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Hydrology, water quality and land-use assessment of Tasik Chini's feeder rivers, Pahang, Malaysia

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Abstract

This study was carried out in October and December 2004, February, March and April 2005 to assess the hydrological characteristics and water quality of the seven feeder rivers of Tasik Chini, in the Malaysian state of Pahang. A total of nine sampling stations was selected in this study: namely Sg. Datang, Sg. Cenahan, Hilir Sg. Gumum, Pertengahan Sg. Gumum, Sg. Kura -kura, Sg. Melai, Hilir Kuala Merupuk, Hulu Kuala Merupuk, and Sg. Jemberau. Nine water quality parameters (pH, dissolved oxygen, conductivity, temperature , turbidity , Ammonical nitrogen, Nitrate, Phosphate, Sulphate) were analyzed based on in-situ and ex-situ analyses during two season periods; and a laboratory analysis was carried out according to the HACH and APHA methods. Stream flow was determined during the sampling days with a range of 0.0042 to 0.9083 m^3/sec or an average of 0.1674 m^3/sec. The annual rainfall for the lake ranged from 1487.7 to 3071.4 mm. Of late, illegal logging, farming and other unsustainable development undertakings had occurred in the surrounding areas of the lake. The impact of these activities may cause some real environmental problem to the Lake Chini and adjacent areas by changing the area's hydrological characteristics which in the long run may lead to deterioration.

Keywords: environmental problem, feeder river, hydrological characteristics, Lake Chini, stream flow, water quality parameters

Introduction

Surface water resources have played an important function throughout the history of human civilization. About one third of the drinking water requirement of the world is obtained from surface sources like rivers, canals and lakes (Das & Acharya, 2003), these sources seem to have been used for the discharge of domestic , agricultural and domestic wastes. According to the UNEP (2003), dams serve to function as a visible tool for managing freshwater resources, thereby contributing to socio-economic development through supplying drinking water. However, the dam has been identified with several negative impacts, namely, degradation of water quality, increase of in-lake sedimentation, lake and river bank scouring, blocked movement of migratory species, and loss of aquatic biodiversity. Tasik Chini has undergone tremendous change since 1984 or even earlier due to rapid development of surrounding areas in such activities as mining, oil palm planting and urbanization. Tasik Chini was once famous for its biological resources. A study carried by the the Malaysian Nature Society (1999) found that there were 288 species of plants, 21 species of aquatic plants, 92 species of birds, and 144 species of freshwater fishes in the Tasik

Chini area.

The condition of Tasik Chini worsened when a small dam was built in 1995 to retain the lake's water for tourism purposes (Mushrifah Idris & Ahmad Abas Kutty, 2004). The dam had caused water movement to become less dynamic. Fish activities were also affected and water current became unstable, although the lake water was defined as safe for recreational purposes (Ahmad Abas *et al.,* 2004). It follows that a better understanding of the hydrology of the Tasik Chini will make it possible to develop and manage the lake in a more sustainable way. This paper describes an analysis which was carried out to examine the water quality of Tasik Chini through several physico-chemical parameters, and to determine the factors contributing to the pollution load of the lotic water bodies in and around Tasik Chini.

Objectives

This research on the hydrological and water quality status of Tasik Chini was carried out in order to examine the existing physical environment during the study period of October 2004-April 2005. Its main objectives are as follows:

- To study the stream flow characteristics measured at feeder rivers of Tasik Chini;
- To examine the water quality status through several physico-chemical parameters; and,
- To identify possible sources of pollution

Data and methods

Study area

Tasik Chini is located in the southeast region of Pahang, Malaysia. The lake system lies at 3°15′40″N and 102° 45′40″E and comprises 12 open water bodies. The area has a humid tropical climate with two monsoon periods, characterized by bimodal pattern: southwest and northeast monsoons bringing an annual rainfall which varies between 1488 to 3071mm. However, the open water area has expanded greatly since 1995, due to increased retention of water after the construction of a barrage at Chini River. Tasik Chini is surrounded by variously vegetated low hills and undulating lands which constitute the watershed of the region. There are three hill areas surrounding the Tasik; namely, (1) Bt. Ketaya (209m) located at the southeast; (2) Bt. Tebakang (210m) at the north and (3) Bt. Chini (641m) at the southeast. The lake drains northeasterly into Pahang River *via* Chini River. The lake is drained by Chini River, which meanders for 4.8 km before it reaches the Pahang River.

Sampling and preservation

Global Positioning System (GPS) was used to determine the actual coordinates of sampling stations and to re-confirm the location of stations during the subsequent sampling periods. Nine sampling stations were selected during the first trip to Tasik Chini, and which were established as the main feeder rivers of Tasik Chini. They are Sungai Datang (Station 1), Sungai Cenahan (Station 2), downstream of Sungai Gumum (Station 3), middle passage of Sungai Gumum (Station 4), Sungai Kura-kura (Station 5), Sungai Melai (Station 6), downstream of Sungai Kuala Merupuk (Station 7), upstream of Sungai Kuala Merupuk (Station 8) and Sungai Jemberau (Station 9). Surface water was collected from each station in HDPE bottles, the concentration level measured using standard laboratory methods (APHA 1998). Surface water samples were collected about 10 cm below the water surface using a 500 ml HDPE bottle . The samples were stored in an icebox and transported back to the laboratory for analysis on the same day.

Analytical methods

The temperature, electrical conductivity, dissolved oxygen and pH of the water samples were measured in the field as in-situ measurements. Water samples were measured as laboratory analysis to evaluate parameters of water quality such as turbidity, TSS, TDS, NH_3-N, NO_3^-, PO_4^{3-} and SO_4^{2-}. Total Suspended Solid (TSS) was measured using filtration methods with membrane filter 45□m and vacuum pump (Gravimetric methods), Total Dissolved Solid (TDS) was measured using sample water after filtration for TSS; turbidity was measured using spectrophotometer. Four chemical water quality parameters such as NH_3-N, NO_3^-, PO_4^{3-} and SO_4^{2-} were determined by Salicylate method (HACH KIT DR 2010). Current flow and river width were measured by Flow meter (model FP101) to determine their stream flow and Rangefinder (model Bushnell 20-0001) to measure the distance.

Results and discussion

Hydrology

Hydrological analysis was carried out to evaluate water level characteristics of the water body as well as their drainage systems (Gray, 1970 & Ceballas and Schnabel, 1998). Annual total rainfall for the Chini area ranged from 1487.7 mm to 3071.4 mm, the highest rainfall of 3071.4 mm was recorded in 1994 and the lowest of 1487.7mm in 1997 (Figure 1). The average rainfall was 2235mm/year or 186mm/month. The total annual rain days in the study area ranged from 154 to 197 or an average of 178 days/year or 15 days/month. The highest total rain days were identified in 1993 and 1994 at 197 and 190 days respectively, while the figure for 1997 was 154 days (Figure 2). For 2004, a total of 159 rain days was identified (Figure 3). The highest number of rain days (21 days) was obtained during the wet season, especially during October to December, while February recorded the lowest number of rain days (5 days) in 2004. The highest rainfall recorded was 553.5 mm in October 2004 and the lowest recorded was 16.2 mm in February 2004 (Figure 4). The total annual rainfall was 2192 mm in 2004. During the half year of 2005, total rainfall ranged from 5.3mm (February) to 182.9 mm (May), equivalent to an average of 98 mm/month (Figure 5). Total rain days for the same year ranged from 1 day (February) to 11days (June)), equivalent to an average of 7 days/month (Figure 6).

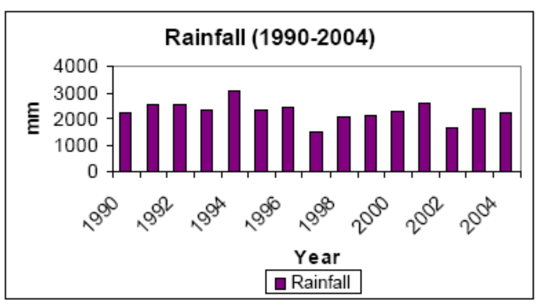


Figure 1. *Distribution of rainfall from 1990 to 2004*

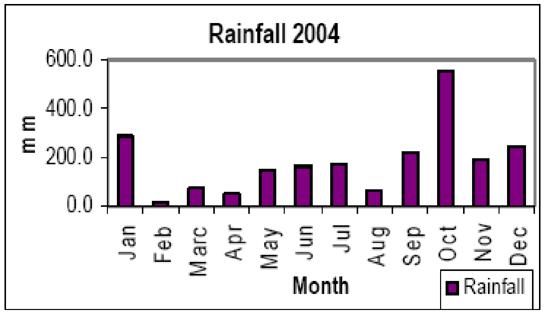


Figure 2. *Distribution of rainfall from January to December 2004*

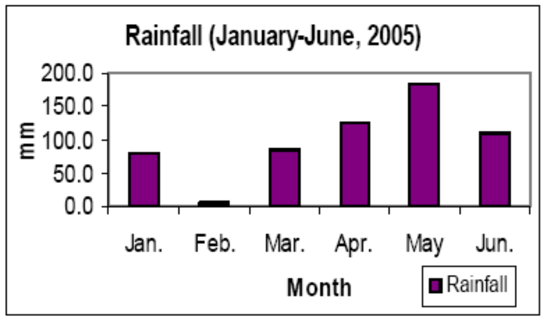


Figure 3. *Distribution of rainfall from January to June 2005*

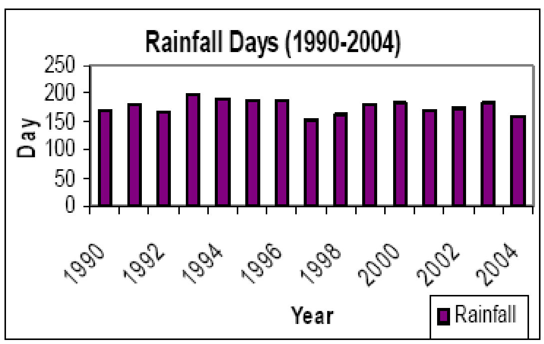


Figure 4. *Distribution of rain days from 1990 to 2004*

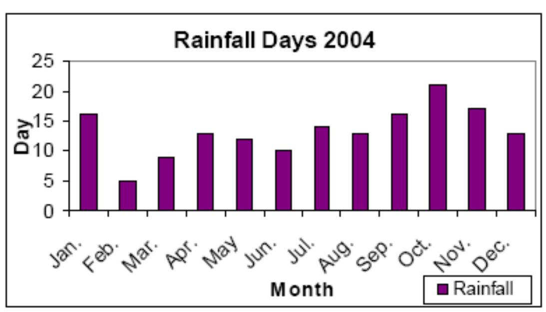


Figure 5. *Distribution of rain days from January to December 2004*

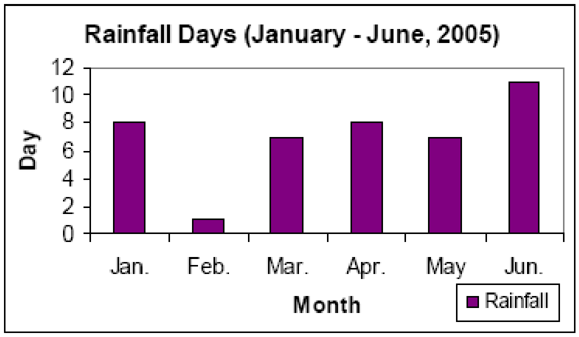


Figure 6. *Distribution of rain days from January to June 2005*

Stream flow

Stream flow from each feeder river of the Tasik Chini is relatively low; ranging from 0.0042 to 0.9083 m^3/sec or an average of 0.1674 m^3 /sec. The stream flow of Sungai Kuala Merupuk was the highest at 0.9083m^3/sec , and that of Sungai Melai the lowest at 0.0042 m^3/sec.

Sungai Datang was considered a dead river because there was no water flowing. Similar inferences were obtained on earlier observations of different feeder rivers of Tasik Chini (Muhd. Barzani *et al.*, 2005; Tan Choon Chek *et al.*, 2005). The range values of discharge from the feeder river based on each sampling are as follows: 0.033 to 0.6166 m^3/sec on October, 0.172 to 0.9083 m^3/sec on December 2004, 0.0118 to 0.207 m^3 /sec on February 2005, 0.0042 to 0.2448 m^3/sec on March and 0.0029 to 0.0718 m^3/sec on April 2005. The respective average steam flow of the nine feeder rivers of the Tasik Chini on October, December 2004, February, March and April 2005 were 0.2162 m^3/sec, 0.5308 m^3/sec, 0.0624 m^3/sec, 0.0655 m^3/sec and 0.0157 m^3/sec. The stream flows of those rivers mainly depend on rainfall events. The highest steam flows were recorded during the wet season, especially in October (0.6166 m^3/sec) and December 2004 (0.9083 m^3 /sec), while the dry season, especially February to April 2005 recorded the lowest steam flows (0.0118 m^3/sec, 0.0042 m^3/sec and 0.0029 m^3/sec) (Figure 7). The results obtained fall within the threshold (0.0026 m^3/s to 1.248 m^3/s) as measured by Mohd Ekhwan (2004) using Artificial Neural Network (ANN) (Figure 8).

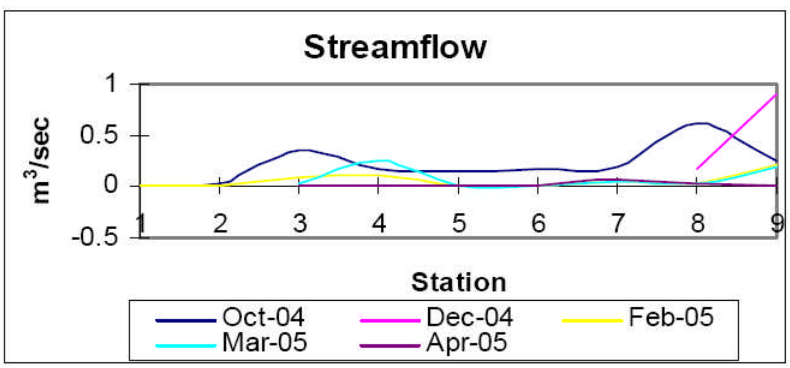


Figure 7. *Stream flow distribution in nine sampling stations*

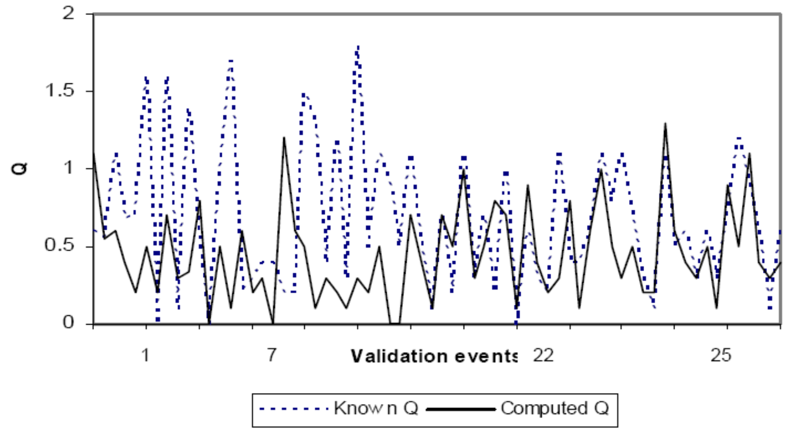


Figure 8. *Validation output of ANN model for Tasik Chini*

Water quality

In general, the status of water quality at each sampling site could provide useful information on land activities within the lake's catchment area. It is believed that at the catchment studied, higher concentrations of DO, for example, was triggered by intensive agriculture activities which resulted in changes in land use and land cover. The overall results are presented below, Figure 9 depicting the schematic diagram of 11 water quality parameters.

Temperature

The range of temperature value based on each sampling are as follows: 24.07˚c – 25.47˚c on October, 24.87˚c – 27.97˚c on December 2004, 24.87 – 28.4˚c on February, 24.3 – 29˚c on March and 24.57˚c – 32.1˚c on April 2005. For all sampling stations, the water temperature ranged from 24.07 to 32.1˚c. Station 7 (downstream Sungai Merupuk) recorded the lowest value (24.07˚c) in the wet season and station 9 (Sungai Jemberau) recorded its highest value (32.1˚c) in the dried season. The range of temperature at these sampling sites during the different seasons seemed normal for the climate. Yet, the temperature values did not show any spatial change but indicated only temporal variations.

pH

The range of pH values in the different sampling times were recorded, *viz*: 4.96 to 6.32 on October, 5.15 to 5.94 on December 2004, 4.17 to 5.39 on February, 3.2 to 5.46 on March and 4.24 to 5.82 on April 2005. The value of pH ranged from 3.2 at station 4 (middle of Sungai Gumum) to 6.32 at station 7 (downstream Sungai Kuala Merupuk). Most of the stations showed slightly acidic pH values indicating the water to be in Class III according to Interim National Water Quality Standards (DOE, 1994) . It is clear that the pH values increased from the dr y to the wet season, a finding similar as that found in Sim (2004). Basically, the pH value is controlled by the dissolved carbon dioxide (CO_2), which forms carbonic acid in water (Hem, 1985). The INWQS threshold range of pH for Malaysian rivers is 5.00 to 9.00 (DOE, 1994).

Conductivity

Conductivity (EC) values ranged from 14.33µS/cm to 85.7µS/cm at different location and time, as indicated by the *in situ* readings obtained during the sampling days. The average value of conductivity was 40.96µS/cm. The range values of conductivity in the different seasons were recorded, *viz.* 24.83 to 80.33µS/cm on October, 25.3µS/cm to 81.4µS/cm on December 2004, 14.33µS/cm to 84.7µS/cm on February, 16.5 µS/cm to 85.7µS/cm on March and 27.93µS/cm to 76.43µS/cm on April 2005. The highest and lowest values were recorded as 85.7µS/cm and 14.33µS/cm at station 4 in March 2005 and station 1 in February 2005, respectively. The conductivity value obtained was higher compared to the range of 13.2 to 25.13µS/sec found by Sim (2004).

Dissolved Oxygen (DO)
The DO concentration ranged from 0.56 to 6.4 mg/L. This value did not show any difference between two seasons. The range of DO value in the different sampling days were recorded as 0.88 to 5.48 mg/L on October, 1.23 to 5.37 mg/L on December 2004, 0.59 to 5.16 mg/L on February, 0.72 to 6.4 mg/L on March and 0.56 to 4.21 mg/L on April 2005. The highest value recorded was 6.4 mg/L at Sg Jemberau in March 2005 while the lowest value recorded was 0.56 mg/L at downstream Sungai Gumum during the dry season (April 2005). The DO value was very low (0.56 to 0.88 mg/L) at downstream Sungai Gumum during the dry season (February to April 2005). There is similarity in DO on earlier observations in different feeder rivers of Tasik Chini (Norlida *et al.*, 2005). The DO values are higher (4.03 to 6.4 mg/L) at Sungai Jemberau in both seasons. The water flows of Sungai Jemberau during both seasons are higher, thus providing more oxygen to dissolve into the water. The threshold range for Malaysian main river is 3.00 to 5.00 mg/L (DOE, 1994).

Total Dissolved Solid (TDS)
The range of TDS values based on each sampling obtained were as follows: 73.33 to 112.76 mg/L on October, 75.33 to 100.67 mg/L on December 2004, 22.67 to 78.33 mg/L on February, 50 to 8.67 mg/L on March and 35.33 to 66.67 mg/L on April 2005. Total Dissolved Solid (TDS) of water samples collected in different seasons varied from 22.67 to 112.67 mg /L , well within the permissible limit of World Health Organization (WHO, 1984). The highest concentration of 112.67 mg/L was measured at Sungai Kuala Merupuk (Station 8) in the wet season and lowest value of 22.67 mg/L was recorded at Sungai Datang in the dry season (February 2005). According to INQWS all the feeder rivers are in Class I (TDS < 500 mg/L). In general, TDS increased from dry to wet seasons. In dry season (February to April 2005) TDS ranged from 22.67 to 80.67 mg/L and from 73.33 to 112.67mg/L in wet season (November to December 2004). The TDS values were always higher at Sungai Jemberau (Station 9) where they ranged between 45.33 to 108 mg/L in both seasons.

Total Suspended Solids (TSS)
The total suspended solids (TSS) of water samples collected from 7 feeder rivers during the different seasons varied from 1.17 to 34.0 mg/L. The mean concentration of TSS was 12.27 mg/L; the highest (34.0 mg/L) was recorded at Sungai Kura-kura (station 5) in the dry season and the lowest (1.17 mg/L) at Sungai Kuala Merupuk (station 7) in the wet season. The range of TSS values in the different seasons were recorded *viz*.: 1.17 to 19 mg/L on October, 4.25 to 27.83 mg/L on December 2004, 4.0 to 34.0 mg/L on February, 4.5 to 26.67 mg/L on March and 4.17 to 22.5 mg/L on April 2005. Comparatively, the TSS values were higher at Sungai Gumum in both seasons. There was a sudden rise in the TSS values at Sungai Gumum (Stations 3 & 4) in February 2005 and March 2005 respectively. The TSS value also rose at Sungai Kura-kura (Station 5) in February 2005 and March 2005. Overall, the TSS concentrations recorded in this study shows a low value. By INQWS standard , the acceptable range of TSS for Malaysian rivers is 25 to 50 mg/L. The INQWS threshold level of TSS for supporting aquatic life in fresh water ecosystems is 150 mg/L (DOE, 1994).

Turbidity
The turbidity of water samples varied between 4.67 to 28.67 NTU. The mean concentration was 16.41 NTU; the highest was 28.67 NTU at Sungai Cenahan (Station 2) in the wet season and the lowest 4.67 NTU at Sungai Melai (Station 6) in the dry season. The range of turbidity values in the different sampling times were recorded *viz*.: 11.0 to 28.67 NTU on October, 16.0 to 27.33

NTU on December 2004, 5.33 to 22.67 NTU on February, 10.67 to 18.33 NTU on March and 4.67 to 21.67 NTU on April 2005. Overall, in the wet season turbidity is higher than the dry season. Comparatively, the highest turbidity value was measured at Sungai Kura-kura in both seasons. According to International standards the acceptability of water for domestic use ranges between 5 to 25 NTU (Hammer and Mac Kichan, 1981). INWQS does not propose any threshold level for turbidity of fresh waters for the support of aquatic life. Instead, the Malaysian Ministry of Health has set a threshold level of low water turbidity at 1000.00 NTU.

Ammonical Nitrogen (NH_3-N)
The range values of ammonical nitrogen, based on each sampling, are described as follows: 0.007 to 0.34 mg/L on October, 0.013 to 0.57 mg/L on December 2004, 0.003 to 0.43 mg/L on February, 0.014 to 0.26 mg/L on March, and 0.03 to 0.24 mg/L on April 2005. The values of ammonical Nitrogen of water samples collected during the different seasons ranged from .003 to 0.57 mg/L. The highest concentration (0.57 mg/L) was observed in the Sungai Datang (Station 1) particularly during the wet season. The lowest concentration was recorded in the dry season. The lowest (0.003 mg/L) was recorded at Sungai Jemberau (Station 9) in February 2005. The average is 0.17 mg /L. All samples collected during dr y season were well below the maximum permissible limit set by World Health Organization (WHO, 1984). As for the samples collected in the wet season, higher values were measured but not exceeding the WHO limit. The INWQS recommended maximum threshold level of ammonical nitrogen to support aquatic life for Malaysian rivers is 0.90 mg/L.

Nitrate (NO_3^-)
The range values of nitrate recorded during the two dry and wet seasons were 0.7 to 2.9 mg/L on October, 0.0 to 1.27 mg/L on December 2004, 0.0 to 2.03 mg/L on February, 0.09 to 0.44 mg/L on March and 1.03 to 2.1 mg/L on April 2005, respectively. The nitrate concentration varied between 0.0 to 2.9 mg/L. The NO_3^- ion is usually derived from anthropogenic sources like agricultural fields, domestic sewage and other waste effluents containing nitrogenous compounds (Das and Acharya, 2003). On February 2005 , nitrate concentration recorded was comparatively low, ranging from 0.0 to 0.44 mg/L. In the wet season, nitrate concentration ranged higher between 0.7 to 2.9 mg/L. The nitrate level was recorded zero at downstream Sungai Gumum (Station 3) in the dry seasons. According to INQWS classification all the feeder rivers are in Class I.

Phosphate
The phosphate values of water samples measured during the two dry and wet seasons varied from 0.0 to 0.50 mg/L. The mean concentration recorded was 0.11 mg/L.; the highest value of 0.50mg/L was recorded at upstream Sungai Kuala Merupuk (Station 8) in the wet season and the lowest of 0.0 mg/L at downstream Sungai Kuala Merupuk (Station 6) in the dry season. The range values of phosphate in the two dry and wet seasons were recorded *viz*.: 0.01 to 0.5 mg/L on October, 0.01 to 0.19 mg/L on December 2004, 0.01 to 0.04 mg/L of urban and agricultural activities in the drainage basin (Joseph, 1997). on February, 0.0 to 0.25 mg/L on March and 0.03 to 0.21 mg/L on April 2005. Overall ate was higher than in the dry season. Comparatively, higher phosphate values were measured at Sungai Gumum during the the two dry and wet seasons . Kampung (village) Gumum is located near the Sungai Gumum. So the main causes of water pollution were the local people’s activities. The rapid increase in the concentrations of Organophosphate pesticides which coincided with discharge was due to the runoff phenomenon in major rivers, thus reflecting the preponderance

Sulphate
The sulphate content ranged from 0.0 to 2.0 mg/L. The highest value (2.0 mg/L) was recorded at

Sungai Datang (Station 1) during the wet season and the lowest value (0.0 mg/L) during the dr y season. The range values of sulphate in both dry and wet seasons were recorded *viz*.: 0.33 to 1.33 mg/L on October, 0.0 to 2.0 mg/L on December 2004, 0.0 to 2.0 mg/L on February, 0.0 to 1.67 mg/L on March and 0.0 to 1.67 mg/L on April 2005. Comparatively, the sulphate values in both seasons were higher at Sungai Gumum. As this river is nearer to the village Gumum, the main source of sulphate pollution was, so far, the activities of local people. According to Hem (1985), the major sources of sulphate in streams are rock weathering, volcanoes, and human activities such as mining, waste discharge and fossil fuel combustion process. All of the samples collected in both seasons were well below the maximum permissible limit set by World Health Organization (WHO, 1984).

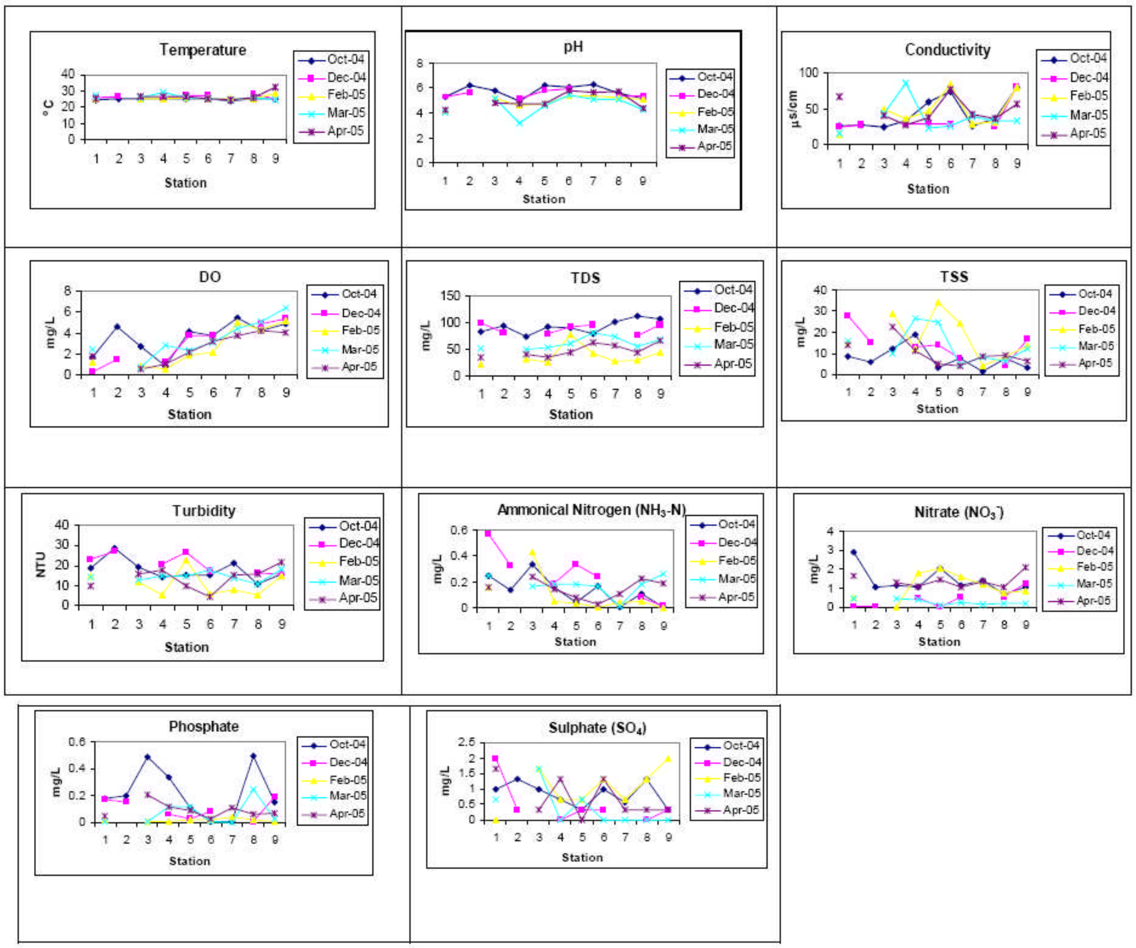


Figure 9. *Distribution of eleven water quality parameters; i.e. Temperature; pH; Conductivity; DO; TDS; TSS; Turbidity; Ammonical nitrogen; Nitrate; Phosphate and Sulphate*

Analytical statistics

There are no significant correlations between stream flow and TSS, TDS, turbidity, Nitrate, and Ammonical nitrogen (NH_3-N) during the dry and wet seasons since most of the results show a very weak R^2, albeit at the moderate r value. The correlation values vary from and below 0.16 (Figure 10). However, the correlations with stream flow for TSS and TDS were respectively positive and negative in the dry and wet seasons. DO and sulphate were correlated as positive slope and turbidity and nitrate were correlated as negative slope with stream flow in both seasons. Phosphate and sulphate are positively correlated (r= 0651; r= 0.624) with stream flow in both seasons respectively. This means that pollutant loads came from dilution and not from erosion.

Raining during the wet season had diluted the soil into the river and increased the concentration of TSS and turbidity.

Stream flows were recorded in the dry and wet seasons and rainfall data of the earlier five days of sampling days were collected. At r= 0.821, the measurement of discharge and rainfall showed a statistically significant relationship between rainfall and discharge (Figure 11).

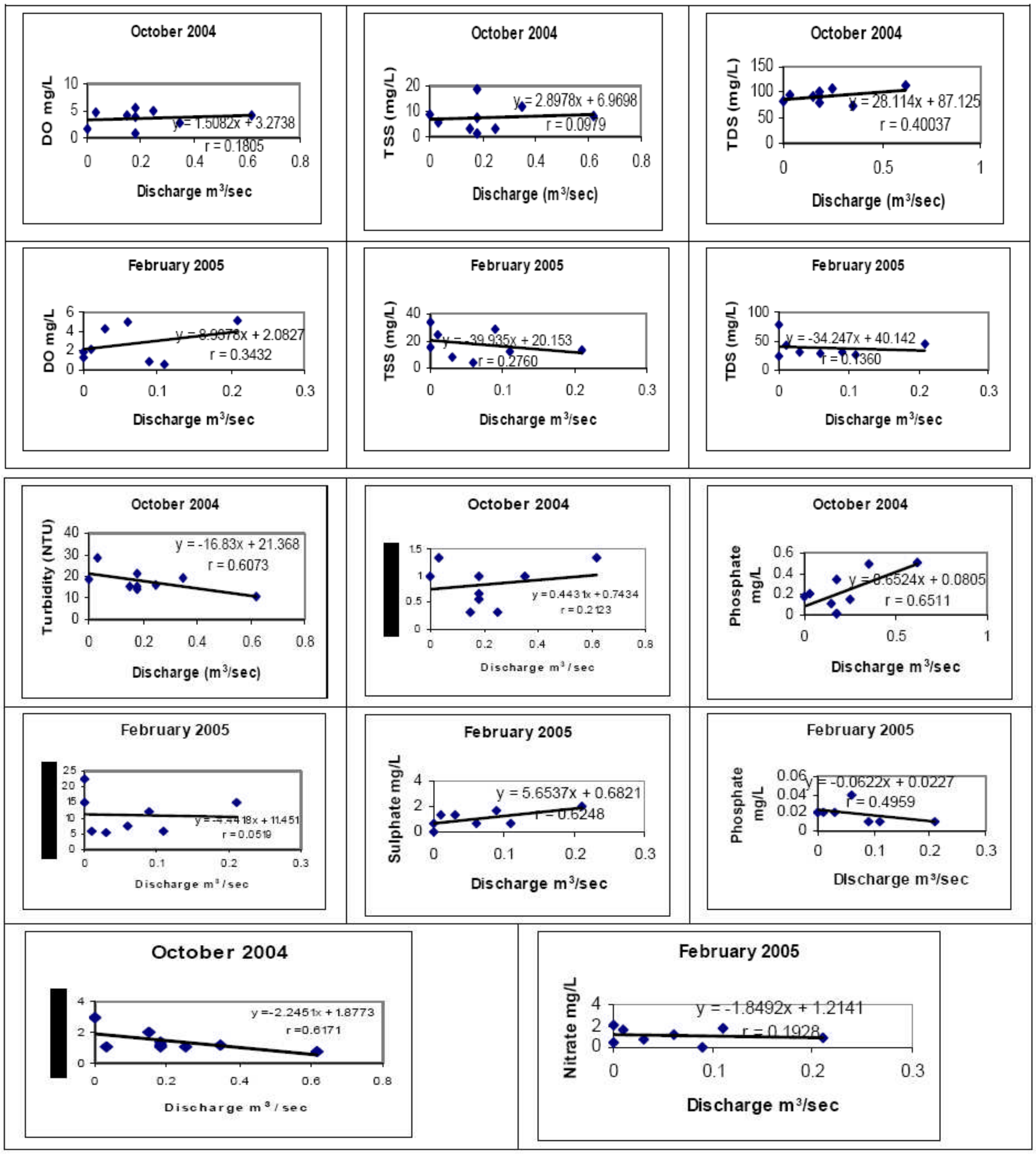


Figure 10. *Relationships between discharge and DO, TDS, TSS, Turbidity, Sulphate, Phosphate, and Nitrate during the wet and dry season samplings*

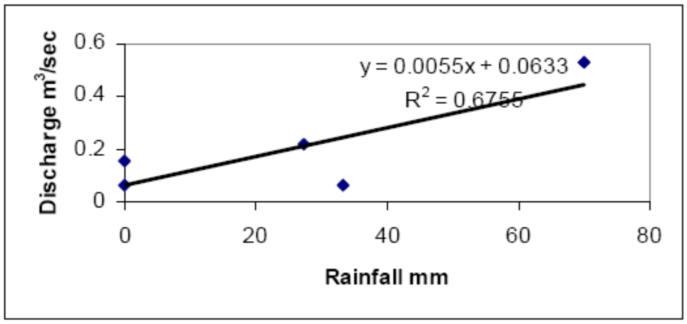


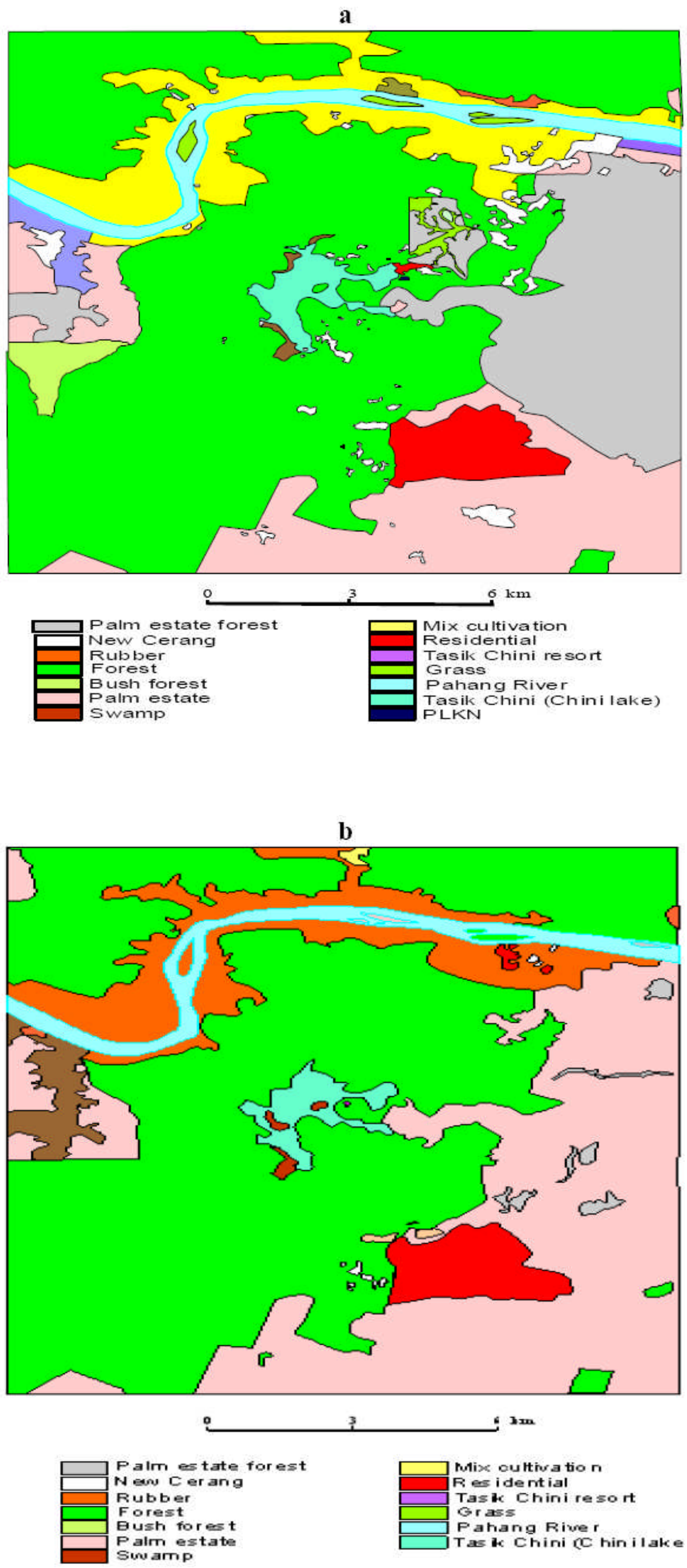
Figure 11. *The relationship between rainfall and discharge*

Sources of pollution

The catchment of Tasik Chini is highly dependent on the upstream conditions and surrounding area both in regard to water quality and quantity. As with upstream rivers and lakes, the quality of the inflowing water to it ,as a water land, is a function of the point and non-point pollutant sources in the lake; water pollution can readily modify the natural flora and fauna of Tasik Chini. Based on the discussion above, this study revealed that most of the river pollutants were sourced from the water runoff that discharged into the Tasik Chini. Several point and non-point sources of pollutions for Tasik Chini may be listed as follows:

- Direct runoff from cleared land activities, i.e. deforestation, agriculture and cultivation;
- Direct discharging of resort operators and the PLKN camp's wastewater with or without sufficient treatment; and
- Pahang River pollutants entering Tasik Chini during maximum discharges.

Over the last decade, significant land conversions from forests to agriculture had rendered Tasik Chini vulnerable to water pollution. In gauging the impacts of land use changes in the catchment, this study engaged the use of two different maps, dated 1994 and 2004, for the purpose of comparison of base line analysis. Both maps were abstracted from satellite imageries, namely, the SPOT 2 and IKONOS (Figures 12a & b). Significant changes in land use size can be seen in palm oil plantation (an increase of 14.1 percent), rubber plantation (a decrease of 8.9 percent) and forest land (a decrease of to 5 percent). Due to extensive land in the area used for agricultural purposes, excess emission of nitrogen and phosphorus from the area will bring excess nutrition to Tasik Chini. Nutrient enrichment due to wastewater runoff of oil palm plantations, containing fertilizers, pesticides, and herbicides had caused eutrification phenomena in the lake. In addition, there was also pollutants from the existing PLKN and Tasik Chini resorts. Although relatively small in size (0.01% and 0.04%), they play a vital role in abetting water pollution in Task Chini (Figures 13a & b). It follows that proper mitigations are needed in order to maintain the water quality of the lake.



Figures 12a & b. *The series of maps compares changes in forested, agriculture land, resort and residential areas in the Tasik Chini (1994-2004)*

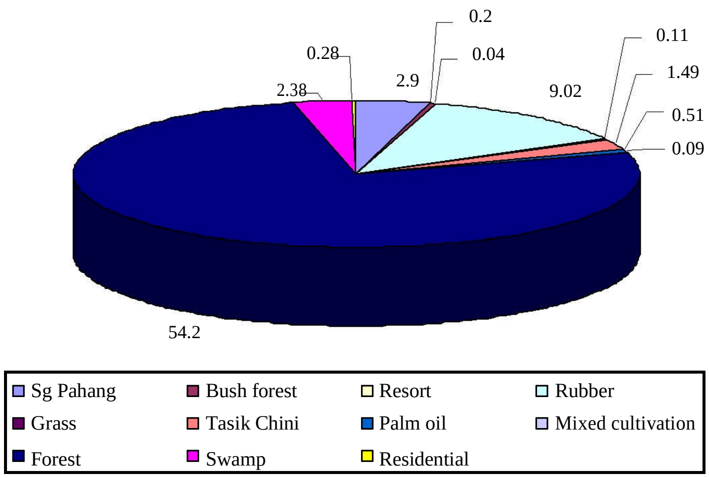


Figure 13a. *Land use characteristics in 1994*

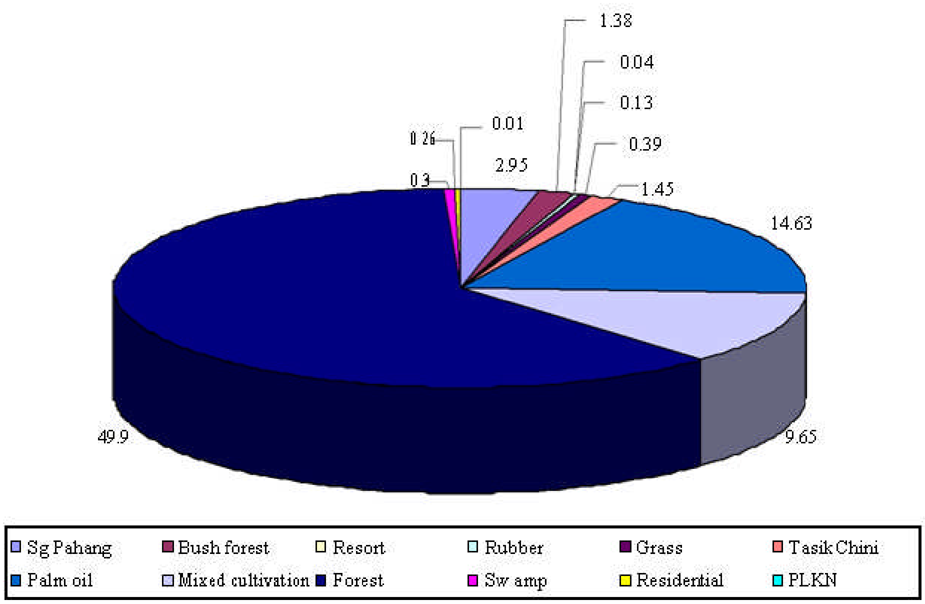


Figure 13b. *Land use characteristics in 2004*

Conclusion

A detail physico-chemical study of the lotic water of the feeder river of Tasik Chini during the wet and dried seasons brought out the following facts. The seven feeder rivers showed different seasonal fluctuation in various physico-chemical parameters. The results of water quality trends clearly show that the majority of the water quality parameter is quite high in the wet season compared to dry season. Water quality analysis show that pH, NH_3-N, NO_3, phosphate sulphate, TDS, TSS and turbidity are lower in the dried season, but DO is higher. In the wet season all the parameters are higher except DO. From the above investigation it is clear that Sungai Gumum (station 3) and Sungai Datang (station 1) are comparatively more polluted than other. Sungai Gumum is located near the village (Kampung) Gumum. So the pollutants are expected come from local people's activities. Sungai Cenahan (station 2), Sungai Kura-kura (station 5), Sungai Melai (station 6), and Sungai Jemberau (station 9) are less polluted. The least polluted river is Sungai Kuala Merupuk (station 7). The main sources of pollutant are residential areas, illegal logging, development and agricultural activities, generating both organic and inorganic waste. These wastes are ultimately contaminating the water bodies**.** According to INWQS classification all the feeder rivers are in Class II**.** Stream flow discharge from each feeder river to Tasik Chini is directly related with rainfall. In the dried season rain fall is low so discharge from feeder rivers are low than the wet season. The feeder rivers' water quality status in the catchment is mainly influenced by the stability of the catchment area. A basin protection strategy in the form of development of the monitoring system, assessment of pollution, pollution control and basin conservation should be proposed in order to minimize the impact. If proper alternative arrangements like sustainable management of water resources, protection of logging and awareness of local people are not made then the situation may be deteriorated and alarming to the environment of the Tasik Chini.

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