Available online at www.iseec2012.com

I-SEEC 2012

Proceeding - Science and Engineering (2013) 404–408

Proceeding
Science and Engineering

www.iseec2012.com

Science and Engineering Symposium
4th International Science, Social Science, Engineering and Energy Conference 2012

Water Quality Index of San Saeb Canal

K. Charuvan[a,*] , S. Senee[b] , A. Vipavee[c]

[a]*Department of Engineering Management, Graduate School, Kasem Bundit University, Bangkok, 10250, Thailand*
[b]*Planning and Development Section, Kasem Bundit University, Bangkok, 10250, Thailand*
[c]*Faculty of Medicine, Srinakharinwirot University, Bangkok, 10110, Thailand*

Abstract

San Saeb canal is an important waterway in Bangkok It connects to Chao Phraya River and Bangpakong River. It is situated on Bangkok and Chachoengsao province. It plays a role as a main water source for many activities including agriculture, transportation and domestic affairs. In addition, it also received many discharges that result in the deterioration of its water quality. For the assessment of water quality, 22 sampling stations were selected covering about 72 km stretch along the course of San Saeb canal from July 2009 to May 2010 and were analyzed using standard methods. The water quality parameter of San Saep canal was evaluated; the status of the surface water as water quality index (WQI). The average NSF-WQI, PCD-WQI and DOE-WQI were around 55.5 ± 3.82, 46.15 ± 11.07 and 41.07 ± 7.95, respectively, showing poor and unacceptable water quality. The most serious polluted water quality was found at Khlongtan and Theplela whereas the higher water quality index was found at Saikongdin.

Selection and/or peer-review under responsibility of Faculty of Science and Technology, Kasem Bundit University, Bangkok.

Keywords: Water quality index; San Saep canal; land use; drainage; flushing

1. Introduction

Water is essential element for our survival. Deterioration in water quality and contamination of surface water has resulted in increased water-borne diseases and other health impacts. Human activities are a major factor in determining the quality of our water bodies through municipal and industrial wastewater discharge, eroded soils and agricultural drainage.

* Corresponding author. *E-mail address:* K_chruvan@yahoo.com

Nomenclature

W_i	unit weight of i_{th} parameter
q_i	quality rating of i_{th} parameter
$\sum W_i$	sum of weights of all parameters

1.1 Water Quality Index

A water quality index provides a single number that expresses overall water quality at a certain location and time based on several water quality parameters. The objective of an index is to turn complex water quality data into information that is understandable and useable by the public. Two of the best known water quality indices, which have been frequently used, National Sanitation Foundation (NSF-WQI) and the Canadian Council of Ministers of the Environment (CCME-WQI). NSF-WQI consisted of the parameters of dissolved oxygen (%sat), fecal coliform (colonies/100ml), pH (standard unit), temperature change (degree C), total phosphate (mg/L), nitrate (mg/L), turbidity (NTU) and total solids (mg/L). CCME-WQI consisted of the parameters of dissolved oxygen (mg/L), total dissolved solid (mg/L), nitrate-nitrite (mg/L), ammonium (mg/L), total phosphorus (mg/L), fecal coliform (colonies/100ml) and pH (standard unit). The classification criteria standards of NSF-WQI, DOE-WQI (Department of Environment) of Malaysia and PCD-WQI (Pollution Control Department) of Thailand are shown in Table 1. In addition, the classification of DOE-WQI due to water quality was shown in Table 2. Due to the increased urbanization and industrialization surface water pollution has become a crucial problem. It is necessary to obtain appropriate information to observe the quality of water resource. Water quality index provide information on a rating scale from zero to hundred. Higher value of WQI indicates better quality of water and lower value shows poor water quality. The present study was aimed to assess rapid and accurate calculation of WQI of San Saep canal covering a distance of about 72km in order to compare the pollution level between upstream and downstream sampling stations.

Table 1. Classification criteria standards of WQI [1-2]

Category	NSF-WQI	DOE-WQI	PCD-WQI	Degree of Pollution	Water Quality
A	90-100	81-100	91-100	Permissible range	Excellent
B	70-89		71-90	Slight to Permissible range	Good
C	50-69	60-80	61-70	Moderate to slight range	Satisfactory
D	26-49		31-60	Severe to moderate range	Poor
E	0-25	0-59	0-30	Severe to moderate range	Unacceptable

Table 2. Quality rating scale for water quality parameters of DOE-WQI [3]

Parameters	Permissible 100	Slight 80	Moderate 50	Severe 0
pH	7-8.5	8.6-8.8	8.9-9.2	≥ 9.2
Total hardness	≤ 100	101-300	301-500	≥ 500
BOD	≤ 1	1.1-3	3.1-5	≥ 6
Total alkalinity	≤ 50	50-85	85-120	≥ 120
Dissolved oxygen	≥ 6	4.5-5.9	3-4.4	≤ 3
Total solids	≤ 500	501-1000	1001-1500	≥ 1500
Total suspended solids	≤ 30	30- 65	66-100	≥ 100
Chloride	≤ 200	200-400	401-600	≥ 600

In order to calculate water quality index, each parameter has also been assign a rating value, which fall between 0 to 100 as shown in equation 1

$$WQI = \Sigma (W_i \times q_i)/\Sigma W_i \quad (1)$$

Where,
W_i = Unit Weight of i_{th} parameter.
q_i = Quality rating of i_{th} parameter.
ΣW_i = Sum of weights of all parameters = 1
$\Sigma(W_i \times q_i)$ = Sum of sub indices

2. Materials and Methods

2.1 Study Area

San Saep canal is the most important canal of Bangkok. Its length was about 72kms, which is connected to Chao Phraya River and Bangpakong River as shown in Fig. 1. It situated on Bangkok and Chachoengsao province. San Saep canal was constructed since 1837. It was aimed at an efficient irrigation system and transportation. Urbanization has expanded to the surrounding areas. This canal plays a role as a main water source for many activities including agriculture, transportation and domestic. In addition it also received many discharges that result the deterioration of its water quality. The activity and land utilization along SanSaep canal increasing dramatically for example house construction invading into the canal, real estates, industries and aquatic cultivation that have greatly increased in the recent years. Additionally, the great blooming of water hyacinth, one of the problems in water transportation, in San Saep canal reflects the nutrient rich wastewater discharged by human activities.

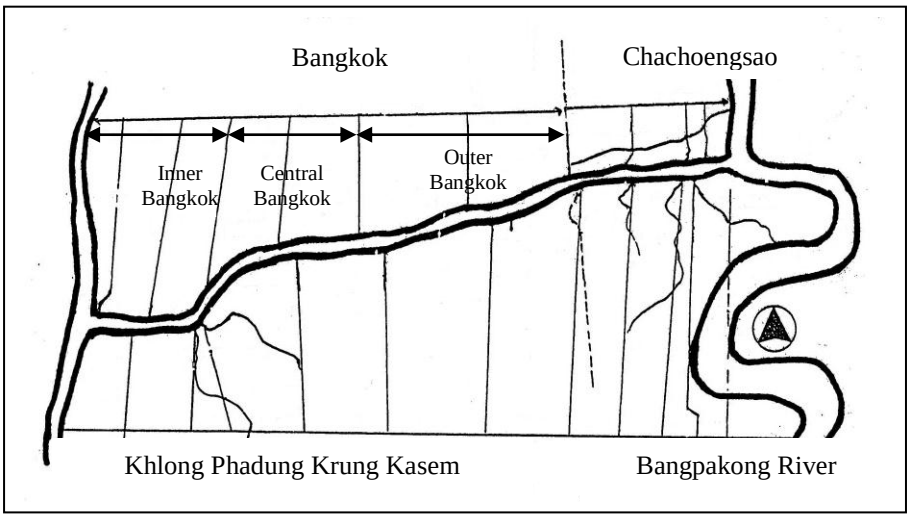

Fig. 1. Location map of San Saep canal [4]

2.2 Methodology

Both primary and secondary data were collected in this study. Subsequent to reviewing the literature, the researcher also accessed published and unpublished reports from the government agencies to complement the primary data collected. Primary data comprised of interviews with the various stakeholders as well as water quality determination along San Saep canal. For the assessment of water quality, 22 sampling stations were

selected covering about 72 kms stretch along the course of San Saep canal from July 2009 to May 2010 and were analyzed using standard method [5]. Preliminary study of chemical and biological water quality of the San Saep canal for further management planning of water pollution was conducted. The water quality parameter of San Saep canal was evaluate the status of the surface water as water quality index (WQI) by using the method of NSF-WQI [1], PCD-WQI [6] and DOE-WQI [7].

3. Results and Discussion

Surface water of San Saep canal is being polluted due to speedy urbanization, industrialization and other developmental activities. The average NSF-WQI was around 55.5 ± 3.82 as shown in Fig.2 and also found to be in the range of 47- 61, showing the water quality as poor to satisfactory. The minimum water quality index was found at Khlongtan because of the lacking of water flushing. The average PCD-WQI was around 46.15 ± 11.07 and found to be in the range 31- 66, showing the water quality as severe to slightly range. The highest water quality index was found at Saikongdin owing to the less dense population. The average DOE-WQI of San Saep canal was around 41.07 ± 7.95 and found to be in the range 28-56, showing the water quality as polluted. The lowest water quality index was located at Theplela because of the effluent drainage from community located in branched canal.

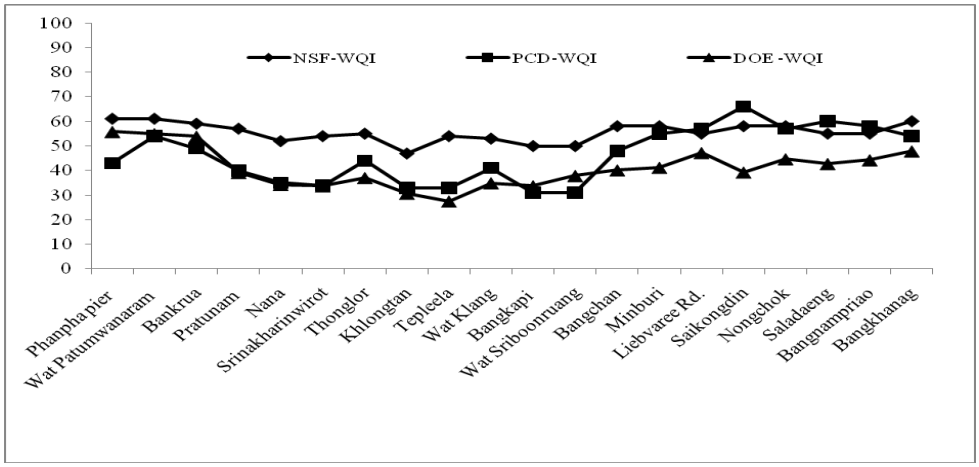

Fig. 2 Water quality index (WQI) as a function of location along San Saep canal

Furthermore, the PCD-WQI and DOE-WQI of Bangkhanag, connected to Bangpakong River, were 54 and 48, respectively, showing poor and unacceptable. The results were related to the average WQI of Bangpakong river (41%), denoting poor environmental quality [10]. The NSF-WQI of San Saep was bad to medium similar to that of Atharbanki River in India as shown in Table 3.

Table 3. Water quality and NSF-WQI of surface water in Asia [8-9]

Sampling Point	pH	DO, mg/L	BOD, mg/L	FC, MPN/100 mL	NSF-WQI	Description	Class
Taladanda River	6.8-7.3	5.6-6.0	3-5	1-2	72-81	Good	B
Mahanadi River	6.6-7.6	5.5-5.9	3-6	1-9	64-77	Medium – Good	B,C
Atharbanki River	6.0-6.9	4.7-5.3	10-18	12-25	48-59	Bad – Medium	C,D
San Saep canal	6.8-7.4	0.0-8.1	2-29	9-210	47-61	Bad – Medium	C,D
Dien Bien River	7.2-7.6	2.2-2.5	87-90	1,150-1,900			
Red River	7.0	4.5	8	5,300			

4. Conclusions

Based on the results obtained above, the following conclusions can be made as the water quality was influenced by wastewater inflow, drainage system, and the flushing system. The average NSF-WQI, PCD-WQI and DOE-WQI were around 55.5 ± 3.82, 46.15 ± 11.07 and 41.07 ± 7.95, respectively. The polluted water quality was found at Khlongtan and Theplela whereas the higher water quality index was found at Saikongdin.

Acknowledgements

The author is gratified to the Office of the Higher Education Commission and the Office of the National Research Council of Thailand for the financial support during 2009-2010.

References

[1] http://www.water-research.net/watrqualindex/index.htm. The Water Quality Index.
[2] http://www.ccme.ca/initiatives/waterfaqs.html. CCME Water Quality Index.
[3] www.doe.gov.my/en/content/river-water.quality-status. DOE-WQI.
[4] Wichai R; Suthep B; Wirun N. *Quality of life and physical development of San Saep canal*. School of Social and Development, National Institute of Development Administration; 1999.
[5] APHA, AWWA, WPFC, *Standard Methods for the Examination of Water and Wastewater*. 17th ed. Washington, D.C.; 2005.
[6] http://iwis.pcd.go.th/first_page/wqi.php. General Water Quality Index, WQI.
[7] Lim FL. *Comparison of Water quality index (WQI) between DOE method and Harkin's index*. Faculty of Chemical and Natural Resource Engineering, Universiti Teknologi Malaysia; 2007.
[8] Asian Development Bank. *IEE VIE: Comprehensive Socioeconomic Urban Development Project – Viet Tri, Hung Yen, and Dong Dang (Hung Yen)*; 2011.
[9] Samantray P; Mishra BK; Panda CR; Rout SP. Assessment of water quality index in Mahanadi and Atharabanki Rivers and Taldanda canal in Paradip Area, India. *J. Hum Ecol* 2009;**26(3)**:153-61.
[10] Bordalo AA; Nilsumranchit W; Chalermwat K. Water quality and uses of the Bangpakong River (Eastern Thailand). *Wat. Res.* 2001;35**(15)**:3635-42.