The Quality Test of Drinking Water in Khon Kaen Province, Northeastern Thailand

by

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Introduction

The staffs of the Institute of the Domestic Science, Nagoya Women's University carried out the basic investigation on Anemia of farmer in Khon Kaen Province, Northeastern Thailand in cooperation with the Division of Nutrition, Depertment of Health of Thailand during the period of June 1972 to January 1973. The investigations were made over the scientific fields such as medical science, dietetics, food science and environmental survey. The present authers dealt with this problem from the view point of the water quality of drinking and other living purposes in this district. Nine villages were selected to examine the water quality. Khon Kaen Province is situated on the Korat Tableland, where continental red soil which contains large

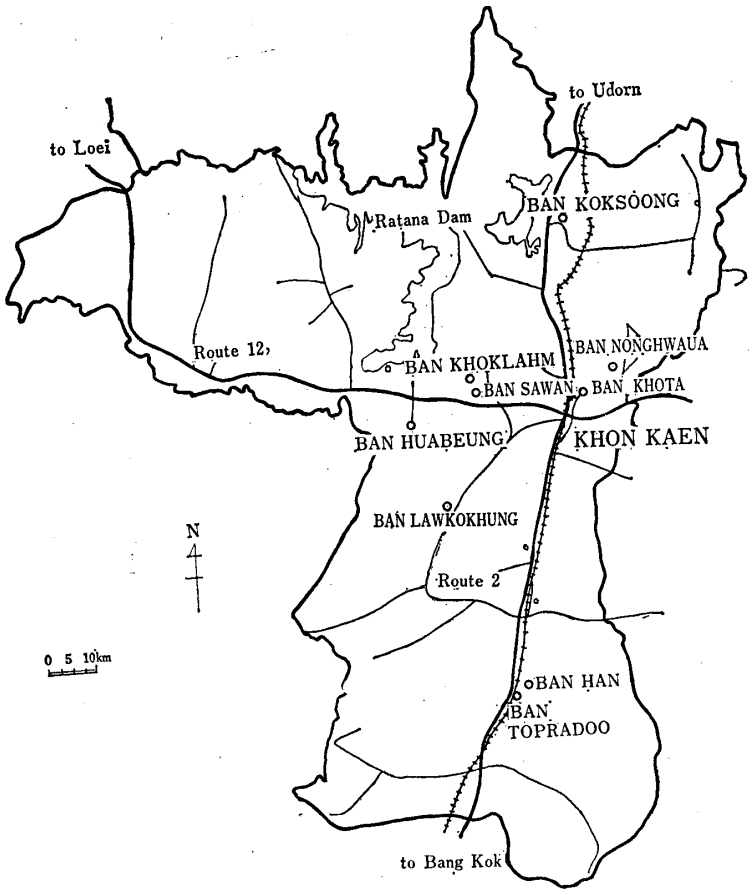


Fig. 1 Locotion of KHON KAEN PROVINCE

amount of iron content distributes widely. The soil is considerably sterile. In the dry season very little rain falls and yellowish wind dust blows. Therefore people stores rainwater during rainy season for drinking and various living purposes. As for the drinking water, people also uses wells, which exist one place or two a village. Most of them are comparatively shallow. The quality test of drinking water was curried out throughout November 1972. The sampling spots are sketched in Fig. 1.

The Methods and Analyses

The methods used in this investigation are as follows:

WT : measured at each sampling spot.

DO : after fixing the samples at each sampling spot, DO was measured by Winkler Sodium Azide method at the Laboratory of Water Supply at Khon Kaen.

COD : measured by the Testing Method for Water Supply of Japan at the same Laboratory.

SS : The precipitates removed by Wattmans glass filter GF/C 47mm were weighed. The filtrates were kept in a deep freezer and their chemical analyses which are listed below were made in our Laboratory after return to Japan.

NH_4-N : tested according to the method of NEWELL (1967) and SAGI (1966).

Table 1 Water Quarity

Station		WT ℃	pH	DO 0_2mg/l	Coliform MPN 100ml	T-Bacteria 1ml	SS mg/l	COD 0_2mg/l	NH_4-N mg/l
Ban Khota	D. Spring	29.2	6.3	3.68	200	1,200	393.0	1.92	0.014
Ban Khota	Well	29.0	6.4	2.11	800	1,600	43.0	1.00	0.013
Ban Nonghuaua	D. Spring	27.9	5.6	2.03	900	—	111.1	1.32	0.008
Ban Sawan	Well	28.6	6.6	2.14	900	250	306.4	0.77	0.042
Ban Khoklahm	D. Spring	28.2	6.1	13.67	3,400	1,280	96.9	5.46	0.066
Ban Han	D. Pond	28.2	7.4	5.17	100	4,500	88.9	9.12	0.097
Ban Topradoo	D. Well	—	—	—	1,140	640	10.0	—	0.050
Ban Huabeung	Well	29.1	7.9	1.32	120	100	46.9	0.92	0.016
Ban Huabeung	D. Well	—	6.6	—	20,500	600	321.0	1.69	0.015
Ban Koksoong	Well	25.6	9.4	6.38	—	—	30.9	1.62	0.014
Ban Koksoong	D. Spring	26.8	5.7	2.36	3,080	480	81.4	1.31	0.010
Ban Lawkokhung	Well	26.2	6.9	1.40	5	100	328.6	2.85	0.006
Ban Lawkokhung	D. Spring	26.8	5.4	2.06	1,025	6,000	109.4	1.39	0.036

D. drinking water :

NO_2-N : tested according to the method of BENDSCNEIDER and ROBINSON (1952).

NO_3-N : tested according to the method of WOOD, ARMSTRONG and RICHARDS (1967).

PO_4-P : tested according to the method of MURPHY and RILEY (1962).

S. org. P : tested according to the method of MENZEL and CORWIN (1965).

Ca, Mg : tested according to the method EDTA. titration.

Cl : tested according to the method Mercuric Nitrate titration.

Fe, Zn : tested by Atomic Absorption (an Atomic Absorption apparatus HITACHI Type 208 was used) after acidification by HCl.

T-Bacteria : total bacteria (colony/m*l*) for 24 hrs., which was kindly measured at the Khon Kaen Regional Health Laboratory.

Number of Coliform : number of Coliform per 100m*l* (M. P. N.) was measured by means of Millipore filter method, which was also measured at the Khon Kaen Regional Health Laboratory.

Results and Considerationss

As for the source of drinking water, three kinds (spring, pond and well) can be classified. Among these the water temperature of spring is nearly same to the ambient temperature at Ban Khota the springs are located on the rice field banks within 2 m from the rice fields. Such springs can be often found in the rice fields of our country. Most community wells in Khon

NO_2-N mg/*l*	NO_3-N mg/*l*	t. in. N mg/*l*	PO_4-P mg/*l*	t. sol. P mg/*l*	S. org. P mg/*l*	Cl mg/*l*	Ca mg/*l*	Mg mg/*l*	Ca+M mg/*l*	Fe mg/*l*	Zn mg/*l*
0.009$_7$	0.426	0.449$_7$	0.031	0.047	0.016	10.0	3.8	—	—	0.529	0.013
0.012$_0$	0.152	0.177$_0$	0.006	0.010	0.004	27.6	12.7	5.1	17.8	trace	0.127
0.006$_9$	0.010	0.024$_9$	0.003	0.008	0.005	6.5	0.6	0.2	0.8	0.265	0.244
0.007$_7$	0.163	0.212$_7$	0.003	0.010	0.007	20.9	4.6	0.5	5.1	0.352	0.044
0.007$_4$	0.168	0.241$_4$	0.013	0.043	0.030	15.0	8.5	—	—	0.735	0.013
0.005$_9$	0.003	0.105$_9$	0.026	0.030	0.005	64.9	14.6	2.6	17.2	0.059	0.013
0.007$_3$	0.043	0.100$_3$	0.021	0.028	0.007	12.5	—	—	—	—	—
0.007$_1$	0.006	0.029$_1$	0.007	0.015	0.008	5.2	0.2	0.6	0.8	0.265	0.067
0.008$_5$	0.017	0.040$_5$	0.005	0.008	0.003	26.6	22.9	2.9	25.8	0.118	0.009
0.008$_7$	0.035	0.057$_7$	0.015	0.035	0.020	4.5	6.6	0.1	6.7	0.059	0.049
0.007$_3$	0.927	0.944$_3$	0.003	0.039	0.041	5.5	3.2	0.9	4.1	0.088	0.044
0.033	—	—	0.018	—	—	138.1	288.7	3.8	292.5	0.044	0.065
0.010$_1$	0.520	0.566$_0$	0.005	0.007	0.002	31.5	12.5	1.6	14.1	0.147	0.015

Fig. 2 Sampling of Water, Ban Huabung

Kaen Province are 1 m to about 4 m in depth. Pump-up type wells are usually not available for drinking. Each community possesses some bucket type wells for drinking. The pH value of springs was in the range of 5.4 to 6.3, while that of wells was in the range of 6.4 to 7.9, i. e. wells generally indicated higher pH value than spring. This may be because the wells are wider in diameter and shallower in depth than the springs. As an exception, an extraordinary high pH value (7.4) was obtained from a pond.

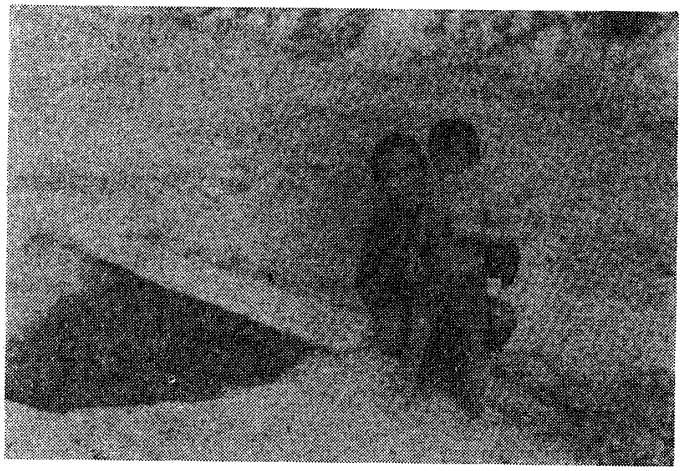


Fig. 3 Well, Ban Laokokung

DO : In agreement with the well-known fact, DO density of most springs and wells indicated comparatively small value. At Ban Khoklahm, however, an abnormally high DO density (13.67 ppm) was detected. This is due to the situation of the water sources which are located in the rice fields, i. e. the pollution of soluble organic materials (COD 5.45 ppm) from rice fields are large. In these water sources we always found the propagation of green-algae, which supports the above inference.

SS : As had already pointed out by Kobayashi (1958), the water in Thailand is muddy and contains large amounts of suspended materials by the influence of the tropical red soil. Except the value of 10 ppm at Ban

Topradoo, the precipitates of the suspended materials reached as large as 30.9 to 393 ppm, but there existed a great difference among the sampling spots. As for SS, very fine particles penetrated through a 0.45 μm glass filter were observed. Such suspended particles are often recognized in the drain water of silica factories of Japan. Fig. 4 shows the relation between the suspended materials determined by GF/C and the sampling spots (station 1 to station 13). Though most of the suspended materials settled in a few minutes, some of them kept cloudy even for more than a few hours.

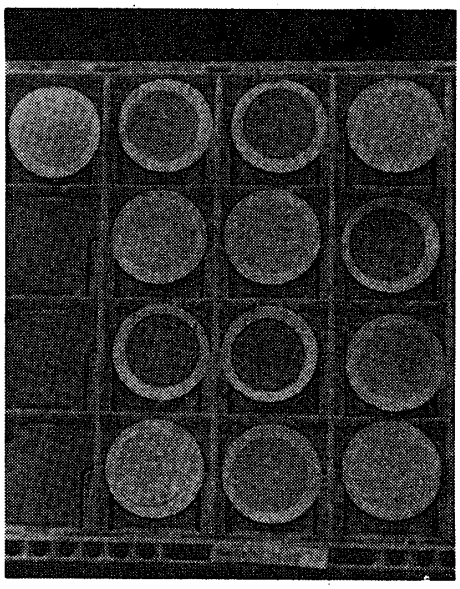


Fig. 4 Samples of SS

COD : COD value of the drinking water at Ban Han was 9.12 ppm, which is rather high judging from the prescription for Japanese water supply. It is therefore considered that this water is inadequate for drinking. From the same reason, thh water at Ban Khoklahm is also inadequate to drinking use. COD value of the other sources was below 2 ppm, which is not so high for drinking.

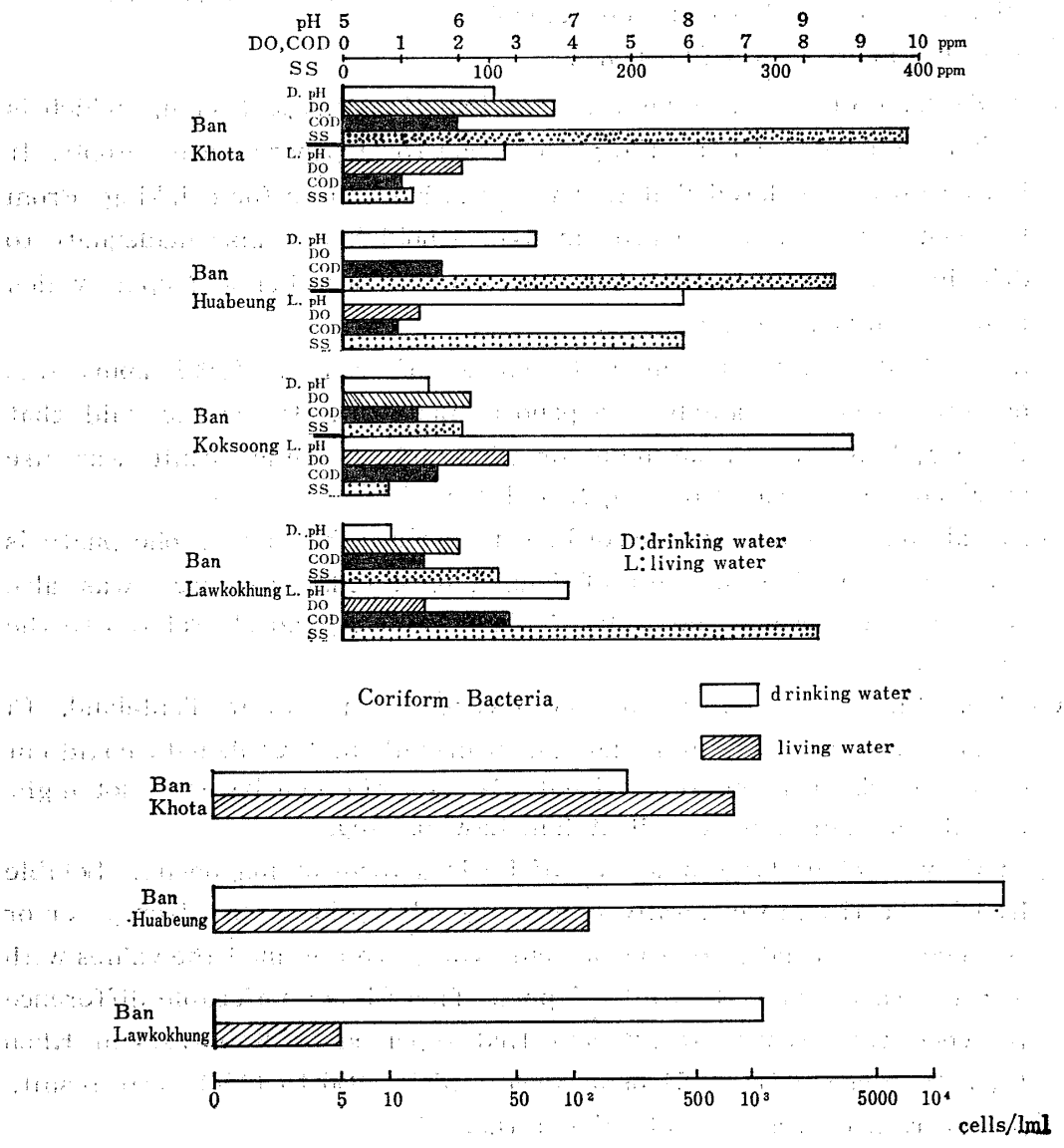
NH_4-N, VO_2-N, NO_3-N, : The highest density of NH_4-N (0.097 ppm) was detected from the sample of a pond at Ban Han. It can be said that the NH_4-N density is not high for all samples. Same result was also obtained for the cases of NO_2-N and NO_3-N.

PO_4-P, total sol. P, S. org. P, : According to Kobayashi (1958), phosphate is very poor in river waters of Thailand. Similar tendency was also recognized in springs and wells. This is probably closely related to the red soil.

Cl, Ca, Mg, : Similar to the case of the rivers in the Korat Tableland, Cl density was generally high, but an abnormally high Cl density could not be detected. On the other hand, Ca and Mg density was not high, except the sample of a well at Ban Lawkokhung.

Fe, Zn, : Cray involves large amounts of Fe in a form of magnetite. Soluble iron in the filtrate generally reduces by adsorption on a filter paper or suspended materials. In the present work, we obtained the values with a large scatter of 0.059 to 0.735 ppm. There is no noticeable difference between the present result and that reported by Kabayashi at Khon Kaen Province (0.00—0.54 ppm, measured in 1956 to 1957). Our result, however, shows as a whole higher than his.

Now let us compare the water quality for drinking to that for other living purposes such as bathing and washing. As we have briefly stated in Introduction, people in Thailand use water distinguishing drinking water from water for other purposes. Water is generally very muddy even for drinking. Hence we have examined the water quality of both uses by the same methods mentioned above. In Fig. 5 the amounts of chemical solutes (pH, DO, COD, and SS) and those of bacteria (Coliform and T-bacteria) are illustrated against each individual community. From this figure, it may be concluded that at Ban Koksoong drinking water is more suitable for drinking than water for other living purposes except SS, to the contrary, at Ban Khota, and Ban Huabenung, the former is, as a whole, more inadequate to the latter. At Ban Lawkokhung, chemical salute is more abundunt in drinking water while bacterias are more abundunt in water for other living purposes.



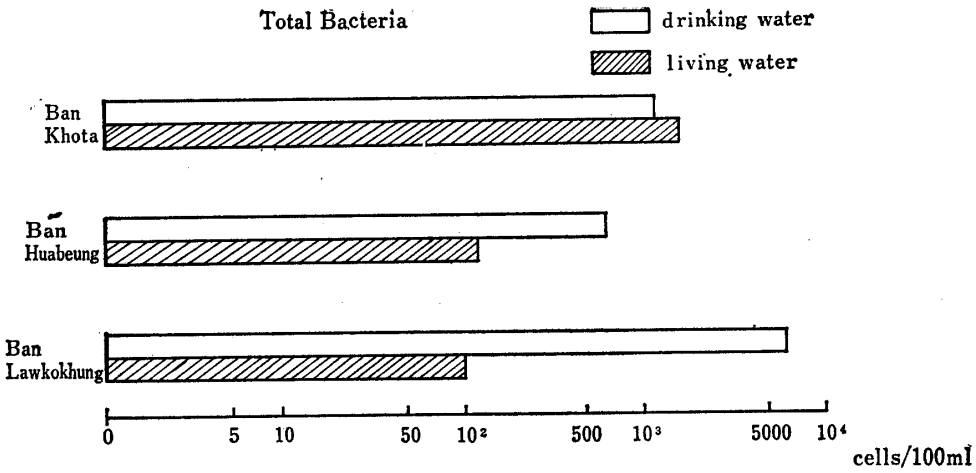


Fig. 5 Comparison of water quality between drinking and living waters

The sources of drinking water mostly locate at a distance of about 10 minutes' walks away from the villages, which is, as it were, a "wisdom of living" for protection of drinking water against artificial pollution.

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