Physical-Chemical Properties Relationship of Pattani River and Implication for Water Quality Monitoring Study and Academic Service

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Physical-Chemical Properties Relationship of Pattani River and Implication for Water Quality Monitoring Study and Academic Service

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Abstract. STEM learning is methodology toward providing students with cohesive and conducive learning environments that expand their knowledge in fields relating to technology, engineering, mathematics, and science. The environment learning and management is large scale impacted by the people who do the actual influencing, teaching and managing. Pattani River is considered as the important river of the southern region. Which has a length of 210 kilometers, is an important river for environment studying and developing area including academic place, industrial-agricultural area and domestic settlements across Yala, Pattani and Narathiwat province. The river consumption which should be studied and monitored to assess and prevent deterioration Especially the part of the river that passes through urban communities like Yala and Pattani Municipality. Therefore, this research aims to study the relationship between physical water quality and chemical water quality of water in the Pattani River. Classified by water sampling stations Land use and seasons The research was conducted using a single sample water collection method on the waterfront and in the middle of the Pattani River that flows through the Yala province, with 11 sampling stations. Used to analyze pH, temperature, transparency, electrical conductivity, suspended sediment and dissolved oxygen once a month from January-June 2019 and the remaining data from the Office of Natural Resources and Environment, Region 16. The results showed that the water quality varies with the season (p-value < 0.05) but does not vary with water sampling stations and land use. In the dry season, Pattani River has higher water quality than the rainy season. For areas that do not have land use, water quality is slightly better than agricultural and community areas. Chemical water quality such as pH and dissolved oxygen are related to physical water quality changes such as transparency, electrical conductivity and temperature (p-value < 0.05). Which can be used as a guideline to prevent degradation of water quality and can be developed into indicators that can be applied to communities Causing the Tambon Administrative Organization and the community to be ready to be a leader in monitoring water quality.

1. Introduction

Pattani River is the main river of the southern region. Which is 210 kilometers long and has an average annual volume of 3,024 million cubic meters. Is an important river that benefits the industry agriculture and consumption. It is also used for electricity generation. Which should be monitored to assess and prevent deterioration especially the parts of rivers that flow through urban communities like Yala Municipality because the environment around each river is different, for example, there are industrial plants, rubber plants, markets as agricultural areas or as community sources. Which may result in water quality in each area of different quality and deterioration The use of water quality indexes indicating river conditions limited to only those departments or people with experience assigning communities to participate or the development of environmental leaders unable to act at full capacity because of lack of skills guidelines and tools for monitoring water quality [1]. Study of water source conditions and factors related to water quality changes such as land use, season, and the relationship of physical and chemical water quality index will be able to increase the potential for monitoring and prevention, including the development of simple water quality indicators for the benefit of water quality monitoring for local agencies and communities.

The purpose of this research is to study the relationship of physical-chemical parameters of water quality in the Pattani river flowing through municipality area of Yala province and implication for studying and monitoring water quality in the area of Pattani river basin.

2. Research Methodology

2.1 Methods

To study the physical and chemical water quality of the Pattani river that flows through the Yala municipality along the Pattani river route from Sateng subdistrict, mueang district of Yala province to Khao Tum subdistrict, Yarang district of Pattani province for a distance of 22 kilometers. Water sampling by grab samples at 11 water quality monitoring stations (every 2 kilometers), systematically specifying 3 points in each stations from the waterfront to the middle of river, the water samples were sampling once a month within a period of 6 months covers the rainy season and dry season.

Physical and chemical water quality analysis both the field are transparency measuring devices (Secchi disk), pH meter (Hanna HI2424) and conductivity meter (Hanna HI8733). Use the Iodometric Method and Gravimetric Method according to the UNEP / WHO method [2], which analyze general water quality data by using the statistics of average (x) and standard deviation (SD) to analyze the relationship between seasons. Land use and water quality using t-test hypothesis and one-way ANOVA and to analyze the relationship between physical and chemical water quality parameters by using Correlation & Regression statistics at the significant level of 0.05.

2.2 Study area

Established a water quality monitoring station in the Pattani riverside area, from Sateng Subdistrict, Mueang District, Yala Province to Khao Tum Subdistrict, Yarang District of Pattani province is approximately 22 kilometers divided into 11 stations can specify geographic coordinates and land use as in Figure 1 and Table 1.

2.3 STEM application for water quality study and monitoring

To study the water quality variation by spatial-temporal change of season and land use for develop water quality meaning table and explained the relationship of physical-chemical water quality parameters by using the principles of natural science. To analyze the relationship by statistical mathematics and created with modified transparency Secchi disk which easier for student learning and population monitoring by couple using of Secchi disk with water quality meaning table.

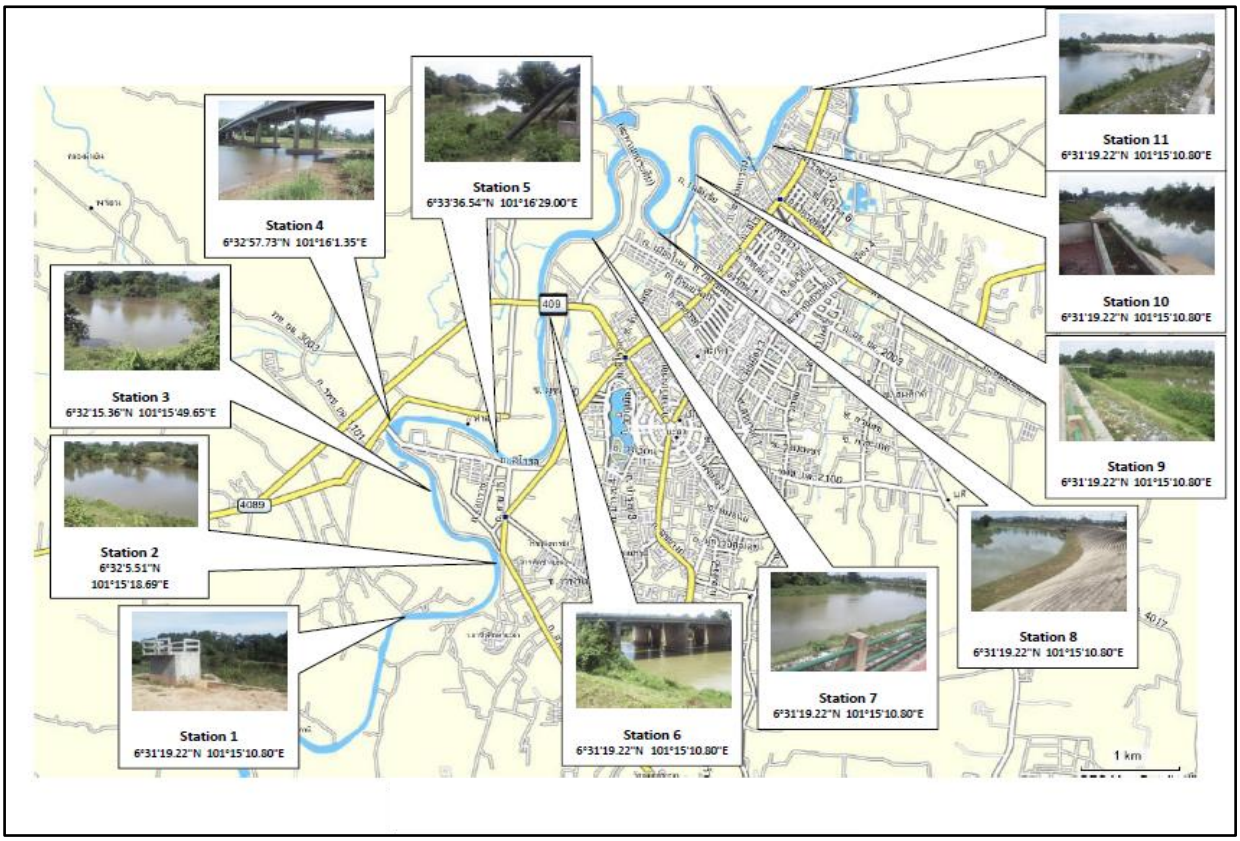

Fig.1 water quality monitoring stations

Table 1 water quality monitoring stations and description of land-use

Water quality monitoring stations	**Land-use description**
Stations 1 (PR1) Stations 2 (PR2) Stations 3 (PR3)	Forest area which no settlements but some river side with domestic animal and dry crops, including with big and density of trees
Stations 4 (PR4)	Small communities with less activity by river side
Stations 5 (PR5) Stations 6 (PR6)	Middle and large communities with agricultural practices
Stations 7 (PR7)	Agricultural area
Stations 8 (PR8)	Middle and large communities with agricultural practices
Stations 9 (PR9)	Small communities without agricultural but plenty by food market
Stations 10 (PR10)	Middle and large communities with source of various market
Stations11 (PR11)	Agricultural area

3. Results

3.1 Water quality classification by land-use

Results of physical and chemical water quality studies based on land use in each season, water quality study stations PR1 - PR3 use forest land or land that is no human activities Type 1 is a forest source. The second type is land use in agriculture. It is an area that is utilized only in agriculture without any settlement of people. Which agriculture is the animal husbandry such as cows and goats. The cultivation includes horticulture and field crops such as rubber plantations and fruit orchards such as rambutan and durian. As for crops corn and cassava areas that fall under category 2 are the water quality study stations PR7 and PR11. Type 3 land use residential type is an area that is used for community settlement. There are other activities that affect the quality of water resources due to occupations such as markets, factories, recreation places including various government agencies which the water quality study station which is classified into type 3 is the water quality study station PR4 and PR9 - PR10. Category 4 land use, residential and agricultural types are areas that are used together, both for housing and agriculture, with areas in this category including water quality study stations PR5-PR6.

Table 2 Water quality variation in each classified

Land-use classification	**Description**	**mean and standard deviation of water quality**					
		pH	**Temperature (temp)**	**Transparency (trans)**	**Electrical conductivity (EC)**	**Total suspended solids (TSS)**	**Dissolved oxygen (DO)**
Category 1	Forest	7.2±0.87	28.5±1.06	34.4±9.24	39.1±2.98	51.4±1.64	3.9±1.23
Category 2	Agriculture	7.2±1.09	29.1±1.16	33.4±9.59	44.1±2.41	41.8±7.67	3.3±1.10
Category 3	Communities	7.3±1.12	29.0±1.13	33.3±9.86	43.8±2.79	47.8±11.6	3.5±1.16
Category 4	Communities with agricultures	7.1±0.98	28.9±1.09	33.3±9.56	44.2±2.75	49.2±1.76	3.5±1.11
Total	Rainy	7.1±1.09	28.6±1.28	30.5±6.43	38.4±2.43	49.7±1.58	3.1±0.57
	Dry	7.4±0.77	29.3±0.49	40.0±1.12	51.3±3.15	44.9±1.12	4.6±1.41
	average	7.2±1.0	28.8±1.12	33.6±9.4	42.7±2.75	48.1±1.45	3.6±1.16

According to studies, it has been found that the average pH value and standard deviation of all areas of land use are 7.2 ± 1.0 units and the highest value in land use category type 3 is areas with residential communities. The average temperature is 28.8 ± 1.12 degrees Celsius and the highest value in the land use type 2 is an area with only agriculture. The average transparency value is 33.6 ± 9.4 centimeters and is most valuable in land use categories. Type 1 is an area with forests or an original area. Average electrical conductivity 42.7 ± 27.5 micro-cement per centimeter and the most valuable in the 4th type of land use area is the area where there are communities living and farming The average suspended sediment value was 48.1 ± 14.5 milligrams per liter and the most valuable in the land use category type 1 is the forest area. The average dissolved oxygen value in all areas of land use is equal to 3.6 ± 1.16 milligrams per liter and the most valuable in the land use category type 1 is the forest area. Overall, all index values show that the Pattani River that flows through the Yala Municipality is of good quality, especially during the dry season (Figure 2 and 3). It is within the criteria for water quality standards type 2 and 3 of surface water sources [3].

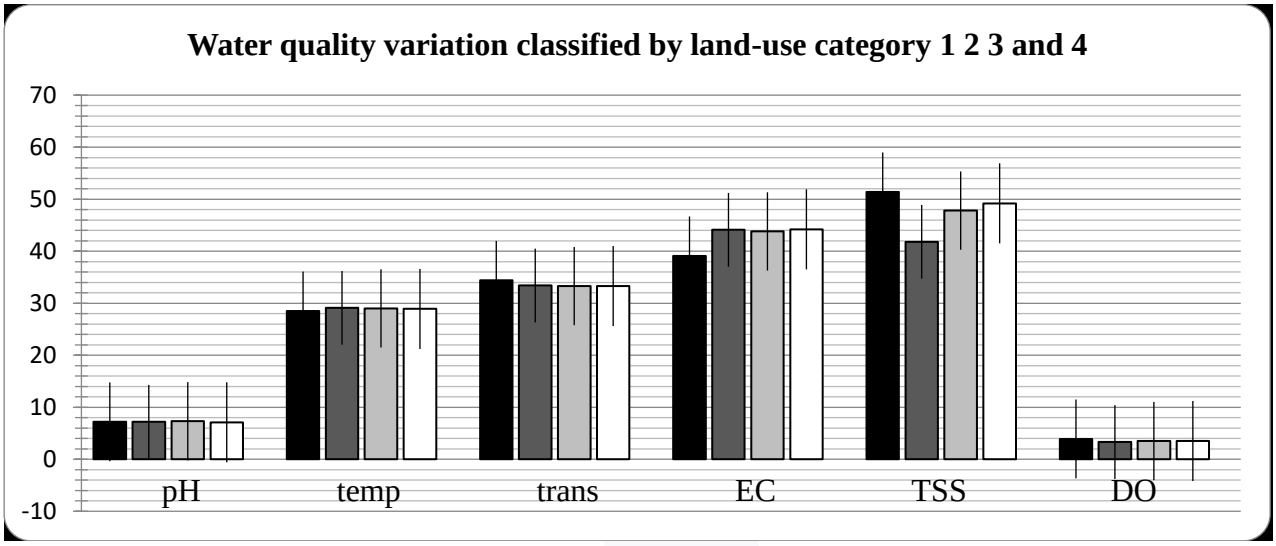

Fig. 2 Water quality index indicators classified by land use

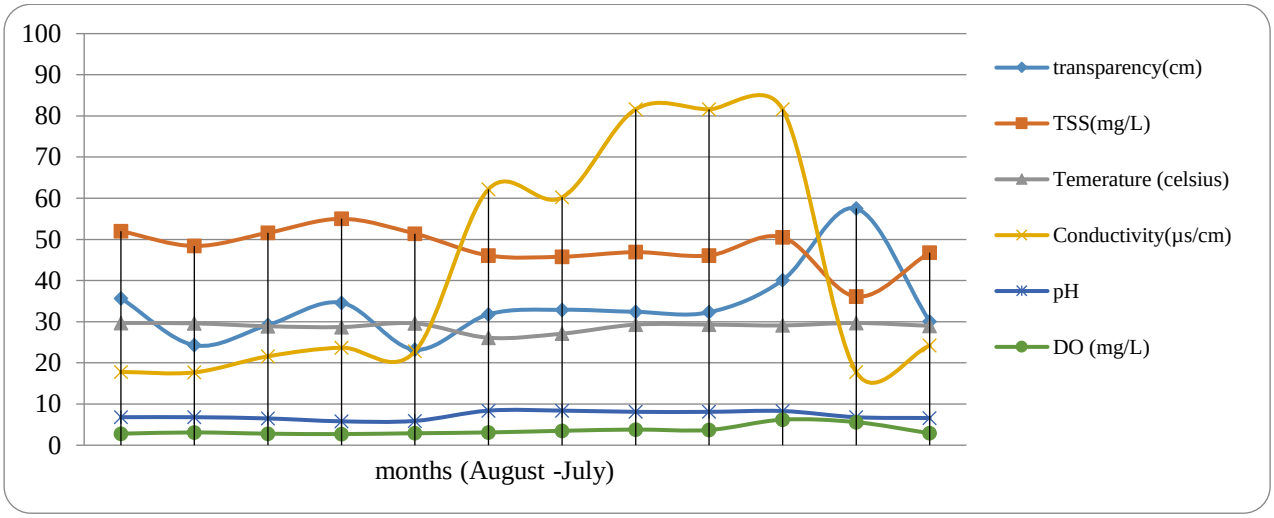

Fig. 3 Water quality index indicators by season

3.2 The relationship study by spatial-temporal variation

Results of the relationship between seasons, land use and water quality presented that pH, temperature, transparency, electrical conductivity and dissolved oxygen were higher in the dry season than rainy season and were significantly different in each season at the level of 0.05. The suspended sediment had the average value during the rainy season higher than the dry season but there were no significant differences at the statistical significance level of 0.05. pH, temperature, transparency, electrical conductivity and dissolved oxygen in each phase of the water quality study station, PR1 - PR11 had no statistically different mean values at the level of 0.05. The suspended sediment in each phase of the water quality study station had statistically significant differences at the level of 0.05 by Suspended sediment values at PR2 and PR8 stations were higher than those at PR3, PR4, PR5 and PR11 stations. pH, temperature, transparency, electrical conductivity, sediment, sediment and dissolved oxygen according to land use have different mean values at no .05 level.

3.3 The relationship study of physical and chemical water quality parameters

pH has a negative relationship with temperature at a moderate level (R = -0.468), and a positive relationship with a high level of conductivity (R = 0.795). The relationship equation as in Table 3 means every Increased electrical conductivity 1 micro-cement per centimeter result in the pH value increased by 0.026 units and all temperature values increased by 1 degree Celsius, resulting in the pH value decreased by 0.242 units, predicted at 70.0 percent. The transparency is positively correlated with dissolved oxygen at a moderate level (R = 0.588). The relationship equation, as in Table 3, refers to every transparency increase of 1 centimeter, resulting in an increase of dissolved oxygen at 0.072 milligrams per liter, forecasted at 34.5 percent and considered the changing seasons by multiple linear regression analysis found that the variable group influencing the prediction of dissolved oxygen levels at a higher level of 59.6 percent. Electrical conductivity has a positive relationship with pH and temperature at a high level (R = 0.803). The equation as in Table 3 means that every pH value and temperature rise 1 unit results in increased electrical conductivity. 26.442 micro-cement per centimeter and forecast at 64.5 percent.

Table 3 Multiple linear regression equation for forecasting of pH, DO and EC

Equation	Percentage of prediction
pH	
pH= 13.127- 0.242(temp)+ 0.026(conduct)	70.0
DO (rainy = 1, dry = 2)	
DO= 0.608+ 0.046 (trans) +1.098 (ss)	34.5
DO= -1.866+ 0.070(trans)+ 0.432(pH)	48.4
DO=-1.937+0.047(trans)+0.371(pH)+0.949(ss)	59.6
Conductivity	
Conduct = -216.13+ 23.348(pH)+3.094(temp)	64.5

3.4 The Implication to water quality variation study and monitoring

Secchi disk transparency using for developing the basically method of study and monitor water quality variation by modified the regression equation of transparency and dissolved oxygen using Simple Correlation and Regression statistics. In the dry season (April - July) and rainy, because dissolved oxygen content the Pattani River slightly decreased as it passed the area of Yala city. In dry season transparency value is related to the high level of dissolved oxygen and in the same direction. The correlation coefficient is 0.867 which has the regression equation equal to DO = 3.256 + 0.061 (transparency); standard.error equals 0.15. This equation can use transparency values to explain the change in dissolved oxygen at 75.2 percent. In rainy season there are too many sediment and mud factors. Causing low-level relationship, correlation coefficient is 0.357. Water quality index for communities can be calculated as a basis for evaluating water quality by use couple of Secchi disk and water quality meaning (table 4).

Table 4

Transparency (cm)	Dissolved oxygen (mg/L)	Water quality meaning
< 10	< 3	Very poor: polluted
10-15	3-4	Poor: somewhere and what polluted
16-30	4-5	Fair: moderately clean
31-60	5-7	Good

The study of the relationship between transparency values and dissolved oxygen shows a high level of correlation. Which can be developed using transparency values as an indicator of water quality for the community to encourage the community to participate in the monitoring of water quality. Using a transparency measuring device, this is a device that communities can create by themselves and simple methods that can be used to assess water quality in the Pattani River. In the summer, especially in the municipality area, which will be another way to monitor for the variation and protection of the quality of the Pattani river.

Fig. 4 Secchi disk and using practice by student

4. Discussion

pH, temperature, transparency, electrical conductivity and dissolved oxygen mean different values in each season. As a result of soil washing resulting in water quality in the rainy season lower than in the dry season. The suspended sediment in each section of the water quality study station had different values. In which the PR2 and PR8 stations, which are There is a floodgate near the community. The sediment values were higher than in the areas of PR3, PR4, PR5 and PR11 [4] but the mean values were not statistically different. Since land use is unclear, it is found that community and agricultural areas tend to affect water quality. The relationship between the water quality index showed that PH had a high level of positive electrical conductivity. Because the water conductivity of the water will vary according to the concentration of the solution which depends on the influence of the environment of the water source or the basin any area with a high pH value means the dissolution of various elements. High, resulting in high electrical conductivity as well [5]. The transparency is positively correlated with dissolved oxygen at a moderate level because the amount of dissolved oxygen is a factor in the photosynthesis of plants. The increased light transmittance increases the photosynthesis [6].

5. Conclusion

The Pattani River that flows through the Yala Municipality is of good quality especially in the dry season, meeting the water quality standards of Class 2 and 3 of surface water sources. The electrical conductivity is classified as Category 1 Irrigation water quality standards for agriculture. pH, temperature, transparency, electrical conductivity and dissolved oxygen mean different values in each season. The suspended sediment in each section of the water quality study station had different values. The sediment suspended values at stations 2 and 8 were

higher than those at 3, 4, 5 and 11, but the mean values were not significantly different according to land use at the level of .05. There were 5 regression relations. And can be applied to the community as 1 equation DO = 0.608+ 0.046 (trans) +1.098 (ss) Because the transparency value uses a tool, a Secchi disk, that the community can develop on its own and has a specific index for use in monitoring especially in community and agricultural areas which has conditions and restrictions of use due to are 1) the suitable time for measurement is between 09.00-14.00 hrs. 2) should not be used on rivers with areas with high waste contamination such as drains because the water quality fluctuations are too high and waterfront areas should have a plan for establishing an integrated water resource management plan by focusing on the management of water quality for consumption and crisis basin management especially in agricultural areas that are often contaminated with heavy metals and food minerals from the use of herbicides and fertilizers while also emphasizing community and public participation in the implementation.

References

[1] Thai Pollution Control Department, **The Monitoring of Environmental Quality**. 2015: 1-3.

[2] UNESCO/WHO/UNEP, 1992, 1996. **Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition**. Published by E&FN Spon, an imprint of Chapman & Hall.

[3] United State Department of Agriculture (USDA), 2003. **National water quality handbook.**

[4] Vichit Rangpan, (2008). **Effect of Water Quality on Periphyton in the Pattani River, Yala Municipality, Thailand**. PhD Thesis Environment Biology Department, Faculty of Biology Science, University of Science Malaysia, Penang.

[5] Uma Seeboonruang, 2012. **A statistic assessment of the impact of land uses on surface water quality indexs**. *Journal of Environmental Management* 101: 134-142.

[6] Ting, H., Liangen, Z., Yan, Z., Chuanying, Z., Jing, L. 2012. **Water quality comprehensive index method of eltrix river in Xin Jiang province using SPSS**. *Procedia Earth and Planetary Science* 5: 314-321.

[7] REO16, 2006-2010. **Water quality in Khlong U-Tapao river basin**, year reports.