B－3 14th Environmental Study Tour

in Bali 2013~water quality and sanitation~

○Koyanagi Ryo[1] ・Tsushima Kotaro[2] ・Kudou Kenta[3] ・Ono Shohei[4]・Kusuda Tetsuya[5]

Ymamoto Koichi[6] Yamamoto yuko[7]

[1] Department of Environment Science and Enjineering, Kochi University of technology

(185,Miyanoguchi, Tosayamadatyou, Kamishi, Kochi 782-8502)

[2.6] Deperment of Civil and Environmental Enjineering, Yamaguchi University

(1677-1, Yoshida, Yamaguchishi, Yamaguchi 753-8511)

[3] Hokkaido Railway Company

(15-1-1, Jyounishi, 11, Kita,Tyuuouku, Sapporoshi, Hokkaido 060-0011)

[4] Deperment of Civil Engineering Kagawa National College of technology

(355, Tyokushityou, Takamatsushi, Kagawa 761-8058)

[5] Professor emeritus of Kyuusyu uuniversity

[7] Deperment of civil and environmental Engineering, Hokkaigakuen university

(4-1-40, Asahimachi, Toyohiraku, Sapporoshi, Hokkaido 062-8605)

*E-mail:koyakoyaisaisa@mail.goo.ne.jp

1. Introduction

This study tour is organized by the environmental engineering committee of JSCE in association with Udayana University (UNUD), Yayasan Siki Bali and Yamaguchi University. It has been held from 4 - 9 of March 2013. The purpose of this tour is not only to visit the filed but also exchange the view and information with university students and researchers of Indonesia.

2. Abstract

In recent years, tourism industry of the Bali island in Indonesia has been developing to increase in the number of foreign visitors owing to the local natural environment and the support from government policy initiative. Infrastructure development of the new international airport and highways are also extended under the guideline of regional resort development plan. On the other hand, the plan causes the negative impacts on the environment including the problems of decreasing Mangrove forest and farm land, water supply and sewage and treatment of waste disposals. The tourism industry is not promising unless otherwise the environment problems are solved in Bali .This study has a focus on the water and sanitation improvement problems to analyze the water samples in some points. The purpose of this study is to elaborate the sustainable development scenario of the Bali island and think our role.

Fig.1 Location of Bali

3. Questionnaire survey about water sanitation

We sent out questionnaires for water sanitation to 6 Udayana University students .Questions include source, treatment and drain for drinking, cooking, dish-washing, face-washing, shower, laundry and toilet water.

The consequence is shown in below. (Table1.2)

Table 1 Numbers and kinds of using water

	Source	Treatment	Drain
Drinking water	TW1 PE1 RW1 GA3	R3 F2 S1	—
Cooking	TW4 PE1 RW1	R3 B3	—
Dish washing	TW5 RW1	R6	SW2 ST3
Fface washing	TW5 SG1	R5 S1	—
Shower	TW5 SG1	R6	SW2 ST4
Laundry	TW5 SG1	R6	SW2 ST4
Toilet	TW5 SG1	R6	ST6

Table 2 Abbreviated in Table1

Source	
GA	Gallon Bottle
RW	River Water
PW	Pond Water
TW	Tap Water
PW	PET Bottle Water
Treatment	
R	Raw
F	Filtration
S	Settle
B	Boil
Drain	
SW	Sewer
ST	Septic Tank

Four sixth students drink water from Gallon or PET bottles. The others get it from roof rain water harvesting. The one student use tap water. The source of drinking water is different in the region.

One student uses river water for shower, laundry and toilet. All students use a sewer or septic tank for the drain.

4. Water quality analysis

Simplified water quality analysis of the tap water of the Eco-village, hotel, lake Batur, Unda river are as shown in below(Table 1).

Japanese water quality standards of drinking water and lake-marshes water and Indonesian standard I (drinking water) II (public water) are compared with the result of in-situ water quality analysis(Table3).

Table 3 water quality analysis

	Water Temp	pH	EC	DO
Eco Village water	24	8.1	24	9.1
Hotel (Tap water)	25	7.3	83	5.9
Lake Batur	28	8.4	199	6.8
Unda river	26	7.5	38	9.9
JPN water quality standerds	—	5.8-8.6	—	—
JPN lakes and marshes water quality	—	6.5-8.5	—	>7.5
Indonesian standard water quality I	±3	6-9	—	6
Indonesian standard water quality II	±3	6-9	—	4

	COD(mg/L)	NH4+ (mg/L)	chlorine(mg/L)	Coliform Bacteria(x/100mL)
Eco Village water	3	0.2	—	300
Hotel (Tap water)	—	—	100	—
Lake Batur	>8	1	—	3000
Unda river	5	0.4	—	—
JPN drinking water standerd	—	—	<600	0
JPN lakes and marshes water quality	<3	—	—	1000
Indonesian standard water quality I	10	—	600	1000
Indonesian standard water quality II	25	—	—	5000

From the water quality analysis of the samples, Indonesian water standard is cleared at all points. However, Coliform Bacteria are detected at Eco-village and lake Batur. The lake Batur is water front of which the water quality is a problem to detect the Coliform Bacteria. There is possibility of following sewer water of homes around the lake. Upgrading of sewer or Septic tank is subject of Indonesian infrastructure.

5. Eco-village of Bali

This village is located in the eastern part of Bali. This village equips with exclusively excellent eco-system in the region. The eco-system application in the village includes the effective use of organic compost from the faces of livestock and the introduction of self-support accounting system in the water supply. On the other hand, traditional local waste water treatment system has been applied to suffer from the waterborne diseases problems in Bali. In this chart the current status of environmental problems in Bali island to overview the action plan of the village.

(1)Sewage water system

This village keeps a unique traditional toilet and

sewer system to separate urine and faces. The urine is separated to be directly discharged into the underground pipe, and the feces is accumulated into septic tank. The septic tank is covered by concrete except the bottom. The top is covered by raw concrete when the tank is fully filled up with faces. Groundwater pollution by the seepage from the bottom of the septic tank is a common problem to suffer from the waterborne diseases. The distance between septic tank and dug well is to be kept to avoid the contamination problem of bacillus coli in a yard, while the distance from the neighbor boundary is not clearly fixed yet.

First priority issue is to protect the contamination of dug well from the leakage of septic tank. The point is how to treat the human waste in a small village with low population density. Small scale individual sewage treatment system is not in the scope of social development planning in the local areas.

(2)Drinking water supply system

The village equips with water distribution pipe system to collect a bill for house water consumption. The community water supply system is being sustained to invest the money deposit for the operation and maintenance of water infrastructure in the village. Underground water storage reservoir is equipped to supply drinking water for emergency including the water contamination of dug well by heavy storm.

6 Action plan of sustainable development

First priority is sewer system to treat the waste water. The realistic stepwise development plan of water quality management plan is to install the sewer system in urban area , Jyokasou (aerobic and un-aerobic combined grey and black water treatment) in the semi-urban area and septic tank in the rural area. Developed country including Japan should support these environmental conservation activities in Indonesia. What shall we do for the next of the sustainable developments are to (1) continue the collaboration between the university of Indonesia and Japan, (2) show the original date and among the relation of stake holder (3) propose the stepwise policy of improving the water quality environment.

7. Concluding Remarks

This study tour was good opportunity to exchange views and information of the environmental problems in rural areas between the university students of two countries such as Indonesia and Japan.

8. Acknowledgments