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Effects of water quality assessment and soil sedimentary deposition through the floating basket aquaculture in the Chi River environments

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ABSTRACT

The survey and experimental research methods to assess water quality assessment and soil sedimentary deposition through the floating basket aquacultures of the Chi River in Northeast region, Thailand through the sub-section Mahasarakham Province flowed and the collecting determination data along the 122-length kilometers at six waterway stations, and six soil sedimentary points for the scheduled times in three seasons from January to July 2017 under the fish floating basket aquacultures were measured and assessed to the key parameters: pH, Dissolved Oxygen (DO), Oxygen used in Biochemical Oxygen Demand (BOD), Nitrate (NO_3^--N) and Orthophosphate (PO_4^{3-}) through utilizing the efficiency of water. The analyzing parameter data indicates the mean averages of temperature ranged 24.06–26.93°C, transparency as 16.66–46.33 cm., pH value ranged 6.76–7.30, DO quantity was 4.24–4.89 mg/L., BOD was 2.86–4.03 mg/L., NO_3^-–N was 0.48–0.90 mg/L., and PO_4^{3-} was 0.24–0.47 mg/L, for assessing the determination of the river water quality. The soil sediments' types were deposited that composed of sandy loam, sand, loam, and clay loam at six stations. The mean averages for each parameter; pH value was 5.27–6.73, the EC was 0.06–0.41 ms/cm, OM value as 0.02 – 1.36 %, nitrogen quantity was 0.00-0.06%, and available PO_4^{3-} was 28.12–158.19 mg/kg. There also found that the comparisons between each parameter from six sampling points are differentiated at the level of .05, significantly.

Keywords: Water quality assessment, soil sedimentary deposition, floating basket aquaculture, Chi River, utilizing efficiency, water resource.

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INTRODUCTION

Thailand location, a comprising an area of 514,000 km² in Southeast Asia, Northeastern Region is a square shaped plateau almost completely surrounded by mountain ranges and divided into two basins by a relatively small mountain range (McCarthy, 2006). The soil has four important functions: it is a medium for plant growth; a means of water storage, supply, and purification; a modifier of Earth's atmosphere (Danoff-Burg, 2017). Traditionally, they transplant rice seedlings when the floating basket aquaculture in the Chi River environments is sufficiently flooded without fear of drought (Thai Land Development Department, 2013) (Figure 1).

a) Freshwater aquaculture in the Chi River b) Effects change with the freshwater aquaculture

Fig. 1: Environmental water source in the Chi River according to the floating basket aquaculture in the Chi River environments
Source: Kasemsiri & Thaimueangphon (2515)

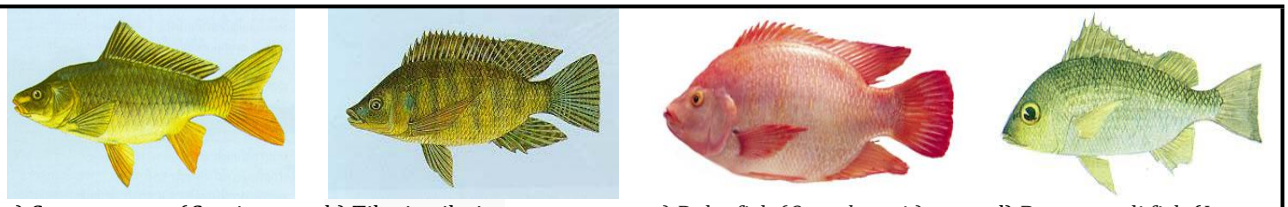
Fish aquaculture production in Thailand

Fish is the primary source of animal protein for most of Thailand's population, particularly those in the coastal provinces. About one-third of those employed in the aquaculture. Particularly in activities related to feeding preparation, feeding, harvesting, processing, accounting, and marketing (Yenpoeng, 2017).

Freshwater aquaculture

Freshwater aquaculture is carried out either as monoculture or polyculture, depending on the species

cultured. Monoculture is not only common for raising carnivorous species. Polyculture is employed principally to raise herbivorous and filter-feeding species, such as tilapia, silver barb, common carp, Chinese carps, and milrigala for cage culture (Figure 2).



a) Common carp (*Cyprinus carpio*) b) Tilapia nilotica (*Oreochromis niloticus*) c) Ruby fish (*Oreochromis*) d) Barramundi fish (*Lates calcarifer)*

Fig. 2: Types of fishes raised up for floating basket aquaculture in the Chi River
Source: Voicetv.com (2014)

Fish utilization

Around 24% of marine fish was consumed fresh and the remaining was processed into chilled, frozen, canned, or steamed, smoked, dried and/or salted, and/or converted into shrimp paste or fish sauce. All freshwater fish was used as food and as much as 76% was consumed fresh (Department of Fisheries of Thailand (DOF), 2016).

Fish aquacultures in a river in Thailand

Cage-based or Floating Basket Aquacultures in rivers raise issues of natural resource management more familiar to fisheries management than aquaculture in fishponds on private land. Hybrid red and black Nile tilapias (Oreochromis niloticus L) are reared for 4 - 5 months in floating basket aquacultures in the upper Ping River in northern Thailand. Fish farming was usually a component of a portfolio of household activities (Government of Thailand, 2010) (Figure 3).

Fig. 3: Samples the floating basket aquaculture in the 25 rivers in Thailand
Source: Postsod (2017)

The Chi River Basin

The Chi River is the longest river flowing wholly within Thailand. It is 765 kilometers (475 mi) (Government of Thailand, 2010). The river rises in the Phetchabun mountains then runs east through the central Northeastern provinces of Chaiyaphum, Khon Kaen, and Maha Sarakham then turns south in Roi Et, runs through Yasothon and joins the Mun River at Sisaket Province (Kuntiyawichai et al, 2008) (Figure 4).

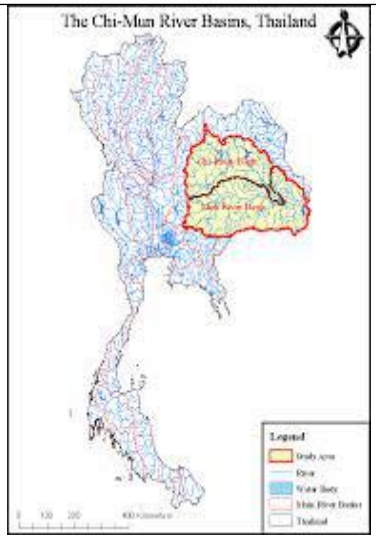
The geographical Chi River

The Northeastern is a dry plateau at 100 to 200 m elevations. Based on geographical characteristics, the average annual rainfall for the country is about 1,700 mm. The total annual rainfall of all river basins is about 800,000 million m^3 of which 75% of the amount is lost through evaporation (Figure 4).

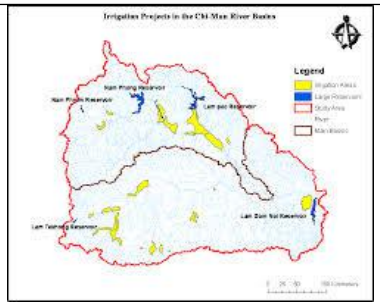
Thus, the available water quantity was 3,300 m^3/capita/year. The Chi River system, the longest river of Thailand; whereas the origin from Petchbun Mountains flows into Nakhon Ratchasima, Khon Kaen, Maha Sarakham, Kalasin, Roi-Et, Yasothorn, and joined the Mun River at Sisaket Province (Office of National Water Resources Committee, 2000) (Figure 4).

Previous water quality in the Chi River situation

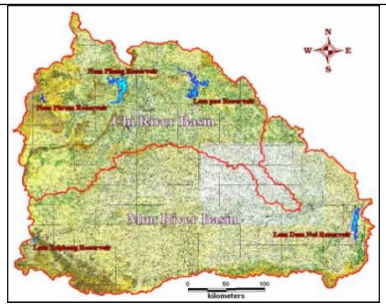
Water quality in the Chi river situation that reported from research studied in 2014, in terms of water temperature ranged 22.50-31.10°C, pH = 6.83-8.16, conductivity = 327.80-566.90 µs/cm, dissolved oxygen = 2.00-6.40 mg/l, Total Suspended Solids (TSS) as 17.00-138.67 mg/l, chlorophyll A 1.07-12.02 mg/l, NH_3-N = 0.07-0.40 mg/l, NO_3^--N 1.80-4.50 mg/l, and PO_4^{3-}-P with a limit of detection of 0.01 mg/l (Kasamesiri & Thaimuangphol, 2015). Coliform bacteria total 90-50,000 MPN/100 ml and Peacoliform bacteria 20-20,000 MPN/100 ml, which are only some of the streams that are higher than the standard (Mongkolsawat & Thirangoon, 1990).



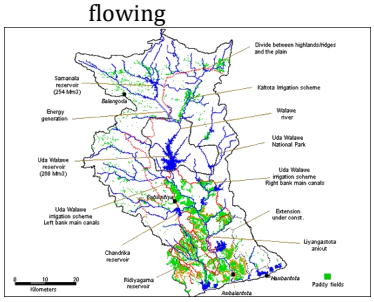
A) Map of the Chi River Basin in Northeastern Region of Thailand



B) Focused on the Chi River flowing



C) The Chi River location photo is rated 1:1000



D) Map of the Chi River Basin

E) Petchabun Mountains, the origin of Chi river

F) Tributary of the Chi Water in the Rain Fall Season

G) Main river in the summer season

H) the floating basket aquaculture in the Chi River

Fig. 4: Maps and geographical model (A, b, C), the Chi River Basin map (D), the Petchabun Mountains, the origin of Chi river (E), The water quality in different seasons (F, G), and the floating basket aquaculture in the Chi River environments (H)
Source: Water Crisis Prevention Center (2014)

Fish aquacultures in the Chi River

Environmental scientists work to understand how these systems function, which in turn helps to identify the sources and fates of contaminants. Environmental lawyers and policymakers work to define legislation with the intention that water is maintained at an appropriate quality for its identified use (Wongsomsak, 2010) (Figure 5).

Fig. 5. Samples of the floating basket aquaculture in the Chi River environments that an important of the occupation of people who are supported form the Thai's Government

The parameters for measuring water quality

Measurements commonly made on-site and in direct contact with the water source in question include temperature, pH, dissolved oxygen, conductivity, and oxygen reduction potential (ORP), turbidity, and Secchi disk depth (Land Development Department, 2009).

Soil sedimentary deposition in the river water quality

Sedimentation is a process whereby soil particles are eroded and transported by flowing water or other transporting media and deposited as layers of solid particles in water bodies such as reservoirs and rivers, it is a complex process with watershed sediment yield, the rate of transportation and mode of deposition (Kohyama & Subhasaram, 1993). Sediment deposition reduces the storage capacity and lifespan of reservoirs as well as river flow (Hewitt, 2004). The sediment load was determined

by multiplying the sediment load at a particular gauge by the area of influence (Moncharoen & Wiensil, 2001).

Materials and methods

The fish farmers have the producing business process on fresh fish food for their floating basket aquacultures are contributed. The quality of water to relate to the soil sediment is available that used to synthesize of the Chi River.

Research Objectives

To access and analyze the physical and chemical water quality whereas the part area of the fish floating basket aquacultures for solving-problem water quality that was deposited of soil sedimentation in the Chi River, whereas it flows past the environmental area in Maha Sarakham River Basin.

Design and Analyze for testing the Chi water quality

Quality of the Chi water is a relative concept expressed in terms of the variables (physical, chemical and biological) are tested and measured. The comparisons between variables are integrations on water quality usually yield diverse data types and design was associated. Using the parameter included: physical water quality; Temperature by Thermometer and Transparency. Chemical water quality: pH, Dissolved Oxygen (DO), Oxygen used in Biochemical Oxygen Demand (BOD), Nitrogen in the form of nitrogen (NO_3^--N) and orthophosphate (PO_4^{3-}), to design and analyze. The physical sediment properties include soil evaluation. The properties of soil sediments are pH, the water EC, organic matter, and total Nitrogen and Phosphorus quantities.

Primary Data by Survey

Area survey, general information of the river is the water head, dividing, tributary, and Main River, branch, flowing through the width of the river, and watershed flood plain, the water uptake in the river, the direction, and the flow of the river.

Secondary Collecting Data

The general characteristics of the Chi river basin, the physical characteristics of the basin, topography climate, geographical environment, and beneficial land was modified.

The checking point was the determining empirical data in the river at six waterway stations, and six soil sedimentary points in three seasons from January to July 2017.

Station 1: Kok Village, Kosum Phisai District (16º 20'55 "N 102º57'52" E)

Station 1: Kok Village, Kosum Phisai District
Many fish floating basket aquacultures are fish on both sides of the Chi River. The water is clear, yellowish, with a foul odor, and the smell of fish food is spreading over the fishponds on the shore, and there are grass covers on both sides of the river.

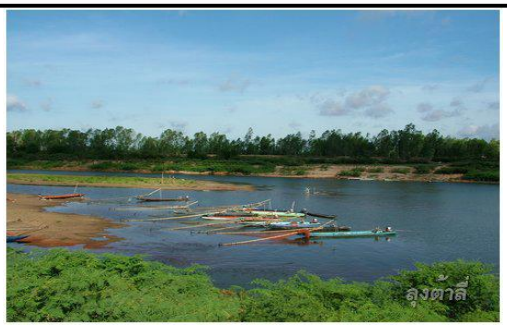
Fig. 6: General conditions of the station area, roasting around the floating basket aquaculture fish cage in Kok Village whereas the 1st station

Station 2: Leng Tai Village, Kosum Phisai District (16o12'50 "N 103º07'52" E)

Station 2: Leng Tai Village, Kosum Phisai District
There is a lot of fish farming in floating basket aquacultures. The water looks yellowish. The smell of food used for fish farming around the shore fish farming and the grass covering both sides next to the shore up.

Fig. 7: General conditions of the sampling station at Leng Tai Village

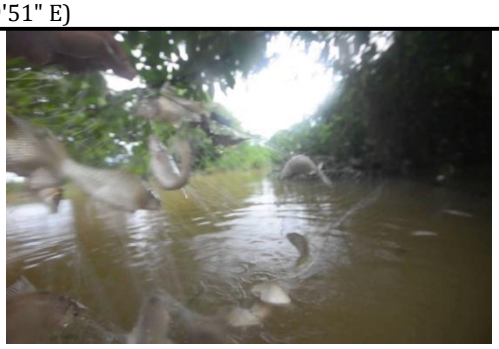
Station 3: Sri Suk, Village, Kosum Phisai District (16o15'04 "N 103º03'39" E)

Station 3: Sri Suk Village, Kosum Phisai District
The environment is generally the area where fish are cultured in floating basket aquacultures along the length of the river. The number of fish floating basket aquacultures is smaller than stations 1 and 2.

Fig. 8: General conditions of the sampling station at Srisuk Village

Station 4: Khluck Village, Kosum Phisai District (16o11'45 "N 103°09'51" E)

Station 4: Khluck Village, Kosum Phisai District
A source to the community. There are not many fish in the cage. There are also local fisheries, such as dragging fishing nets.

Fig. 9: General conditions of the sampling station at Khluck Village

Station 5: Tha Prathai Village, Muang District (16o12'44 "N 103°25.18'57" E)


Station 5: Tha Prathai Village, Muang District
At this station, adjacent to the community. People make farming. The local fishermen living in Ban Tha Prathai

Fig. 10: General conditions of the sampling station at Tha Prathai Village

Station 6: Mung Village, Muang District (16o13'21 "N 103°22'10" E)


Station 6: Mung Village, Muang District
The water is yellowish, odorless, along the banks of the river. This area has an electric pumping station, which utilizes the Chi River in agriculture. There is less fish farming in the cage.

Fig. 11. General conditions of the sampling station at Mung Village

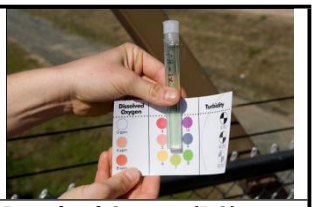
Collecting water sampling data for analyzing random sampling data

1. Grab Sampling: using water samples in the floating basket aquaculture points for analyzing parameters, soil sediment samples were collected by gravimetric sampling at the same location.
2. Water sampling was sufficient to allow an analysis of the parameters was measured. The sample was less below 4°C, Thus, to analyze the parameters in the laboratory, immediately.
3. The water quality, physical and chemical parameters, water temperature and dissolved oxygen (DO) using YSI 550 Dissolved Oxygen Meter. Transparency was measured by Succi Disc; pH is measured by a pH meter model PCT ester 35. The oxygen requirement for organic degradation (BOD) was determined using the Azide Modification method. Nitrogen (NO_3^--N) and orthophosphate (PO_4^{3-}) were measured using a DR4000 W - VIS (APHA, AWWA, and WPCF, 2005).

Collecting soil sedimentary deposition sampling

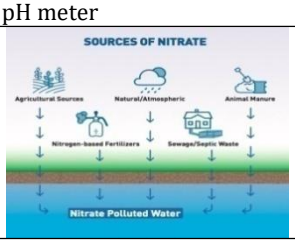
Soil samples were collected in the same area as water sampling, using the Ekman Grab as the parameter, analysis of sediment samples, and each sample was analyzed for soil properties with the parameters being pH, Organic matter, and Phosphorus quantities.

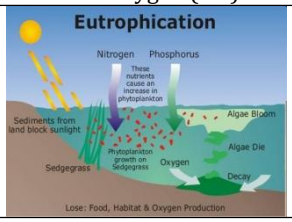


Water temperature | Transparency | pH meter | Dissolved Oxygen (DO)

BOD Level in mg/liter	Water Quality
1 - 2	**Very Good:** There will not be much organic matter present in the water supply.
3 - 5	**Fair:** Moderately Clean
6 - 9	**Poor:** Somewhat Polluted - Usually indicates that organic matter present and microorganisms are decomposing that waste.
100 or more	**Very Poor:** Very Polluted - Contains organic matter.





The OD value | Nitrate quantity in water | Phosphate quantity

Fig. 12: Using the 7-parameter to analyze for the Chi water was designed
Source: Determining the parameters' experimental laboratory by research team

Parameters being pH of soil sedimentary deposition

Weighting mixed of soil: water (1:1) as 20.00 grams of soil sediment, 100 ml of beaker; adding 20 ml of distilled water and leave to stand for 30 minutes, set aside for 15 seconds and dip the electrode into the solution. The electrode was dipped in a sludge solution to read of the pH value.

Analysis of Soil Organic Matter by Walkley-Black Method

Weighting soil sediment sieve through a brook soil of 0.5 millimeters (2.00 grams) into a 125 ml Erlenmeyer flask; adding weight 1.0 N $K_2Cr_2O_7$ as 10 ml of the swollen flask slowly to a solution of well mixed soil; adding concentrated H_2SO_4 20 ml swing flask again to a solution of well-mixed soil, and leaving it for about 30 minutes.

Determination of Total Nitrogen Quantity (Kjeldahl Method)

Step I: Substrate Soil Digestion

Weighting the brook soil sediment sift through the sieve of 0.5 millimeters, 2.00 grams in a digestion tube; accelerate 2 g and conc. H_2SO_4 10 ml and mixed carefully; blanking together with the sample by adding 2 g of the catalyst to the tube without soil, and adding 10 mL H_2SO_4; Submerge at about 200 until the color of the solution is

clear and blue, continuing for 30 minutes; removing the tube from the stove, leaving it cool, adding the distilled water and adjust the volume to 100 ml, and storing for distillation for ammonia.

Step 2: Distillation of Ammonia

The pipette of distillation substance of 10 milliliters, adding 5 ml of 40% NaOH to the distillation tube, and adding 5 ml of the mixed indicator prepared in a 125 ml apple-shaped bottle was distilled (the color of the solution; Dissolve the sample until it reaches a volume of 50 - 75 ml., the temperature of the distillation must not exceed 22°C; Titrate with a standard solution of 0.02 N H_2SO_4 until the solution turns green to pink, recording the volume of acid was used.

Useful Phosphorus Quantity with Bray II and Murphy Riley Methods

Weighting the brook soil sediment sample, sieve through a 2 mm sieve weighing 5.00 g, in a 125 ml apple-shaped bottle; adding 50 ml of Bray II solution into the apple tube with the rubber stopper and shaking for 1 minute, filtering immediately through filter paper 5 and storing the filtered solution for phosphorus with the absorption of 2.0 ml of H_3BO_3 to 5 ml.

Adding Murphy's reagent to 2 ml and 1 ml of the ascorbic acid solution and adjusting the volume to 25 ml (the color of the solution is blue); leaving it at least 10 minutes to complete the color. (Blue is stable for 24 hours), measured at 870 nm wavelength that compared to the standard graph, and using a spectrum sub-micrometer. Finally, preparing a series of standard solutions, the concentrations of 0, 0.4, 0.8, 1.2, 1.6 and 2.0 ppm were measured by standard pipette 10 ppm in the volume of 0, 5, 1, 2, 3, 4 and 5 ml respectively in a 25 ml volumetric flask.

Analysis of Potassium Extracted by Ammonium Acetate

Soil sediment samples were sieved through a 2 mm sieve weighing 10 g and placed in a 1 liter NH_4OAc pH 7.0 bottle with 50 ml of water and then with a rubber stopper; Apply to shake for 30 minutes through filter paper number 5 to keep filtered; Preparing the standard solution of potassium from the standard solution of 1000 ppm, the concentrations were 0.00, 1.00, 2.00, 3.00, 4.00 and 5.00 ppm, respectively

Quantitative soil estimation by hydrometer method

To sieve weighing 2 mm 20 g of the brook sedimentary soil; Removal of organic matter by adding 50 ml of distilled water and adding 35% H_2O_2 5-10 ml to the beaker closed with a clock glass, bring the beaker to a temperature of 90°C on a heating pad until no bubbles of carbon dioxide occur; Adding the Calgon solution to the 20 ml soil sample and pour the sample into the blender jar, and adding 500 ml of water and mix for 5 minutes. Mixing the ingredients together with the puncture, then leave to settle with the hydration dropped to measure the density of sand, clay and clay particles, after 40 seconds, read the hydrometer with a thermometer; Leaving the silting sediment for 2 hours, read the hydrometer to measure the density of the clay particles and the Calgon along with the thermometer. The physical characteristics at the six points' stations for floating basket aquaculture are reported.

Results and discussions

The physical characteristics at the six points' stations

Based on a survey of the general environmental characteristics of the Chi River, each station has its own characteristics.

The results of the water quality assessment of the Chi River

Each of the parameters studied would be measured for 3 replicates for the physical water quality index, temperature, transparency, water quality study, chemistry, pH, DO content, organic matter, Nitrate, Orthophosphate content in the Chi River water.

Temperature

Water temperature sampling showed an average temperature range 24.83±0.15-25.66±0.26, 24.83±0.15-25.76±0.05, 24.06±0.23-26.00 ±0.00, 24.53±0.15-26-33±0.05, 25.10±0.51-26.16±0.05, and 25.13±0.05-26.93±0.11°C, respectively (Table 1).

Table 1. Mean water temperature results at each station

Station	Water Temperature (°C)					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	25.66±0.26	24.83±0.15	26.36±0.40	25.46±0.05	24.90±0.17	25.66±0.11
2nd station	24.83±0.15	25.06±0.11	25.76±0.05	25.33±0.05	25.16±0.05	24.96±0.15
3rd station	26.00±0.00	24.06±0.23	25.83±0.05	25.30±0.00	25.03±0.11	25.13±0.05
4th station	26.33±0.05	24.53±0.15	25.83±0.05	25.26±0.11	25.00±0.10	25.03±0.20
5th station	26.06±0.11	25.10±0.51	26.16±0.05	25.23±0.05	25.16±0.05	25.13±0.05
6th station	26.50±0.00	26.53±0.05	26.93±0.11	25.36±0.05	25.13±0.05	25.23±0.05

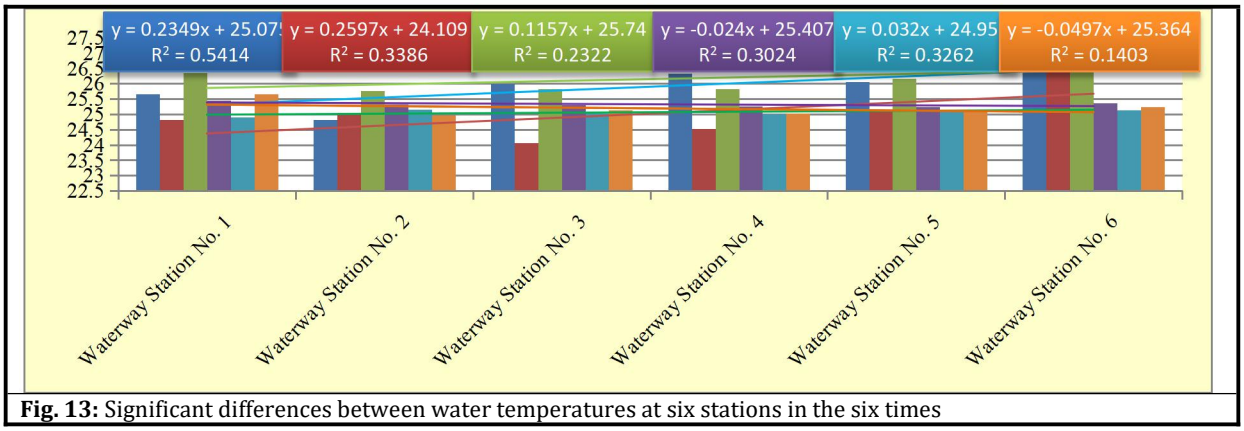


Fig. 13: Significant differences between water temperatures at six stations in the six times

Normally, the total means average temperature as 25.86°C per year as reported in Table 1.

Transparency

The water transparency responses of 16.66±0.57-44.33±0.57, 16.66±1.54-39.33±0.57, 19.00±0.00-43.6±1.54, 18.66±0.57-44.00±1.00, 20.66 ± 0.57-46.33 ± 1.54 and 22.66 ± 0.57-42.66 ± 1.54 cm, respectively (Table 2 and Figure 14).

Table 2. Water transparency (cm) in the Chi River results at each station

Station	Water Transparency (cm)					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	20.00±0.00	16.66±0.57	27.33±0.57	26.66±0.57	35.66±0.57	44.33±0.57
2nd station	19.33±0.57	16.66±0.57	23.66±0.57	25.66±0.57	31.66±0.57	39.33±0.57
3rd station	18.33±0.57	19.00±0.00	23.00±0.00	23.66±0.57	31.66±1.52	43.66±1.54
4th station	25.33±0.57	18.66±0.57	21.00±1.00	21.66±0.57	31.33±1.54	44.00±1.00
5th station	28.33±0.57	20.66±0.57	24.00±0.00	24.33±0.57	33.66±0.57	46.33±1.54
6th station	23.66±0.57	22.66±0.57	23.66±0.57	24.66±0.57	32.66±0.57	42.66±1.54

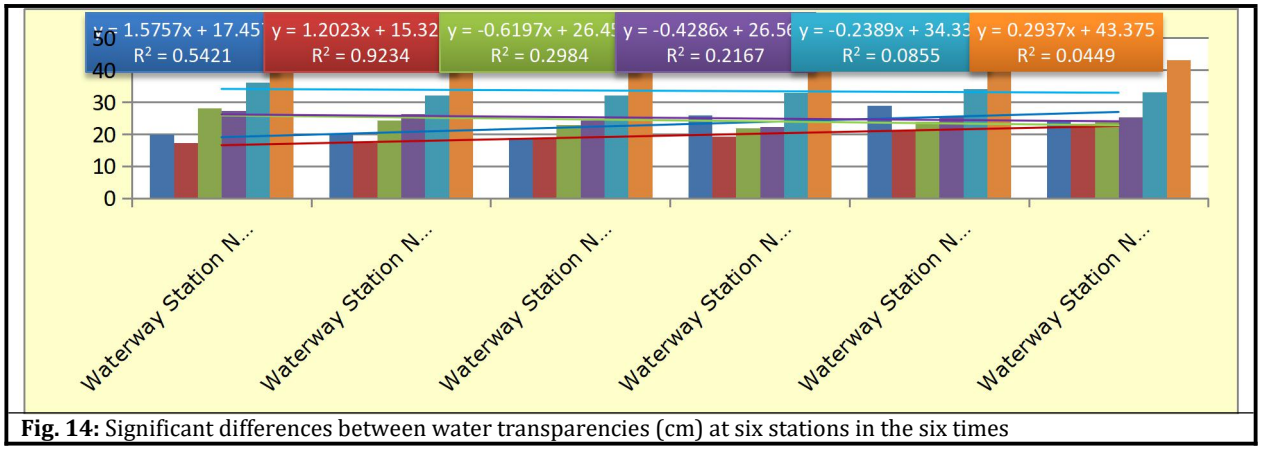


Fig. 14: Significant differences between water transparencies (cm) at six stations in the six times

pH Values of Water

The mean averages of pH values indicated that of 6.76 ± 0.05-7.23 ± 0.05, 6.86 ± 0.05- 7.20 ± 0.00, 6.93 ± 0.05. -7.23 ± 0.05, 6.83 ± 0.05-7.20 ± 0.10, 6.96 ± 0.05-7.30 ± 0.10, and 6.93 ± 0.05-7.23 ± 0.05, respectively (Table 3 and Figure 15).

Table 3. Water pH qualities in the Chi River results at each station

Station	The pH values of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	6.86±0.05	6.93±0.05	6.76±0.05	6.76±0.05	7.13±0.05	7.23±0.05
2nd station	7.16±0.05	7.10±0.10	6.86±0.05	6.86±0.05	7.16±0.05	7.20±0.00
3rd station	7.13±0.05	6.93±0.05	7.23±0.11	7.23±0.05	7.13±0.05	7.06±0.05
4th station	7.20±0.10	6.83±0.05	7.06±0.05	7.10±0.00	7.10±0.10	7.06±0.05
5th station	7.30±0.10	7.13±0.05	7.06±0.05	6.96±0.05	7.13±0.05	7.10±0.10
6th station	7.20±0.10	7.23±0.05	7.20±0.10	7.13±0.05	7.16±0.05	6.93±0.05

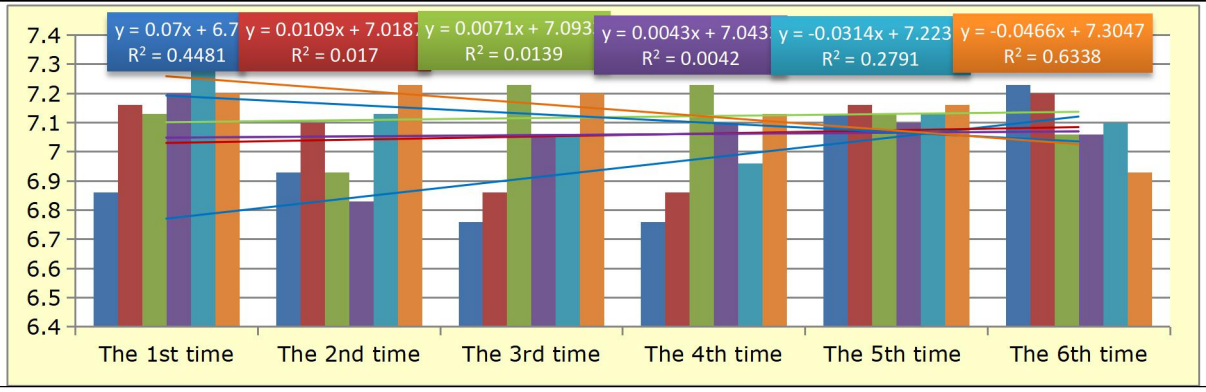


Fig. 15: Significant differences between water pH values at six stations in the six times

Dissolved Oxygen (DO) of Water

The DO quantity indicated that of 3.71 ± 0.02-5.19 ± 0.02, 3.62 ± 0.09-5.23 ± 0.02, 4.28 ± 0.02-5.31 ± 0.02, 4.26 ± 0.02-6.09 ± 0.01, 4.29 ± 0.01-6.17 ± 0.02, and 4.40 ± 0.02-6.04 ± 0.05 mg/l, respectively (Table 4 and Figure 16).

Table 4. Water Dissolved Oxygen (DO) qualities (mg/L) in six stations

Station	The DO values of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	3.88±0.03	4.11±0.02	3.71±0.02	4.21±0.03	4.36±0.05	5.19±0.02
2nd station	3.62±0.09	4.21±0.02	3.78±0.07	4.30±0.01	4.35±0.05	5.23±0.02
3rd station	4.38±0.14	4.36±0.03	4.28±0.02	4.46±0.01	4.61±0.02	5.31±0.02
4th station	4.37±0.08	4.55±0.05	4.26±0.02	4.41±0.01	4.79±0.01	6.09±0.01
5th station	4.62±0.09	4.82±0.04	4.29±0.01	4.38±0.02	4.49±0.01	6.17±0.02
6th station	4.88±0.03	5.01±0.03	4.40±0.02	4.52±0.04	4.53±0.02	6.04±0.05

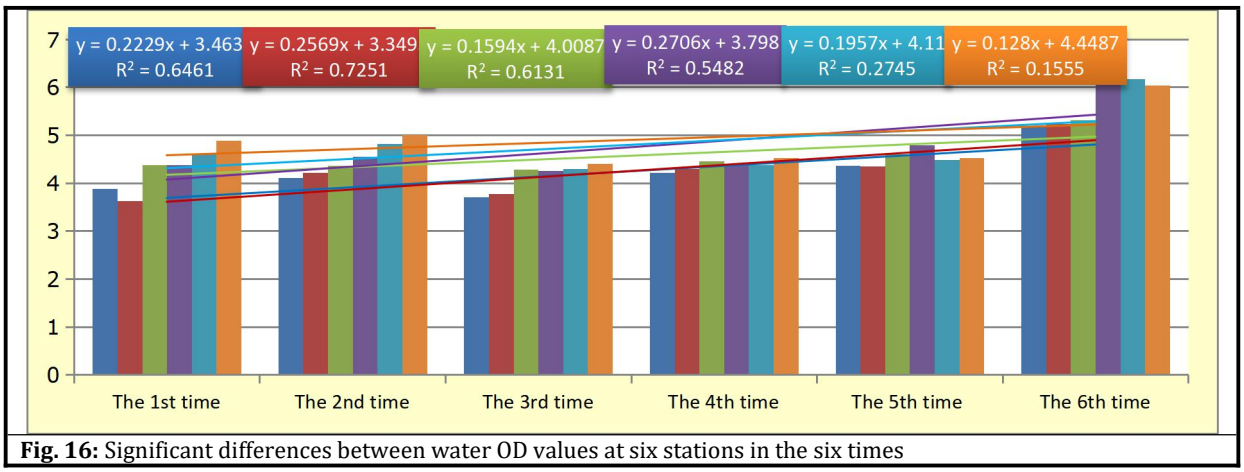


Fig. 16: Significant differences between water OD values at six stations in the six times

Biochemical Oxygen Demand (BOD)

The BOD was tested with the microorganisms used for organic degradation indicated that of 2.51 ± 0.03-4.79 ± 0.01, 2.38 ± 0.02-4.29 ± 0.01, 2.39 ± 0.01-3.86 ± 0.02, 2.14 ± 0.07-3.09 ± 0.01, 2.51 ± 0.02-3.40 ± 0.01 and 2.47 ± 0.02-3.26 ± 0.01 mg / l, respectively (Table 5 and Figure 17).

Table 5. Water Biochemical Oxygen Demand (BOD) qualities (mg/L) in the Chi River results at each station

Station	The BOD values (mg/L) of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	4.25±0.03	4.45±0.09	4.79±0.01	4.79±0.02	3.68±0.07	2.51±0.03
2nd station	4.25±0.07	3.42±0.03	4.29±0.01	4.29±0.02	3.79±0.05	2.38±0.02
3rd station	2.39±0.01	2.71±0.04	3.86±0.06	3.86±0.02	2.66±0.06	2.50±0.05
4th station	2.14±0.07	2.76±0.10	3.09±0.01	3.09±0.02	2.79±0.01	2.78±0.03
5th station	2.71±0.01	2.51±0.02	3.40±0.01	3.40±0.02	2.58±0.02	2.60±0.02
6th station	2.48±0.02	2.63±0.05	3.26±0.02	3.26±0.01	2.79±0.04	2.47±0.02

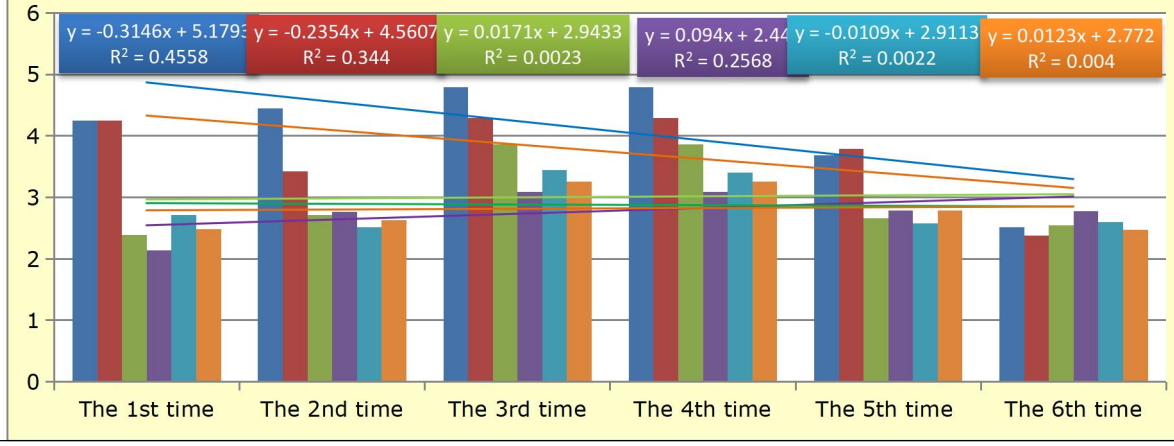


Figure Caption
Fig. 17: Significant differences between water BOD values in at six stations in the six times

Nitrate Quantities in the Form of Nitrogen (NO_3^--N)

The mean averages of nitrate in form of nitrogen (NO_3^--N) content are 0.77 ± 0.001.26 ± 0.05, 0.58 ± 0.01- 0.74 ± 0.04. , 0.61 ± 0.01-0.89 ± 0.00, 0.52 ± 0.01-0.66 ± 0.00, 0.41 ± 0.02-0.66 ± 0.01 and 0.41 ± 0.02-0.59 ± 0.01 mg / l, respectively (Table 6 and Figure 18).

Table 6. Water Nitrate Quantities in the Form of Nitrogen (NO_3^--N) quantities (mg/L) in the Chi River in six stations

Station	The Nitrate Quantities in the Form of Nitrogen (NO_3^--N) values (mg/L) of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	0.83±0.02	0.79±0.00	1.26±0.05	0.91±0.01	0.82±0.01	0.77±0.00
2nd station	0.64±0.01	0.65±0.00	0.59±0.00	0.74±0.04	0.68±0.00	0.58±0.01
3rd station	0.86±0.02	0.89±0.00	0.61±0.02	0.82±0.01	0.74±0.00	0.61±0.02
4th station	0.57±0.00	0.58±0.01	0.65±0.05	0.66±0.00	0.61±0.01	0.52±0.01
5th station	0.48±0.00	0.45±0.00	0.61±0.01	0.66±0.01	0.53±0.00	0.41±0.02
6th station	0.41±0.02	0.41±0.01	0.59±0.01	0.50±0.01	0.44±0.04	0.52±0.01

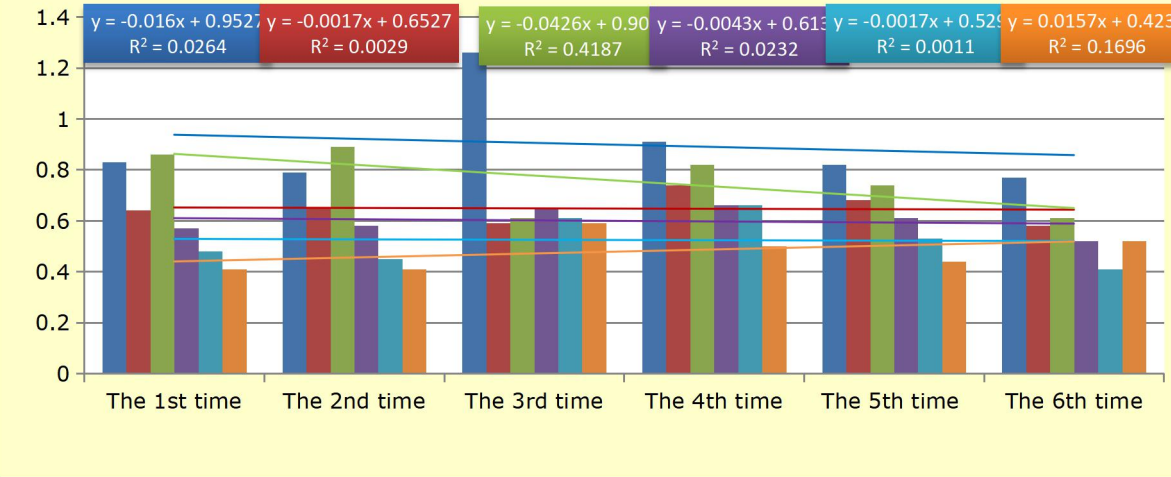


Figure Caption
Fig. 18: Significant differences between water Nitrogen (NO_3^--N) values (mg/L) quantity values at six stations in the six times

Orthophosphate Quantities (PO_4^{-3}-P)

The mean averages of the orthophosphate quantities indicated that 0.26 ± 0.00-0.65 ± 0.01, 0.23 ± 0.00-0.63 ± 0.00, 0.17 ± 0.00-0.65 ± 0.04, 0.21 ± 0.00-0.41 ± 0.01, 0.29 ± 0.00-0.64 ± 0.02 and 0.18 ± 0.00-0.32 ± 0.00 mg / l, respectively (Table 7 and Figure 18).

Table 7. Water Orthophosphate (PO_4^{-3}-P) Quantities (mg/L) in six stations

Station	The Orthophosphate (PO_4^{-3}-P) quantities of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	0.65±0.00	0.43±0.02	0.65±0.01	0.49±0.00	0.34±0.01	0.26±0.00
2nd station	0.29±0.00	0.32±0.00	0.63±0.00	0.45±0.01	0.37±0.00	0.23±0.00
3rd station	0.17±0.00	0.28±0.00	0.65±0.04	0.37±0.01	0.27±0.00	0.20±0.00
4th station	0.39±0.01	0.21±0.00	0.41±0.01	0.34±0.00	0.25±0.00	0.27±0.00
5th station	0.40±0.02	0.29±0.00	0.64±0.02	0.36±0.00	0.45±0.00	0.30±0.00
6th station	0.18±0.00	0.28±0.01	0.32±0.00	0.28±0.00	0.18±0.00	0.21±0.01

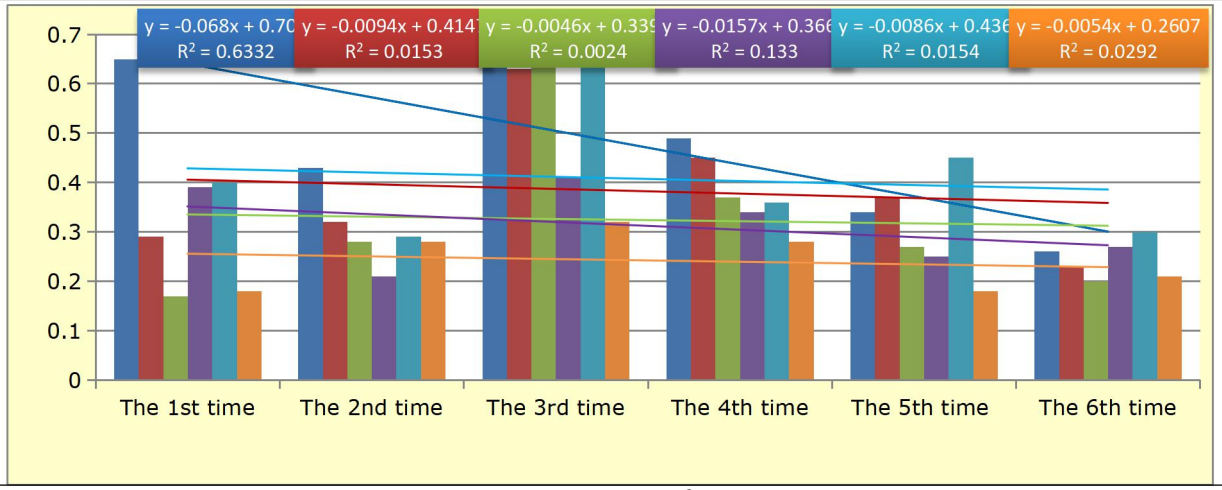
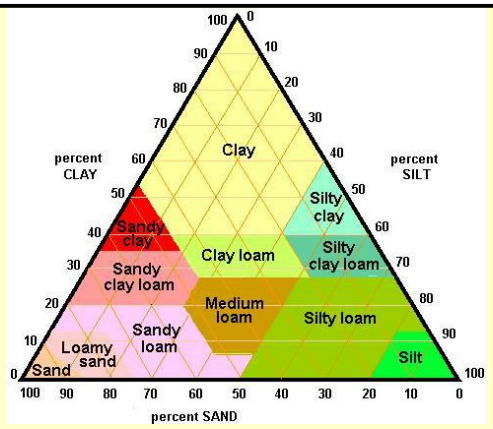


Fig. 19: Significant differences between water Phosphate (PO_4^{-3}-P) quantity values (mg/L) quantity values at six stations in the six times

The properties of depositing soil sedimentation

Soil structure profiles

The soil sediment accumulation under the floating basket aquacultures are as follows: 73.80, 87.50, 41.80, 67.90, 51.50 and 32.40; 9.60, 36.50, 21.00, 30.40 and 39.40; the percentage of clay as 10.30, 2.90, 21.70, 11.10, 18.00 and 28.20, respectively (Figure 20).



Station	Particle Size			Textures
	Sand (%)	Silt (%)	Clay (%)	
1st station	73.80	15.90	10.30	SL
2nd station	87.50	9.60	2.90	S
3rd station	41.80	36.50	21.70	L
4th station	67.90	21.00	11.10	SL
5th station	51.50	30.40	18.00	L
6th station	32.40	39.40	28.20	CL

SL=Sandy loam, S= Sand, L= Loamy sand,
CL=Clay loam, C=Clay, SC=Sandy clay
SCL=Sandy clay loam, CL= Clay loam

Fig. 20: Show the triangulation of soil textures and soil types soil sedimentary quantity that deposited under the floating aquaculture farming (FAF) of the Chi water in six stations

The soil pH values

The pH indicated that of 5.06 ± 0.05-5.40 ± 0.00, 6.40 ± 0.00-6.80 ± 0.00, 6.40 ± 0.00-6.63 ± 0.05, 6.50 ± 0.00-6.56 ± 0.05, 6.53 ± 0.05-6.80 ± 0.00 and 6.63 ± 0.05-6.80 ± 0.00 respectively (Table 8 and Figure 21).

Table 8. pH values in soil with sediment accumulation under the floating basket aquacultures in the Chi River results at each station

Station	The pH of water in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	5.40±0.00	5.30±0.00	5.06±0.05	5.20±0.00	5.36±0.05	5.33±0.05
2nd station	6.80±0.00	6.76±0.05	6.40±0.00	6.63±0.05	6.70±0.00	6.73±0.05
3rd station	6.50±0.00	6.43±0.05	6.40±0.00	6.46±0.05	6.50±0.00	6.63±0.05
4th station	6.50±0.00	6.56±0.05	6.53±0.05	6.53±0.05	6.56±0.05	6.56±0.05
5th station	6.60±0.00	6.80±0.00	6.63±0.05	6.66±0.05	6.63±0.05	6.53±0.05
6th station	6.80±0.00	6.73±0.05	6.63±0.05	6.76±0.05	6.73±0.05	6.76±0.05

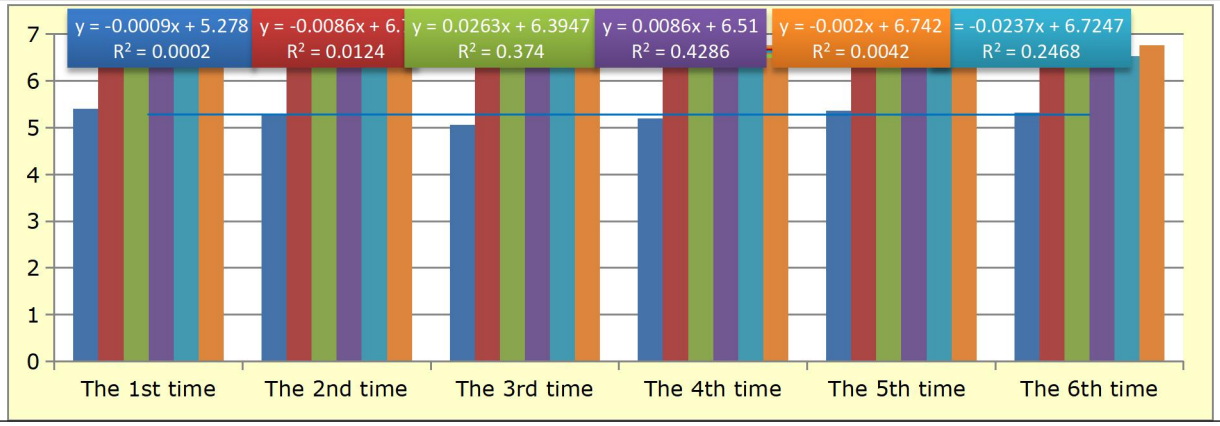


Fig. 21: Significant differences between pH values of soil sedimentary quantity that deposited under the FAF at six stations in the six times

The electrical conductivity of soil sedimentation (EC)

The EC values in soil with sediment accumulation under the floating basket aquacultures indicated that of 0.40 ± 0.00-0.42 ± 0.00, 0.05 ± 0.00-0.06 ± 0.00, 0.11 ± 0.00-0.12 ± 0.00, 0.06 ± 0.00-0.08 ± 0.00, 0.07 ± 0.00-0.08 ± 0.00 and 0.16 ± 0.00-0.18 ± 0.00 ms/cm, respectively (Table 9 and Figure 22).

Table 9. Electrical conductivity values in soil with sediment accumulation under the floating basket aquacultures in the Chi River results at each station

Station	The EC values in soil sediment accumulation under the floating basket aquacultures in the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	3.88±0.03	4.11±0.02	3.71±0.02	4.21±0.03	4.36±0.05	5.19±0.02
2nd station	3.62±0.09	4.21±0.02	3.78±0.07	4.30±0.01	4.35±0.05	5.23±0.02
3rd station	4.38±0.14	4.36±0.03	4.28±0.02	4.46±0.01	4.61±0.02	5.31±0.02
4th station	4.37±0.08	4.55±0.05	4.26±0.02	4.41±0.01	4.79±0.01	6.09±0.01
5th station	4.62±0.09	4.82±0.04	4.29±0.01	4.38±0.02	4.49±0.01	6.17±0.02
6th station	4.88±0.03	5.01±0.03	4.40±0.02	4.52±0.04	4.53±0.02	6.04±0.05

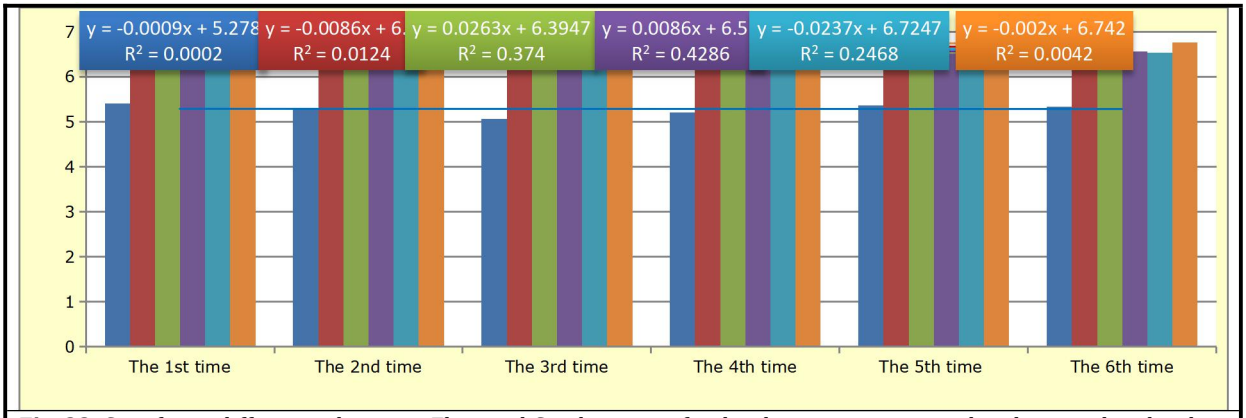


Fig. 22: Significant differences between Electrical Conductivity of soil sedimentary quantity that deposited under the FAF at six stations in the six times

Organic matter of soil sediment (OM)

The soil organic matter was analyzed indicated that of 0.94 ± 0.00-0.96 ± 0.00, 0.02 ± 0.00-0.03 ± 0.00, 1.11 ±

0.00-1.14 ± 0.00, 0.61 ± 0.00-0.63 ± 0.00, 0.63 ± 0.00-0.65 ± 0.00 and 1.35 ± 0.00-1.37 ± 0.00%, respectively (Table 10 and Figure 23).

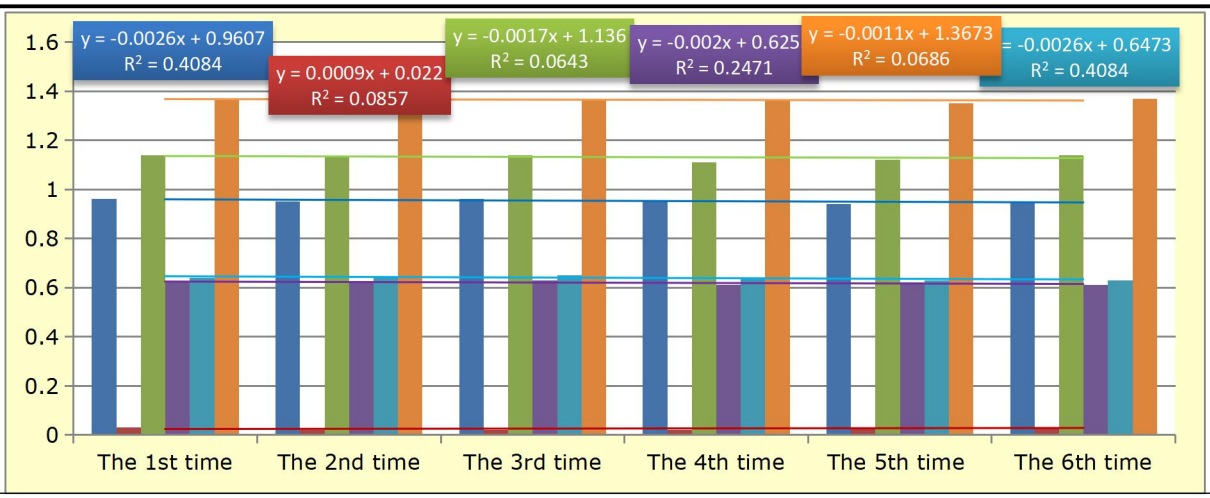


Figure Caption
Fig. 23: Significant differences between OM quantity values of soil sedimentary quantity that deposited under the FAF at six stations in the six times

Table 10. Organic Matter of Soil Sediment (OM) values (%) in soil with sediment accumulation under the floating basket aquacultures in the Chi River results at each station

Station	The OM values in soil sediment accumulation under the floating basket aquacultures at the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	0.96±0.00	0.95±0.00	0.96±0.00	0.95±0.00	0.94±0.00	0.95±0.00
2nd station	0.03±0.00	0.02±0.00	0.02±0.00	0.02±0.00	0.03±0.00	0.03±0.00
3rd station	1.14±0.00	1.13±0.00	1.14±0.00	1.11±0.00	1.12±0.00	1.14±0.00
4th station	0.62±0.00	0.62±0.00	0.63±0.00	0.61±0.00	0.62±0.00	0.61±0.00
5th station	0.64±0.00	0.64±0.00	0.65±0.00	0.64±0.00	0.63±0.00	0.63±0.00
6th station	1.37±0.00	1.36±0.00	1.37±0.00	1.36±0.00	1.35±0.00	1.37±0.00

Nitrogen Mineral (NM)

The NM quantities (%) in soil indicted that mean average of NM as 0.00 ± 0.00-0.04 ± 0.00, 0.00 ± 0.00-0.05 ± 0.00, 0.03 ± 0.00-0.03 ± 0.00, 0.03 ± 0.00-0.03 ± 0.00 and 0.06 ± 0.00-0.06 ± 0.00%, respectively (Table 11 and Figure 24).

Table 11. Shows the Nitrogen Mineral (NM) values (%) in soil with sediment accumulation under the floating basket aquacultures in the Chi River results at each station

Station	The NM values of soil sediment accumulation under the floating basket aquacultures at the six times					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	0.04±0.00	0.04±0.00	0.04±0.00	0.04±0.00	0.04±0.00	0.04±0.00
2nd station	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
3rd station	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00	0.05±0.00
4th station	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00
5th station	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00	0.03±0.00
6th station	0.06±0.00	0.06±0.00	0.06±0.00	0.06±0.00	0.06±0.00	0.06±0.00

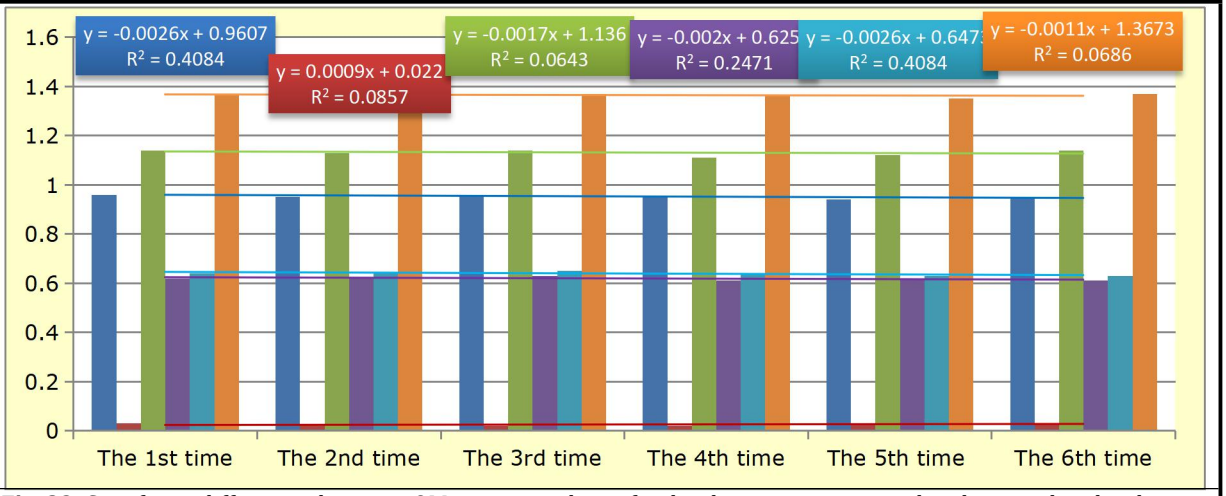


Fig. 23: Significant differences between OM quantity values of soil sedimentary quantity that deposited under the FAF in the Chi River at sampling six stations in the six times

Phosphorus Mineral Beneficial to Plants (PM)

The mean averages of the (PM in soil indicated that of 156.38 ± 0.16-159.10 ± 0.00, 27.86 ± 0.21-28.36 ± 0.07, 42.63 ± 0.40-45.65 ± 0.00, 85.12 ± 0.02-86.40 ± 0.62, 33.19 ± 0.01-34.60 ± 0.00 and 30.05 ± 0.00-32.44 ± 0.01 mg / kg respectively (Table 12 and Figure 24).

Table 12. Show the Phosphate Mineral values (%) in soil with sediment accumulation under the floating basket aquacultures in the Chi River results at each station

Station	The PM values in soil with sediment accumulation under the floating basket aquacultures at the six times were tested					
	1st Time	2nd Time	3rd Time	4th Time	5th Time	6th Time
1st station	159.10±0.00	158.25±0.26	31.21±0.03	156.38±0.16	158.17±0.10	159.06±0.15
2nd station	28.25±0.00	27.90±0.43	34.12±0.04	28.21±0.10	28.36±0.07	27.86±0.21
3rd station	45.65±0.00	45.26±0.16	86.40±0.62	44.39±0.18	44.09±0.04	42.63±0.40
4th station	85.25±0.00	86.16±0.02	43.25±0.05	86.25±0.05	85.12±0.02	85.88±0.11
5th station	34.60±0.00	33.35±0.10	28.11±0.05	33.66±0.07	33.19±0.01	33.54±0.60
6th station	30.05±0.00	30.97±0.34	158.21±0.22	32.44±0.01	30.35±0.10	30.25±0.04

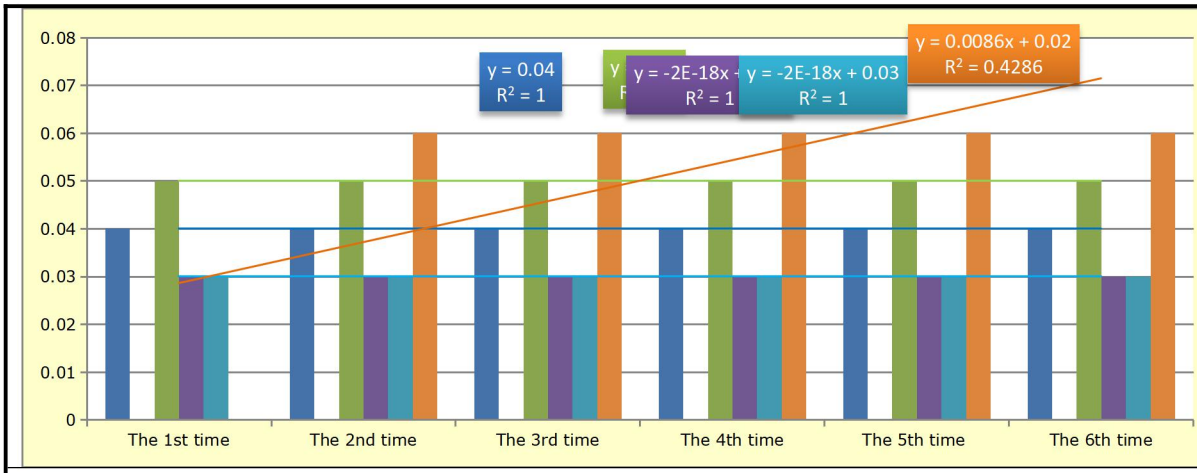


Figure Caption

Fig. 24: Significant differences between N-mineral quantity values of soil sedimentary quantity that deposited under the FAF floating at the six times

Conclusion

The experimental and survey research methods on water quality assessment and soil sediment deposition in the Chi river through the floating basket aquacultures for utilizing the efficiency of water resource are measured and tested with the chemical and physical characteristics to report at this research study as follows:

The general characteristics of the Chi River

Thailand has 25 river basins with 254 sub-basins. The Chi River rises in the Phetchabun mountains, then runs east through the Northeast region of 14 central provinces. The river burst its banks and water flowed across paddy fields after absorbing huge volumes of flood plain. It is important for the people to live, occupation of the fish the floating basket aquacultures to increase. The income and economic value of people, and the food is very important from producing fish food economics.

The Chi water quality assessment

The temperature of the parent is considered to be in the natural range suitability for the life of animals that it is in the range of 23-32ºC (0°C-30°C, normally).

1. Water transparency depends on the number of particles in the water are low and cloudy, the Secchi depth as 16.66-44.33 cm (20 centimeters (8 inch), standardized) in diameter.
2. The pH is on a scale of 0-14. It is a measure of hydrogen ion concentration. It has found that ranges from 6.7 to 7.3 on this scale with 7.0 being neutral. Normally, the optimum pH for river water is around 7.4.
3. The DO ranged from 3.62 to 6.17, that it is less than from the DO standard (7 mg/l) for warm water fish and aquatic life must meet a minimum DO standard of 5 mg/l.
4. The BOD ranged from 2.14 to 4.79 mg/l was tested. Normally, the national river source is less than 4.0 mg/l.
5. The Nitrate in the form of Nitrogen (nitrate-nitrogen: NO_3^- - N) is an oxidized form of nitrogen and formed by combining oxygen and nitrogen. The (NO_3^--N) values was ranged from 0.41 to 0.89 mg/l (the 10 mg/L NO_3-N standard an approved water supply).

6. The Other Phosphate in form of Phosphorous (PO_4^{-3}-P) that ranged from 0.17 to 0.64 mg/l. (Larger streams approaching 0.1 mg/L, small streams may react to at levels of 0.01 mg/L or less).

Soil sedimentary deposition through the floating basket aquacultures

1. Soil sedimentary textures compose of sandy loam soil (SL), sand soil (S), loam soil (L), and clay loam (CL).
2. Temperature affects physical, chemical and biological processes in water bodies.
3. The transparency was ranged from 16.66-44.33 cm, a Secchi disk is usually 20-30 cm in diameter.
4. The pH values of soil sediments ranged from 5.06 to 6.80. The pH of most natural waters is between 6.0 and 8.5 in entropic waters.
5. The electrical conductivity ranged from 0.05 to 0.16 ms/cm that influence on conductivity.
6. The organic matter (OM) ranged from 0.02 to 1.14%. Variations in DO can occur seasonally.
7. The NO_3^--N contained 0.00-0.06. The nitrate ion form of combined nitrogen in natural waters in moles per liter or as mg l-1 of nitrogen.
8. The PO_4^{-3}-P quantities ranged from 27.86 to 156.38 mg/kg. Normally, phosphorus in water ranges from 0.005 to 0.020 mg l-1 PO_4-P.

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