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Assessment of water quality variation for agriculture in Bang Pakong River of Thailand

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Abstract The quality of water from the river was carried out from November, 2021 to April, 2022. The water samples were collected from 13 sampling points and analyzed pH, electricity conductivity (EC), salinity, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), chloride (Cl^{-}), sulphate (SO_4^{2-}) and sodium adsorption ratio (SAR). The seawater mixing ratio was calculated using chloride concentration from the river and sea. The maximum pH value (7.56) was observed in February and the minimum value (6.53) was occurred in December among the collection months. The EC and salinity were the highest in February. The highest concentration of cation in water sample was Na^{+} and the lowest value of cation was Ca^{2+}. The concentration of Mg^{2+} was higher than that of Ca^{2+} from February to April. The sequence of major anions in water were $Cl^{-} > SO_4^{2-}$. All parameters were higher in February compared to other collection months. Additionally, the highest seawater mixing ratio was observed in February (25.40%) followed by March (3.87%) and April (1.27%). The acceptable limits of irrigation water were EC (<0.7 mS cm^{-1}), SAR (< 10) and Cl^{-}(<10 meq L^{-1}). The EC (13.90 mS cm^{-1}), SAR (22.81) and Cl^{-} (117.00 meq L^{-1}) values were high in the river water was unsuitable for irrigation in February, which caused many problems to soil and plants. Therefore, it was concluded that the properties of water in Bang Pakong River were changed in every month depend on precipitation and freshwater flow in this region. Besides, presence of high salinity and sodicity of irrigation water other than rainwater could deteriorate the soil properties of valuable agricultural land as well as damaged the crop production. The results provided that the river water was suitable for irrigation in agricultural fields in specific month in order to increase agricultural production in this area.

Keywords: Electrical conductivity, Chloride, Water sodicity, Water salinity

Introduction

Rivers are surface water flows that flow from upstream to downstream and are used for irrigation in agriculture, drinking water sources and other activities. Natural factors and human factors strongly influence on river water quality such as high or low rainfall intensity resulting in a decrease in water quality (Li and Wu, 2019). Water quality is one of the major environmental determinants that affect the ecosystem, agricultural production and socio-economic development of a country

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(Islam *et al.*, 2016). Carbonate, bicarbonate, magnesium, calcium, sulphate, and hardness are significant ions which at high concentration can alter suitability of irrigation water for use (Choudhary *et al.*, 2007). Poor irrigation agriculture in arid and semiarid regions results in land degradation through soil salinity and sodic soil developments in different parts of the world (Awulachew *et al.*, 2007). Salt intrusion is the movement of saline water into freshwater aquifers resulting in contamination of water resources. Salinity intrusion can occur during the events of reduced streamflow caused by severe drought due to climate change-related sea level rise (Hegde, 2019). Fresh water is commonly over the top of the heavier seawater and serves to push the seawater interface seaward.

The seawater intrusion problem is one of the most critical environmental issues that negatively impacts on groundwater resources significantly since groundwater salinity can lead to a reduction in fresh water availability and the degradation of groundwater quality. The saltwater intrusion increases with decrease of groundwater recharge and rise of water demand during summer season. Water management sectors such as agriculture, domestic and industrial water supply may be affected by the salinization of groundwater systems. Increasing salinity from saltwater intrusion which will affect agriculture, aquaculture, infrastructure, coastal ecosystems, and the availability of freshwater for household and commercial use, this will create negative impact on livelihoods and public health (Sukumaran and Raj P, 2020).

The seawater contains a high salt, mainly sodium chloride (NaCl), the combination of between the base cations such as potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}) and sulphate (SO_4^{2-}), bicarbonate (HCO_3^-), chloride (Cl^-) (Erfandi and Rachman, 2011). Plant roots uptake water that includes a little amount of dissolved salts, leaving major portion of the salts at the root surrounding. Generally, investigation of irrigation water quality should focus on salt content, sodium concentration, nutrients and trace elements, alkalinity, and acidity. Because salinity problem has led to the loss of fertile soils all over the world every year (Numaan, 2011). Naturally, water evaporates and the dissolved salts are left in the soil complex. Within a few years, the salt accumulation gradually increases in the soil, which cause salinity hazard and toxicity (Srinivasamoorthy *et al.*, 2014). Seawater intrusion in accordance with the rising in sea level has transited into the soil and freshwater systems that cause secondary salinity. Besides, the available freshwater content was inadequate to extrude the seawater flow because the drought phenomenon had occurred in Thailand since 2015 (Phankamolsil *et al.*, 2021) and it is still a serious problem in Thailand.

In Thailand, there are five major rivers such as Chaopraya, Pasak, Ratchaburi, Petchaburi and Bang Pakong. Among them, Bang Pakong is 230 km long and it is the main river in eastern part of Thailand. It originates from the combination of Prachinburi and Nakhonnayok Rivers in Bansang district, Prachinburi province, and discharges into the Gulf of Thailand in Bangpakong district, Chachoengsao province. The people in Prachin Buri, Nakorn Nayok, and Chachoengsao provinces use the water mainly for irrigation, aquaculture, animal farming and industry (Bubphamala *et al.*, 2010). Moreover, most of the major rivers in Thailand flow directly into the Gulf of Thailand, these rivers serve as the major source of fresh water for the great Central Plane where the agricultures, livestocks, fisheries, industrials community and human activity are settled down. There is salt water intrusion from sea level rising along these major rivers to several kilometers in land between during the dry period from January to June every year. The salt water intrusion has directly affected on agricultural areas, industries and people who living along the river bank on domestic consumptive use (Ratanajaruraks, 2009).

According to the water resources classification of Thailand, the Bang Pakong River was ranked as class 3 for medium clean water, and it is suitable for agricultural use (Bubphamala *et al.*, 2010). The Royal Irrigation Department (RID) is working to prevent seawater flowing into Bang Pakong River to minimize influences on local people and farmlands in the river basin areas. The total of 2.3 million cubic meter of fresh water is being discharged daily from reservoirs to the river to minimize salinity, which is being affected by seawater intrusion. The attempt is made in order to ensure crops in the farms using water from Bang Pakong River will not be damaged from the increase of salinity (National News Bureau of Thailand, 2017). Bang Pakong River flows through 4 provinces (Prachinburi, Nakhon Nayok, Chachoengsao, Chonburi) and at the center of the basin Bang Pakong Dam built to protect against seawater intrusion and to store freshwater for dry season usage. But dam operations have exacerbated environmental problems including pollution, eutrophication, and erosion of riverbanks. Therefore, the seawater still flowed into Bang Pakong River especially in dry season as seawater move from estuary through Prachinburi province. Due to the intensive land use for agriculture, urban expansion including the climate change crisis tend to exacerbate these problems (Chaiyarak *et al.*, 2019). Khlong Khuean district is a district in Chachoengsao province which Bang Pakong River flows through and locates above Bang Pakong Dam. Around 70% of land use are agriculture and no watergate to prevent seawater with different from the area under Bang Pakong Dam. Then, water salinity and soil salinity accumulation in this area will cause a serious problem in the future.

Therefore, the objective of the study was to investigate the water salinity status and water properties related to salinity in Bang Pakong River under different collection months.

Materials and methods

Water sampling area

The Bang Pakong River along Khlong Khuean District, Chachoengsao Province was selected as water sampling area for this study (Figure 1). It was also about 230 kilometers long and 100 meters wide during the flow through Chachoengsao province. The sampling point was located above the Bang Pakong Dam, a dam for preventing seawater intrusion and occupied with paddy field and orchards, the main plantation of Chachoengsao Province. The 13 points (R1 to R13) were selected to collect water sample. The minimum and maximum temperatures were 26.0°C and 31.0°C during the sampling months. Furthermore, the water sample was also collected from the Gulf of Thailand to calculate seawater mixing ratio. The water sampling was started from November 2021 until April 2022.

Sampling depth

The Water sample was collected at a depth of 1 m from the surface of the water of the Bang Pakong River and the Gulf of Thailand.

Sampling tools and containers

The clean sampling tools and containers were used for collecting water sample. The grab sampler was used to collect water samples from the river. The water sample was put into the plastic bottle. After collection, the sample was maintained at 4 ℃ before analysis.

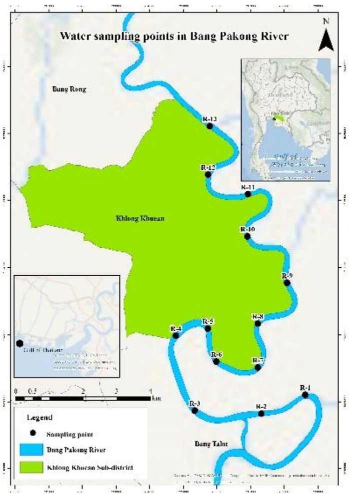

Figure 1. Thirteen water sampling points in Bang Pakong River

Preparation of water sample and analysis

The water sample was filtered through a Whatman No.1 filter and analyzed for water quality. The pH and EC were measured by using meters. The Ca^{2+}, Mg^{2+}, Na^{+}, and SO_4^{2-} were analyzed using Inductively Coupled Plasma - Optical Emission Spectrometer (ICP-OES). The Cl^{-} content was determined with the standard silver nitrate (0.01N) titration method and in the presence of 5 % potassium chromate as an indicator (Richards, 1954). The sweater mixing ratio (F) was calculated using Cl^{-} content from river and sea water in November 2021. The SAR and seawater mixing ratio were calculated by using the following equations.

$$SAR = \frac{[Na^{+}]}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

(Aderoju and Fetus, 2013)

$$F = \frac{[Cl_{Sample}] - [Cl_{Fresh}]}{[Cl_{Sea}] - [Cl_{Fresh}]} * 100$$

(Trabelsi *et al*., 2011)

F = Seawater mixing ratio (%)
Cl_{Sample} = Chloride concentration of the sample (meq L^{-1})
Cl_{Fresh} = Chloride concentration of fresh water (meq L^{-1})
Cl_{Sea} = Chloride concentration in seawater (meq L^{-1})

Statistical analysis

The data were analyzed statistically by SPSS version 28. Analysis of variance (ANOVA) was performed and mean comparison was done using Tukey test at a 0.05 significant level.

Results

pH

The pH value was measured in 13 sampling points of Bang Pakong River from November 2021 to April 2022 (Table 1). There was no significant difference in pH value in November, February and March. However, the pH was significantly different in all sampling points in December, January and April. According to this result, the pH value was low in November, December, February, March and April compared to January. The average pH values ranged from 6.53 to 7.32, 6.22 to 6.92, 7.12 to 7.56, 6.89 to 7.11 and 6.94 to 7.16, 7.07 to 7.26, respectively. The lowest pH value was found in R1 in all months except November. The highest values were observed in R11, R14, R8, R2 and R7 among the sampling points in each month.

Table 1. The monthly changes of pH value in water sample from Bang Pakong River, 2021- 2022

Sample	Nov	Dec	Jan	Feb	Mar	Apr
R1	7.32 a	6.22 b	7.12 c	6.89 a	6.94 a	7.07 b
R2	6.9 a	6.70 ab	7.36 abc	6.94 a	7.16 a	7.16 ab
R3	7.07 a	6.78 ab	7.37 abc	6.98 a	7.09 a	7.23 ab
R4	6.92 a	6.81 a	7.56 a	6.97 a	7.02 a	7.25 ab
R5	6.88 a	6.91 a	7.42 ab	7.04 a	7.13 a	7.23 ab
R6	6.79 a	6.87 a	7.44 ab	7.04 a	7.13 a	7.22 ab
R7	6.63 a	6.86 a	7.38 abc	7.02a	6.98 a	7.26 a
R8	6.55 a	6.60 ab	7.21 bc	7.11 a	7.05 a	7.21 ab
R9	6.54 a	6.91 a	7.37 abc	7.05 a	7.09 a	7.22 ab
R10	6.57 a	6.88 a	7.39 abc	7.01 a	7.15 a	7.21 ab
R11	6.57 a	6.92 a	7.42 ab	7.01 a	6.99 a	7.22 ab
R12	6.56 a	6.78 ab	7.52 a	7.05 a	7.02 a	7.13 ab
R13	6.53 a	6.61 ab	7.41 abc	7.06 a	7.08 a	7.14 ab
F test	ns	**	**	ns	ns	*
CV %	5.46	3.21	1.70	1.01	1.23	0.85

The letters in same column indicated no significant difference. ns- no significant difference, * - significant at 0.05 level, ** - significant at 0.01 level by Tukey test.

Electrical conductivity (mS cm^{-1})

The EC value was measured in 13 sampling points of Bang Pakong River from November 2021 to April 2022 (Figure 2). The EC value was significantly different in all sampling points for all collections months except November. The lowest EC value was observed in November among collection months in all points while the highest value was resulted in February. The average EC values ranged from 0.15 to 0.19 mS cm^{-1}, 0.26 to 0.35 mS cm^{-1}, 0.24 to 0.47 mS cm^{-1}, 6.80 to 13.90 mS cm^{-1}and 0.31 to 2.46 mS cm^{-1}, 0.44 to 0.78 mS cm^{-1}, respectively. The minimum values were resulted in R13 among the sampling points in all months except November. The maximum EC values were occurred in R1 in all months except March and April.

Salinity (g L^{-1})

The salinity value was significantly increased among sampling points in all months except November (Figure 2). The salinity content of the 13 water samples of Bang Pakong River varied ranging from 0. 09 to 0.14 g L^{-1}, 0.16 to 0.23 g L^{-1}, 0.15 to 0.30 g L^{-1}, 4.35 to 8.89 g L^{-1}, 0.20 to 1.15 g L^{-1} and 0.28 to 0.50 g L^{-1} for six months, respectively. The highest salinity was observed in February among the collection times. The lowest values were observed in R13 in all collections except November. The highest values were shown in R1 in all months except April.

Calcium (meq L^{-1})

The calcium value was measured from 13 sampling points in Bang Pakong River from November 2021 to April 2022 (Figure 3). The Ca^{2+} value was not significantly different in all sampling points in November, December and April, however, it was highly significant difference in January, February and March. Generally, the Ca^{2+} value was lowest in November and the highest Ca^{2+} value was observed in February among collection months. The Ca^{2+} content ranged from 0.27 to 0.49 meq L^{-1}, 0.63 to 0.69 meq L^{-1}, 0.53 to 0.69 meq L^{-1}, 2.92 to 5.16 meq L^{-1}, 0.60 to 1.38 meq L^{-}1 and 0.72 to 0.81 meq L^{-1} in each month, respectively. The maximum Ca^{2+} values were given by R1 from December to February and R3 in November, March and April. The R13 showed the lowest value in all months except November and April.

Magnesium (meq L^{-1})

The magnesium value was measured from 13 sampling points in Bang Pakong River from November 2021 to April 2022 (Figure 3). There was highly significant difference in Mg^{2+} content in all sampling points for each month except November. The Mg^{2+} value was the lowest in November and the highest value was observed in February among collection months. The Mg^{2+} content ranged from 0.20 to 0.37 meq L^{-1}, 0.54 to 0.66 meq L^{-1}, 0.46 to 0.84 meq L^{-1}, 10.71 to 22.20 meq L^{-1}, 0.57 to 3.74 meq L^{-1} and 0.69 to 1.17 meq L^{-1} in each month, respectively. The maximum Mg^{2+} values were given by R1 from December to March and, R3 in November, March and April. The R13 showed the lowest Mg^{2+} value in all collection months.

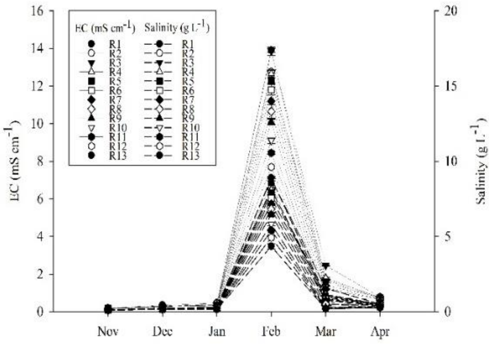

Figure 2. The monthly changes of EC and salinity values in water sample from Bang Pakong River, 2021-2022

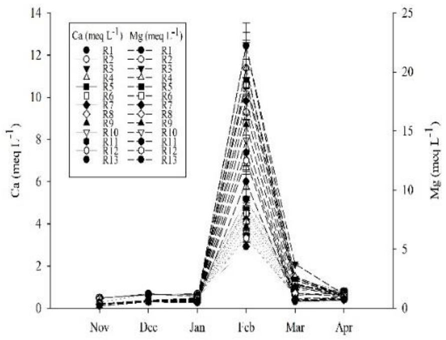

Figure 3. The monthly changes of Ca^{2+} and Mg^{2+} values in water sample from Bang Pakong River, 2021-2022

Sodium (meq L^{-1})

The sodium value was measured in 13 sampling points of Bang Pakong River from November 2021 to April 2022 (Figure 4). The Na^+ content was not significantly different in all points in November, however, it was highly significantly different in other months. The Na^+ value was the lowest in November and the highest value was observed in February among collection months. The Na^+ content ranged from 0.38 to 0.72 meq L^{-1}, 1.16 to 1.60 meq L^{-1}, 1.10 to 2.40 meq L^{-1}, 40.75 to 84.37 meq L^{-1}, 1.38 to 13.88 meq L^{-1} and 1.65 to 3.54 meq L^{-1} in each month, respectively. Moreover, the maximum Na^+ values were given by R1 from December to February, R5 in November and R3 in March and R2 in April among the sampling points. The R13 showed the lowest Na^+ value in all months.

Sodium adsorption ratio (SAR)

The SAR value was calculated from 13 sampling points in Bang Pakong River from November 2021 to April 2022 (Figure 4). The SAR value was highly significant different in all sampling points for all months except November. Generally, the SAR value was the lowest in November and the highest value was observed in February among collection months. The average SAR values ranged from 0.74 to 1.10, 1.49 to 1.95, 1.55 to 2.74, 15.61 to 22.81, 1.80 to 7.19 and 1.95 to 3.60, respectively. The minimum values were resulted in R13 among the sampling points in all months. The maximum SAR values were occurred in R1 from November to February, R4 in March and R2 in April.

Chloride (meq L^{-1})

The chloride content was significantly different among sampling points in January, February, March and April. (Figure 5). However, it was not significantly different in November and December. The Cl^- content of the 13 water samples of the Bang Pakong River varied ranging from 0. 00 to 1.10 meq L^{-1}, 1.00 to 1.55 meq L^{-1}, 1.10 to 2.70 meq L^{-1}, 55.25 to 117.00 meq L^{-1}, 1.60 to 15.50 meq L^{-1} and 1.80 to 4.40 meq L^{-1} for six months, respectively. Among the collection times, it was found that the Cl^- values were highest in February. In November, the highest Cl^- value was shown in R13 among the sampling points. However, the maximum Cl^- values were resulted in R1 from December to February. In March, the R2 gave the maximum Cl^- content and the minimum value was observed in R13. The R3 and R2 gave the maximum Cl^- content among all points in March and April.

Sulphate (mg L^{-1})

The sulphate value was measured in 13 sampling points of Bang Pakong River from November 2021 to April 2022 (Figure 5). The SO_4^{2-} content was significantly different among sampling points in all months except November. It was observed that SO_4^{2-} was not in water sample from River in November. The SO_4^{2-} value was the lowest in December and the highest value was occurred in February among collection months. The SO_4^{2-} content ranged from 6.88 to 8.32 mg L^{-1}, 6.09 to 9.14 mg L^{-1}, 101.36 to 211.54 mg L^{-1}, 7.17 to 31.26 mg L^{-1} and 11.63 to 13.07 mg L^{-1} in each month, respectively. Moreover, the maximum SO_4^{2-} values were given by R1 from December to March and R3 in April. The R13 showed the lowest sulphate value in all months except December.

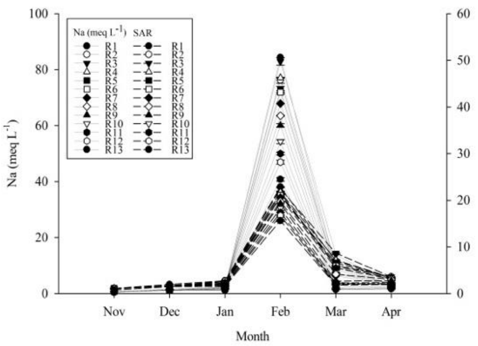

Figure 4. The monthly changes of Na^{+} and SAR values in water sample from Bang Pakong River, 2021-2022

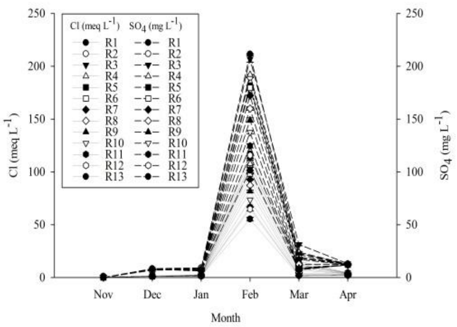

Figure 5. The monthly changes of Cl^{-} and SO_4^{2-} values in water sample from Bang Pakong River, 2021-2022

Seawater mixing ratio (%)

The lowest chloride content of water sample was taken as the chloride content of fresh water. The seawater mixing ratio was changed in every month in Bang Pakong River (Figure 6). The seawater mixing ratio was not significantly different in December, but it was significantly different in other months. The seawater mixing ratio ranged from -0.02 to 0.23 % in December, 0.08 to 0.45 in January, 11.82 to 25.40 % in February, -0.04 to 3.87 % in March and 0.11 to 3.31 % in April. There was significant difference in seawater mixing ratio in sampling points for all months except December. The lowest mixing ratio was occurred in R13 while the highest values were found in R2 in January and March, R1 in February and R3 in April among the collection months.

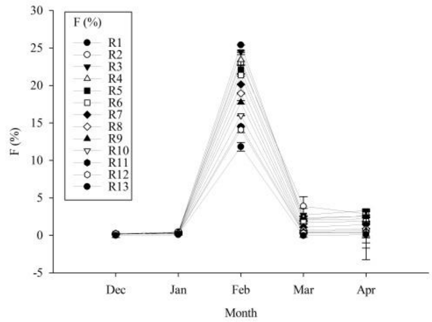

Figure 6. The monthly changes of seawater mixing ratio in Bang Pakong River, 2021-2022

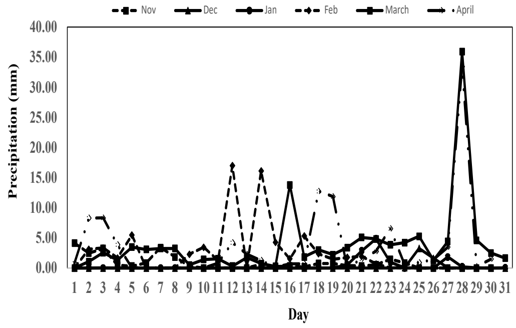

Figure 7. The daily changes of precipitation in Bang Pakong River, November 2021 to April 2022

Discussion

In this study, the pH value was over 7.00 in January and April, however the value was lower than 7.00 in other months. Basically, the pH value was a good indicator for determining whether water was hard or soft. The normal range for pH in surface water systems was in the range of 6.5 to 8.5. The higher value of pH represented that there was high chloride, bicarbonate, carbonate in the water samples that means the water was alkaline (Maraz *et al*., 2021).

The EC which means the concentration of salt content in water was a critical parameter for evaluating the suitability of water for the purpose of irrigation (Haritash *et al*., 2016). According to EC value, water was classified as non-saline (<0.7 mS cm^{-1}), slightly saline (0.7-2.0 mS cm^{-1}), moderately saline (2-10 mS cm^{-1}), highly saline (10-25 mS cm^{-1}) and very highly saline (25-45 mS cm^{-1}). The water with EC less than 0.7 mS cm^{-1}could be used for irrigation without any restriction. However, EC within the range of 0.7-3.0 mS cm^{-1} had slight to moderate restriction and EC greater than 3.0 mS cm^{-1} had severe restriction on use for irrigation (Roy *et al*., 2020). In this study, the maximum EC value (13.90 mS cm^{-1}) was resulted in February among collection months and the water in all points are moderately and highly saline. But the EC value was lower than 0.7 mS cm^{-1} from November to January. This might be due to excessive dilution effect arising from amply of precipitation in Bang Pakong River and inflow from upstream in wet season (Figure 7). The precipitation infiltrated and leached downward to recharge groundwater, which could refresh and dilute the salt of the soil water or groundwater during the rainy season (Wang *et al*., 2012). Furthermore, the maximum value was found in R1 compared to other points. This might be due to the seawater came from the Gulf of Thailand because the R1 was located near the sea.

The highest salinity was found in February among the collection months in this study. The lower values were shown in November, December, January, March and April because of precipitation in this area. The groundwater salinity sharply increased during the dry season, when no precipitation event occurred in that region. The precipitation influenced salt dilution in groundwater. A sufficient amount of rainfall diluted salt in groundwater and decreased the groundwater salinity (Yan *et al*., 2015). The result of previous study recorded lower levels of EC and salinity were due to dilution effect of the ionic composition of the water resulting from precipitation during monsoon season (Huang *et al*., 2014).

In this study, the Mg^{2+} concentration was higher than Ca^{2+} concentration in water sample from February to April, however, it was lower than Ca^{2+} in the first three months. Naturally, Ca^{2+} and Mg^{2+} maintain an equilibrium state in fresh water body. Soil quality and crop yield are adversely affected if Mg^{2+} content is high in water by causing alkaline nature of water (Kumar *et al*., 2007).

The Na^+ content was higher in River water compared to Ca^{2+} and Mg^{2+}. Irrigation water has high Na^+ content can bring about a displacement of exchangeable cations such as Ca^{2+} and Mg^{2+} from the clay minerals of the soil, followed by the replacement of the cations by Na^+. Sodium-saturated soil loses permeability, so that it decreases fertility for cultivation (Islam and Shamsad, 2009). The Na^+ content was maximum in R1 among collection points (Figure 4). This might be due to the seawater came from the Gulf of Thailand because the R1 is located near the sea. Therefore, the SAR value was higher in R1 than that of other points. High SAR in any irrigation water implies hazard of Na^+ replacing Ca^{2+} and Mg^{2+} of the soil through cation exchange process, a situation eventually damaging to soil structure and it ultimately affects the fertility status of the soil and reduce crop yield (Gupta, 2005). The SAR at high level has a noticeable drop in the infiltration rate, which means very limited amount of water is available to plant (Saleh, 2016).

The small amount of Cl^- in the irrigation water was important to crops, however, the high level of Cl^- affected on the plant survival. The standard limit of Cl^- is 10 meq L^{-1} (300 mg L^{-1}) (Hamza, 2012). However, the Cl^- concentration of 4 meq L^{-1} (140 mg L^{-1}) negatively affected on the plant leaves (Al-Shammiri *et al*., 2005). Based on the results, the maximum Cl^- (117.00 meq L^{-1}) content was occurred in February in this study (Figure 5). It was over the acceptable limit in February. Besides, the Cl^- value was higher in some collecting points in March and April.

Although SO_4^{2-} was a major contributor to salinity, its toxicity was a rarely problem except at very high concentrations which may interfere with uptake of other nutrients (Ibrahim, 2014). It was widely distributed in nature and it might be present in natural waters at concentrations ranging from a few to several thousand milligrams per liter. The acceptable limit was 250 mg L^{-1} (Iowa Department of Natural Resources, 2009). The highest value of

SO_4^{2-} was occurred in February followed by March and April. However, the value in February was lower than acceptable limit in all points

The highest seawater mixing ratio was resulted in R1, R2 and R3 among the sampling points. This might be due to these sampling points were near Gulf of Thailand. On the other hand, the lowest value was occurred in R13. It may seem that the nearer the sea, the higher the seawater mixing ratio. The mixing sweater was lower in areas which far from the sea.

The previous studies reported that the contents of cations and anions associated with salinity of the rivers were higher in the dry season compared to the monsoon because of lack of freshwater input from upstream. From October (post-monsoon) to late May (pre-monsoon), salinity generally increased with the gradual reduction in the freshwater flow. The salinity level decreased in the wet season during September or early October as a result of rainfall and increased upstream flow of freshwater (Dasgupta *et al*., 2014).

From this investigation, the Na^+ concentration was higher than other cations and the Cl^- value was higher than other anions in water sample. During the study period, all parameters were higher in February compared to other collection months. Additionally, the highest seawater mixing ratio was observed February followed by March and April. The EC, SAR and Cl^- values in the river water was unsuitable for irrigation in February, which cause many problems to soil and plants. Besides, presence of high salinity and sodicity of irrigation water other than rainwater can deteriorate the soil properties of valuable agricultural land as well as damage the crop production. Therefore, it was concluded that the properties of water in Bang Pakong River were changed in every month depend on precipitation and fresh water flow in this region. Furthermore, the results provided that the river water was suitable for irrigation in agricultural fields in specific month in order to increase agricultural production in this area.

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