.
What is the true intention?

Water source also needs consideration

The water source of Khoksi is Loeng Lake

My students

Water hyacinths and cattails on Loeng Lake

Water buffalo and herons

Cylindrospermopsis raciborskii

Eutrophication dominant species

2. MOU conclusion

and project establishment

Seminar by Ms. Ymamoto at Khon Kaen University

Seminar at RTC2

MOU signing ceremony

February 22, 2019

A project was established to improve the water supply of the community water supply (village water supply).

Titled “Collaborative research on improvement of water supply in rural communities of Thailand: Khoksi and Nong Toom Sub-district, Khon Kaen Province”

Date the project was launched

May 15, 2019

Organization and roles

Chairman: Dr. Rittirong Jungoth

Assistant chairman: Dr. Yoshinobu Ishibashi
(Chairman at the beginning, but as an assistant chairman due to circumstances)
Advisor: Dr. Somsak Pitaksanurat, Dr. Wongsa Laohasiriwong
The above members belong to PH-KKU

Execution members:
- Dr. Jutamas Kaewsuk: Mahasarakham University (Present Mahidol University)
- RTC2: Ms. Wasana PWA, Regional Training Center 2 Khon Kaen
- REO10: Mr. Mongkol Regional Environmental Office 10
- Regional Health Centre 7
- Municipality: Khoksi Tambon Administrative Organization and
  Nong Toom Sub-district Municipality

- The KKU graduate students and MSU undergraduate students are asked to help out with questionnaires, experiments, etc.

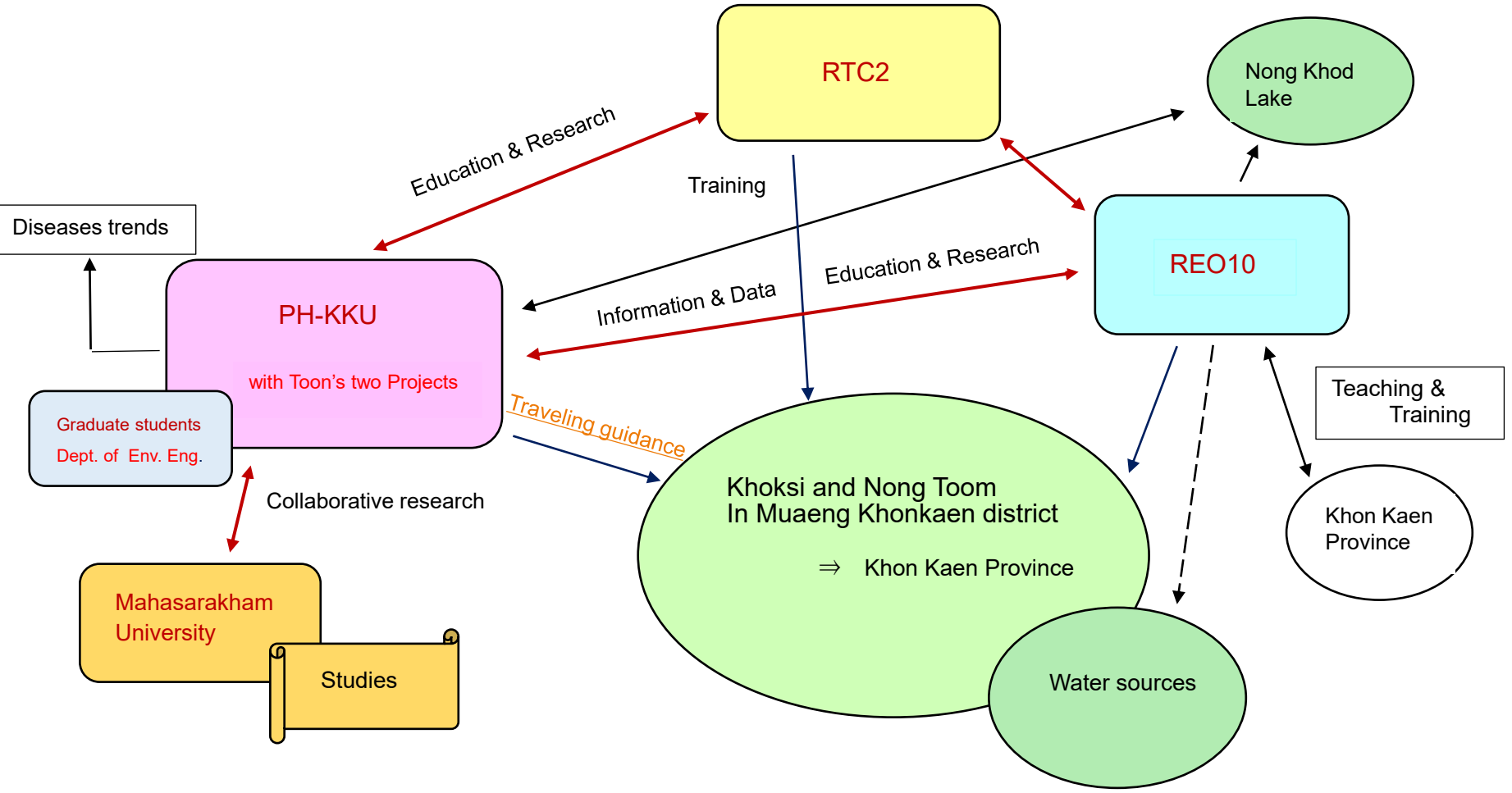


Figure-2 Water supply improvement correlation chart

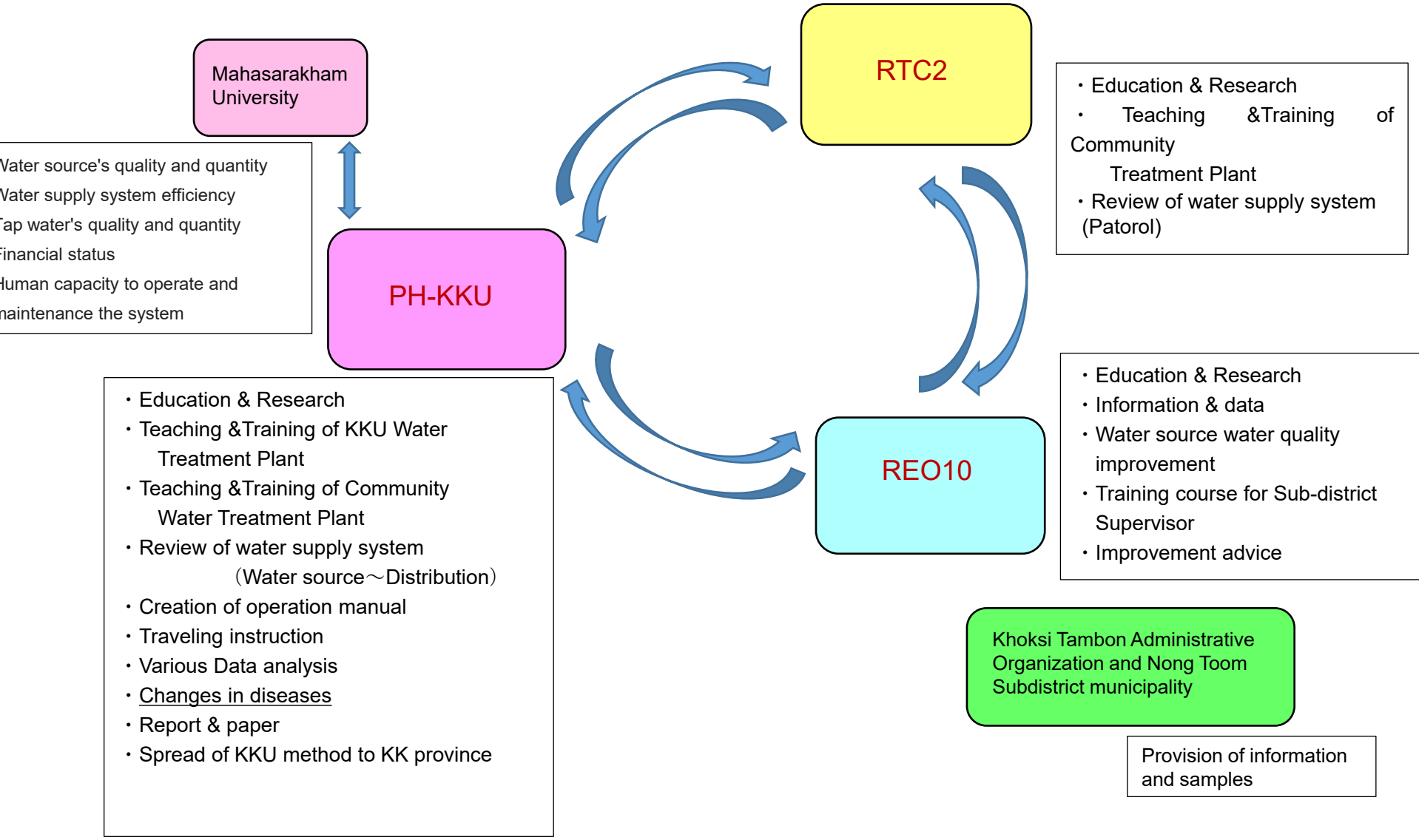


Figure-3 Role sharing in each organization

Project members meet once a month to discuss action plans and methodologies.

We set Khoksi and Nong Toom, which are 20 km away from the university, as model areas and repeated the inspection.

Graduate students started research and experiment to improve community water supply.

On the other hand, applied for proposal and budget to the university (Permission was given in January 2020)

Due to JICA's policy that assistance to Thailand has ended, we have not applied to JICA.

However, I feel that the feeling of freehandmade of this project is interesting.

Meeting at Khoksi at the start of the project

プロジェクト ミーティングの一例
2019年10月10日

3. Details of the project

Project purpose and basic direction

- Control pathogenic microorganisms with safe water before visiting a medical institution

  (Safe and hygienic water)

- Contributing to a well-being life for the people of community through safe water

Water supply is a field of public health as defined by the Waterworks Law

Water supply is a field of preventive medicine

The biggest feature of the project

It will be the first attempt that the different institutions such as universities, provincial waterworks authority, national branch offices, and municipalities work together to improve the community water supply.

It is different from our policy of selling "advanced water purification technology" and "drinkable water“.
Conventional treatments such as flocculation, sedimentation, filtration and disinfection are sufficient for community waterworks.

Conventional training scene targeting municipalities by REO10 alone April 26. 2019

Subjects to be implemented

1.1 Items as research/survey

- Water source and finished water quality
- Search for proper water purification operation
- Economy and management
- Questionnaire survey
- Creation of manual
- Evaluation of water supply improvement
- Establishment of the spread method (KKU method) of water supply improvement

1.2 Training

- Teaching of water purification theory, operation and practice
- Aftercare

1.3 Held the Workshop and/or Seminar

The project is not limited to operations within the water purification plant, but rather is considered as the entire water supply system.

Therefore, the water distribution system, water leakage, and costs are also the subject of consideration.

On the other hand, in the questionnaire, we interviewed the villagers' opinions on water supply as well as their thoughts for improving their lives.

Questionnaire survey

Mahasarakham University students and Khon Kaen graduate students

20 L of bottled water usually purchased by the villagers

4. Training

One year has passed since the MOU was signed, and project members are now able to train water purification plant leaders in the villages.

This project is Thailand's first attempt to improve water supply in villages in cooperation with many organizations, and many new developments are expected.

No need for advanced water purification technology for the water supply in the villages at this time.

No need to supply drinking water.

⇨ It is okay with conventional treatment that is coagulation, sedimentation, filtration and disinfection.

Project meeting February 3, 2020 Training content and schedule decided

1st training schedule (2020)

(Planned before the Corona Pandemic announcement)

Training 1　February 14, March 4 and April 1, 2020
- Concept of water supply (KKU)　April 1
- Visit to Tha Khantho municipal water supply management system　March 4
- Inspect Khoksi and Nong Toom　February 13

Training 2　May 7, 8
- Coagulation (flocculation, Jar test etc.)　(RTC2)　May 7
- Application and practice in the field　May 8

Training 3　June 1, 2
- Distribution pipeline, water leakage (RTC2)　June 1, 2

Training 4　July 9, 10
- Management (KKU)
- WAP ＋ Tha Khantho

Training 5　August
- Disinfection (KKU)
- Application and practice in the field

Preparation for holding training (for April 1st)

- January Questionnaire survey in Khoksi and Nong Toom
- February 3 Project meeting Training content and date confirmation
  Temporary return to Japan (cannot return to Thailand)
- February 13 Project members Visit to Nong Toon & Khoksi
  Nong Ngulearm water purification plant
- March 4 Visit to Tha Khantho municipal water supply management system

At this point, the new coronavirus pandemic was unknown
(WHO announced in March 11)

Project members visit Nong Toon & Khoksi February 13

Project members visit Nong Toon & Khoksi February 13

Visit to Tha Khantho municipal water supply management system

March 4, 2020

Meeting with training Preliminary investigation

5. Interruption due to new coronavirus

A new coronavirus (SARS-CoV-2) outbreak occurred in Wuhan, China in December 2019, WHO named COVID-19 and announced a pandemic on March 11.

Initially, the Thai government took measures such as banning night outings and cross-country travel.
Also, on March 26, an emergency was declared, and thereafter foreigners were prohibited from entering the country.
(I could not return to Khon Kaen for a long time because of this regulation)

Khon Kaen University was closed early.
Students were required to stay home and faculty members were also forced to work from home until the experiment began with permission on May 1.

Under such circumstances, Chairman Dr. Rittirong announced the postponement of training on March 26.

However, RTC2 and REO10 did Jar test etc. independently, and continued to study WSP.

6. Resumption of activities

Thailand, especially Khon Kaen, had very few infected people, so project members resumed their activities in mid-May and decided a new training schedule.

(I also participated online.)

Chairman Dr. Rittirong decided that COVID-19 had calmed down and decided to restart the project.

- May 15　Project online meeting was held
  - June 15　Meeting with the representative of Nong Toom municipality
  - Dr. Jutamas (MSU) Nong Toom survey results announced
  - Discuss training schedule with representative

- June 15　Project meeting held at Nong Toom
  - Meeting with the representative of Nong Toom
  - Dr. Jutamas reports questionnaire results entitled "Application of WHO water safety plans (WSP) to community water supply system at Nong Toom, Khon Kaen"

- June 30-July 1, decides to hold first workshop and training
  - decided to hold the first workshop
  - Lectures and practical training at water purification plant together with workshops
  - Dr. Jutamas will report the results of the questionnaire regarding Nong Toom and Khoksi.

Project online meeting_

May 15, 2020

Project meeting at Nong Toom

June 15

June 30-July 1 **The first workshop was held at Nong Toom**

＜First day＞

Lecture (Gymnastics)
Seminar: **Dr.** Jutamas

- Application of WHO Water Safety Plans (WSP) to Community Water Supply System at Nong Toom, Khon Kaen
- Questionnaire Survey on Water Supply in Village in Khoksi

Laboratory experiment: Jar test, residual chlorine etc.

＜Second day＞

Practice of coagulant and chlorine injection in actual water purification plant（Training）
Staff of PWA, RTC2, and REO10 gave technical guidance

The training was done well. Participants were also enthusiastic!

This point should be emphasized.

Lecture on water purification theory

Jar test and other indoor experiments

Training at an actual Water purification Plant

Not only the calculation of coagulant and chlorine and the practice of injection amount, but also water quality inspection and electrical system were checked.

Impression of the first Workshop and Training

- Project members enthusiastically and cooperatively instructed
- Villagers (participants) also enthusiastically attended
- Manicparity also collaboratively accepted workshops and training
- Next training: Water distribution and pipeline

Schedule from September to December 2020

1 Submission of research progress report to PH-KKU August
Draft by Dr. Ishibashi, translated into Thai by Dr. Rittirong

2 Project extension and funding application Early September

3 On-campus coagulation experiment for simple water purification operation in the field September-mid-November

4 Workshop, Training "Water distribution and pipeline, water leakage" Late September

5 Workshop, Training "Disinfection and microbial removal“ Early October

6 Residual chlorine and pathogenic microorganism removal survey and training in the field Early October

7 Coagulation and turbidity removal experiment in model area, Training Mid-November

8 Submission of research report to PH-KKU Late November-early December

9 Submission of research report and related documents to KKU Early December

10 Preparation for publication of the paper Early November to late December

11 At least one submission to a trusted national / international journal Within 1 year

Recent achievements;

Project meeting will be held on October 12th (combined online)

1. Schedule adjustment for the next Training "Water distribution and pipeline, water leakage"
   - Scheduled for 2 days, at RTC2 and Khoksi's waterworks

2. Report on the progress of research by graduate students
   (Residual chlorine and TCB, FCB Coagulation at model water purification plant)

3. Examination of training for removal of residual chlorine and pathogenic microorganisms at local water purification plants and faucets

Dr. Rittirong and I take care of two graduate students.

In the beginning of August, graduate students underwent final examination for master course student and proposal examination for doctor course student.
Their theme is coagulation and disinfection, and the results will be returned to the operation and management of municipal water purification plants.

Miss Nipaporn Mahasaen (Ying) : Chlorine disinfection and microbial removal
Association of Total, Faecal Coliform Bacteria in Village Water Supply and Chlorination Effectiveness, Khon Kaen Province

Ms. Sujira Prasarnpun (Jeaw) : Coagulation
The use of coagulants to improve the quality of village water supply. A case study of Ban Phrom Nimit water supply plant, Khok Si subdistrict, Mueang district, Khon Kaen province, Thailand

Start with cleaning

Preparation of Chlorine solution

Practice and application of research results at actual water purification plant

The study on the efficiency of using the appropriate amount of chlorine in the water supply system of Phrom Nimit Village, Khok Si Subdistrict, Mueang District, Khon Kaen Province

The optimum chlorine concentration in each coliform bacterial amount

Range of TCB (MPN/ 100 mL.)	Chlorine conc. (mg/L)	TCB , FCB in each contact time (MPN/ 100 ml.)									
		0		2		4		6		24	
		TCB	FCB	TCB	FCB	TCB	FCB	TCB	FCB	TCB	FCB
TCB : 0 – 1,000	Control	560	220	633	220	633	260	767	260	1,600	633
	1.50	6.67	4.00	3.33	2.00	< 1.8	< 1.8	5.33	2.00	3.33	2.00
	1.75	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
	2.00	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
TCB : 1,001 - 2,000	Control	1,440	900	1,340	880	1,560	960	1,560	900	1,960	1,340
	1.75	3.33	< 1.8	31.7	< 1.8	26.0	< 1.8	23.3	< 1.8	18.3	< 1.8
	2.00	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
	2.25	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
TCB : 2,001 - 3,000	Control	2,400	1,220	2,260	1,220	3,200	1,700	2,700	1,440	3,500	1,860
	2.00	6.67	< 1.8	17.0	< 1.8	15.7	< 1.8	29.7	< 1.8	31.0	< 1.8
	2.25	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
	2.50	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8

7. Challenges for the future

The project was established with the aim of providing rural people with "safe water" to live in well-being, rather than supplying water to big cities.

Shortly after the concrete activities of the project started, it was interrupted by the pandemic of COVID-19, and now it has made a new start.

One course of workshops, seminars, training, and reports are scheduled to be completed by December.

The content will be further improved by repeating activities such as seminars and training.
Aftercare (village patrol service, etc.) is also important and needs to be dealt with patiently.
Manual and encouraging materials must be enriched.
(Since the Jar test cannot be done in the village, prepare a diagram of turbidity and coagulant injection amount, a memo showing a guideline for chlorine injection, etc.)

How to spread the Khon Kaen University method:

If the trial by the water supply improvement project of community water supply is successful, members will call it the Khon Kaen University method and spread it not only to Khon Kaen Province but also to the Tohoku region (Isan region) and further to local water supply throughout Thailand. Is dreaming.

A few years later, we hope to be able to evaluate the improvement of water purification plant operations, the improvement of villagers' lifestyles and hygiene ideas, and the status of gastrointestinal infectious diseases.

In December 2019, the Saitama Prefectural Enterprise Bureau signed an agreement with PWA in Thailand and PWA in Laos regarding the proper operation and management of water supply facilities.
The PWA, which is cooperating with our project, is involved in this conclusion and is watching the JICA project with great interest.

8. Conclusion

This project collaborates with universities, PWA, branch offices of the Ministry of water resources and environment and the Ministry of Health and local municipalities to teach and train community water purification managers on water purification theory and correct operation methods to improve community water supply.
This is probably the first attempt in Thailand.

This project has been working to provide people in the community water supply (village water supply) with a healthy and well-being life through "safe water".
And now, I think that the foundation and direction of community water supply improvement measures have been formed.

We hope this project will become a light for the development of Thai community water supply.
We also hope that this project and activity policy will serve as a model case for improving community water supply in Thailand.

Members are currently actively contacting each other, expanding the scope of their activities and research, and working to improve public health.
They no longer have the leadership and knowledge to develop water supply beyond the boundaries of their institutions and taking into account Thai behavior.
It will soon be possible to create a system rich in resilience..

I will continue to support and watch over the project and graduate students behind the scenes, but it is a regret that I have to be in Japan before achieving a goal.
However, I am grateful that I was able to work with the project members and had a wonderful experience.

……

On the other hand, algal bloom at the water source are also a problem, and a new algae growth control project has started. Along with the water supply improvement project of the main subject, we also started activities on solutions from Environmental Health.

References

- Determining Plans and Process of Decentralization to Local Government Organization Act B.E. 2542 (1999), http://thailaws.com/law/t_laws/tlaw0070_6.pdf, Dec. 2019
- Water supply in Provincial Area of Thailand, http://www.jwwa.or.jp/jigyou/ seminar _ file/forum_02_05.pdf, Dec. 2019
- Warintorn Manoworn, Yanyong Inmuong and Uraiwan Inmuong: Assessment of Water Quality at Water Supply Plant in Sawathee Sub-district, Khon Kaen Province, KKU Journal for Public Health Research ,6 ,181-190 , 2013 (in Thai language)
- Khon Kaen Link: www.khonkaenlink.info/home/news/8906.html#.XVO0hKf5VXU.facebook, Sept. 2019