

# Surface Water Quality in Orchard Area, Amphawa District, Samut Songkram Province, Thailand

Sisuwan Kaseamsawat, Sivapan Choo-In

**Abstract**—This study aimed to evaluate the surface water quality for agriculture and consumption in the Amphawa District. The surface water quality parameters in this study included water temperature, turbidity, conductivity, salinity, pH, dissolved oxygen, BOD, nitrate, suspended solids, phosphorus, total dissolved solids (TDS), iron (Fe), copper (Cu), zinc (Zn), manganese (Mn), lead (Pb) and cadmium (Cd). The water samples were collected from small excavation, Lychee, Pomelo and Coconut orchards for 3 seasons from January to December 2011.

The surface water quality from small excavation, Lychee, pomelo and coconut orchards were met the type III of surface water quality standard. The concentration of heavy metal and did not differ significantly at 0.05 level, except dissolved oxygen.

The surface water was suitable for consumption by the usual sterile and generally improving water quality through the process before and was suitable for agriculture.

**Keywords**—Water Quality, Surface Water Quality.

## I. INTRODUCTION

SAMUT Songkram province was a small province located at central of Thailand near the mouth of the Mae Klong river, 80 kilometers west of Bangkok [1]. With regard to the province strategic development this province has been dedicated to ecotourism and hospital [2].

As a result of SWOT analysis, the strengths of the province include magnificent natural resources and environment, diversity of careers, stock of marine and agricultural products, high quality of human resources, and local lifestyle conservation. The weaknesses of province include degradation of natural resources and environment, threat of the water pollution from neighborhood and improper water resources management [3].

Pollution of surface water with toxic chemicals and eutrophication of rivers with nutrients are of great environmental concern worldwide.

The aimed of the study was to evaluate the surface water quality in small excavation and surface water quality in orchard area.

## II. MATERIALS AND METHODS

### A Study Area

The Bang-nanglee Sub-District Administrative Office is situated in central Thailand. There were 5.58 km<sup>2</sup> of low-plain land with rivers and canals located about. Its population was

Srisuwan Kaseamsawat and Sivapan, Choo-In are with the Faculty of Sciences and Technology, Suan Sunandha Rajabhat University, 1 U-tong Nok Road, Dusit, Bangkok 10300, Thailand (e-mail: srisuwan.ka@ssru.ac.th).

3,712 peoples of 850 households. Most people committed to agricultural profession, such as cultivating coconut, pomelo, lychee, and bananas, and household industry such as producing coconut sugar [4].



Fig. 1 Map of Thailand [5]

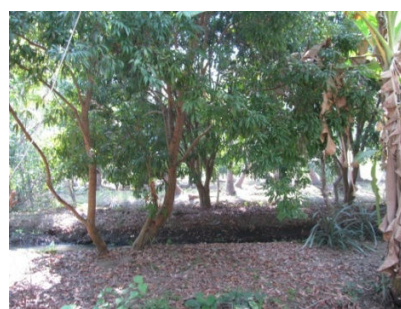


Fig. 2 Lychee orchard



Fig. 3 Pomelo orchard



Fig. 4 Coconut orchard

### B. Research Equipments

In order to measure water quality parameter, the following equipments have been used;

- 1) Water sampling and water depth meter.
- 2) Sampling and preservation container.
- 3) pH meter (HANNA : HI 98217 model and HORIBA : D-54 model).
- 4) Turbidity meter (Lovibond Turbichack model).
- 5) Dissolved Oxygen meter (HORIBA, D-54 models).
- 6) Salinity meter.
- 7) Global Positioning System (GARMIN Etrex 20 model).
- 8) Atomic Absorption Spectrophotometer (GBC Avanta ver 2.02 model).

- 9) Spectrophotometer (Thermo model).
- 10) Ammonia distillation apparatus.
- 11) BOD incubator.
- 12) Cadmium Reduction column.
- 13) Dessicator.

### C. Methodology

This research has been conducted in Samut Songkram Province as the following

- 1) Survey and studied water quality in small excavation and thee orchard (Lychee: Fig. 2, Pomelo: Fig. 3 and Coconut: Fig. 4) for 3 seasons. Date of sample collection shown in Table I.

TABLE I  
DATE OF SAMPLE COLLECTION

Season	Date of sample collection
Winter	3 October 2012
Summer	11 Febuary 2012
Rainy	18 August and 18 September 2012

- 2) The water quality was analyzed by using methods and parameters as shown in Table II.
- 3) Statistical analysis to water quality was analyzed by using One Way ANOVA.

TABLE II  
PARAMETERS AND METHODS USED IN WATER QUALITY ANALYSIS

no	Parameters	Method of analysis	Place of analysis	
			Field	Laboratory
1	Turbidity	Turbidity meter	√	√
2	Total dissolved solids (TDS)	Filtration pass GF/C paper and dried at 103-105 °C for 2 hr.		√
3	Salinity	Salinity meter	√	
4	pH	pH meter	√	
5	Nitogen in nitrite form	Colorimetric method		√
6	Nitogen in nitrate form	Cadmium reduction method		√
7	Nitogen in amonia form	Distillation and titration method		√
8	Dissolved Oxygen (DO)	Azide modification method or DO meter		√
9	Biochemical Oxygen Demand (BOD)	Azide modification method or DO meter at 20 °C for 5 days		√
10	Heavy metal (Pb, Cd, Cu, Fe Mn and Zn)	Atomic Absorption Spectroscopy (AAS) – direct aspiration		√

## II. RESULTS AND DISCUSSION

### A. Surface Water Quality

Surface water quality was measured from 23 sampling sites shown in Table III.

Prominent results can be concluded as the following: Range of water temperature from small excavation, Lychee, pomelo and coconut orchards were 26.6 – 28.8°C (average 28.6°C), 26.1 – 30.0°C (average 25.9°C), 26.6 – 29.9°C (average 27.0°C) and 26.6 – 30.0°C (average 27.5°C) respectively. All values met the surface quality standard (class III) of Pollution Control Department of Thailand (PCD).

TABLE III  
WATER QUALITY

Parameter		Small excavation	Lychee	Pomelo	Coconut	Standard**
Temperature (°C)	Range (mean)	26.6-28.8 (28.6)	26.1-30.0 (25.9)	26.6 – 29.9 (27.0)	26.6 – 30.0(27.5)	Naturally but changing not more than 3°C
SS (mg/l)	Range (mean)	9.6 – 31.8 (25.3)	11.3 – 39 (29.7)	8.0-40.5 (29.1)	16.0-55.0 (40.0)	*
TDS (mg/l)	Range (mean)	287.6 – 503 (421.1)	195 – 346.9(310.2)	178.5-344.0(294.2)	194.5-372.6(302.1)	*
pH	Range (mean)	7.2 – 8.2 (7.9)	7.9 – 8.1 (8.0)	8.0-8.2 (8.1)	8.1-8.2 (8.1)	5-9
Salinity (ppt)	Range (mean)	0.64 – 1.36 (0.65)	0 – 2.5 (0.65)	0-2.0 (0.7)	0-1.75 (0.43)	*
DO (mg/l)	Range (mean)	4.8 – 5.4 (5.2)	3.7 – 4.6 (4.0)	4.7-6.3 (5.2)	3.9-5.0 (4.3)	>4.0
BOD (mg/l)	Range (mean)	3.9 – 9.5 (8.3)	2.2 – 16.5 (10.7)	5.1-11.1 (9.5)	3.0-12.7 (9.8)	<2.0
Turbidity (NTU)	Range (mean)	17.7 – 35.7 (30.5)	37.4 – 63.2 (46.8)	15.90–69.5(51.13)	20.05-42.9 (37.81)	*
Nitrate (µg-N/l)	Range (mean)	0.59 – 10.13 (2.51)	0.43 – 6.42 (1.77)	0.59 – 3.39(1.16)	0.41-7.01 (1.88)	<5,000
P (mg- P/l)	Range (mean)	1.02 – 5.09 (1.92)	1.22 – 5.02 (2.0)	0.92-5.05 (1.84)	1.24-4.32 (1.88)	*
Cu (mg/l)	Range (mean)	0.08 – 1.54 (0.78)	0.05 – 1.62 (0.65)	0.08-1.52(0.66)	0.05-1.70(0.65)	<0.1
Fe (mg/l)	Range (mean)	1.29 – 1.86 (1.64)	1.31 – 1.81 (1.62)	1.50-2.05(1.70)	2.02-4.22(2.90)	*
Mn (mg/l)	Range (mean)	nd	Nd	nd	Nd	<1.0
Cd (mg/l)	Range (mean)	1.62 – 4.92 (2.79)	1.65 – 4.84 (2.38)	1.59-4.93(2.4)	0.59-4.71(1.6)	<0.05
Pb (mg/l)	Range (mean)	1.13 – 2.18 (1.58)	1.25 – 2.22 (1.78)	1.09-2.18(1.49)	1.26-2.24(1.70)	<0.05
Zn(mg/l)	Range (mean)	Nd -7.05 (1.41)	Nd – 7.04 (2.08)	Nd-7.08 (1.57)	Nd-7.04 (2.01)	<1.0

\* : not defined standard of surface water quality.

\*\* : surface quality standard (class III) of Pollution Control Department of Thailand (PCD) [6]

Rang of pH from small excavation, Lychee, pomelo and coconut orchards were 7.2 – 8.2 (average 7.9), 7.9– 8.1 (average 8.0), 8.0 - 8.2 (average 8.1) and 8.1 – 8.2 (average 8.1), respectively. All pH values met the surface quality standard (class III) of Pollution Control Department of Thailand (PCD) that a ranged of pH should be 5 – 9 [6].

Total Dissolved Solid values from small excavation, Lychee, pomelo and coconut orchards were 287.6 – 503.0mg/l. (average 421.1mg/l), 195 – 346.9mg/l (average 310.2mg/l), 178.5 – 344.0mg/l (average 294.2mg/l) and 194.5 – 372.6mg/l (average 302.1mg/l), respectively. However, TDS values could not be compared PCD standard because TDS did not appeared in (class III) standard of surface water quality. From this study, the average TDS in small excavation have the highest.

Dissolved Oxygen (DO) values from small excavation, Lychee, pomelo and coconut orchards were 4.8 – 5.4mg/l (average 5.2mg/l), 3.7 – 4.6mg/l (average 4.0mg/l), 4.7 – 6.3mg/l (average 5.2mg/l), and 3.9 – 5.0mg/l (average 4.3mg/l), respectively. Refer for the average of Dissolved Oxygen in all areas was compliance with specific standard that should not be below 4.00 mg/l.

Range of Biochemical Oxygen Demand (BOD) from small excavation, Lychee, pomelo and coconut orchards were 3.9 – 9.5mg/l (average 8.3mg/l), 2.2 – 16.5mg/l (average 10.7mg/l), 5.1 – 11.1mg/l (average 9.5mg/l), and 3.0 – 12.7mg/l (average 9.8mg/l), respectively. These result showed that all average BOD value were higher than surface water quality standard type III of PCD (less than 4mg/l).

Nitrogen content in nitrate form small excavation, Lychee, pomelo and coconut orchards were 0.59 – 10.13µg/l (average 2.51µg/l), 0.43 – 6.42µg/l (average 1.77µg/l), 0.59 – 3.39µg/l (average 1.16µg/l) and 0.41 – 7.01µg/l (average 1.88µg/l), respectively. Refer to water quality standard type III of PCD; all samples were acceptable (less than 5mg/l or 5,000µg/l)

Lead (Pb) content form small excavation, Lychee, pomelo and coconut orchards were 1.13 – 2.18mg/l (average 1.58mg/l), 1.25 – 2.22mg/l (average 1.78mg/l), 1.09 – 2.18mg/l (average 1.49mg/l) and 1.26 – 2.24mg/l (average 1.70mg/l), respectively. According to surface water quality standard, Lead content in the water were higher than standard type III (over 0.05mg/l).

Cadmium (Cd) content form small excavation, Lychee, pomelo and coconut orchards were 1.62 – 4.92mg/l (average 2.79mg/l), 1.65 – 4.84mg/l (average 2.38mg/l), 1.59 – 4.93mg/l (average 2.40mg/l) and 0.59 – 4.71mg/l (average 1.60mg/l), respectively. Cadmium content were higher than standard (more than 0.05mg/l).

Copper (Cu) content form small excavation, Lychee, pomelo and coconut orchards were 0.08 – 1.54mg/l (average 0.78mg/l), 0.05 – 1.62mg/l (average 0.65mg/l), 0.08 – 1.52mg/l (average 0.66mg/l) and 0.05 – 1.70mg/l (average 0.65mg/l), respectively. According to surface water quality standard, the average concentration of Copper in the surface water were higher than standard type III (over 0.1mg/l).

Zinc (Zn) content form small excavation, Lychee, pomelo and coconut orchards were non detectable (nd) to 7.05mg/l (average 1.41mg/l), nd – 7.04mg/l (average 2.08mg/l), nd – 7.08mg/l (average 1.49mg/l) and nd – 7.04mg/l (average 2.01mg/l), respectively. According to surface water quality standard, lead content in the water were higher than standard type III (over 1.00 mg/l).

This results shown that the concentration of heavy metal (Pb, Cd, Cu and Zn) were higher than water quality standard, except Manganese.

#### B. Analysis of Seasonal Variation of Surface Water Quality

Statistical analysis between water quality in small excavation and three orchards were analyzed by One Way ANOVA (F-test). This results revealed that temperature, pH, TDS, SS, BOD, Turbidity, Nitrate, Phosphorus and heavy

metal are non difference statistically significant at 0.05 level of significance, except DO (difference statistically significant at 0.05 level of significance)

#### IV. CONCLUSION

From the investigation of surface water quality small excavation, Lychee, pomelo and coconut orchards in the Bang Nang Lee Sub-district, Amphawa district, Samut Songkram Province Thailand, we found that water quality met the type III of surface water quality standard issued by the National Environmental Quality Act B.E. 1992. except the concentration of heavy metal which higher water quality standard.

Statistical analysis between water quality in small excavation and three orchards were analysis by One Way ANOVA. These results revealed that temperature, pH, TDS, SS, BOD, Turbidity, Nitrate, Phosphorus and heavy metal are non difference statistically significant at 0.05 level of significance, except DO which difference statistically significant at 0.05 level of significance.

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