CHAPTER 5 : DISCUSSION

5.1 Multiple Analysis of Variance (MANOVA)

In the analysis of MANOVA, there were 5 parameters showing non-significant differences among 4 types of water; total hardness, velocity , nitrate, zinc and copper. They were found to be less useful parameters in water quality classification of the study areas because of their low variation. Therefore , they were omitted from the other analyses. In the analysis of LSD, it was found out that stream and irrigation water were presented the non-significant difference between their means on the basis of ten given parameters; alkalinity, pH, BOD_5, conductivity, iron, manganese, ammonia, total phosphate, saturated oxygen and temperature. However , it is possible to separate irrigation water from river if more parameters will be included, for example turbidity, Chlorophyll-a, total dissolved solids.

5.2 Cluster Analysis

Generally, water condition in rainy season is always better than in dry season due to dilution effect. In the separating seasons using cluster analysis , there were six sites showing very clear separation of dry season from wet season;ST1,R1 , IC1 , ST4, ST2 and R2. In site ST2 and R2 ,dendograms showed combining of May and September , May and August. It is because of increasing of nitrate and phosphate concentration in that particular month and due to missing value of BOD_5 concentration. Therefore, water quality in those two months was lowered to be similar to the water quality in dry season. But in other three sites ;SC1, SC2, and iC2 have dissimilar pattern to those already mentioned due to very high pollution through the entire sampling period especially in August and September. However, the dissimilar pattern of site st3 is , on the other hand, due to very low pollution and differences of velocity.

5.3 Selection of Determinants and Weighting Factor

Two statistical techniques were included. Factor analysis principally identifies underlying constructs or factors that explain the correlation among a set of variables.

In the analysis, manganese showed highly related to water quality due to its good variation pattern among all sampling sites. It was assumed that Mn found in water samples arose from domestic wastewater as it is the component of whitening detergent. But it has less importance in term of pollution factor when presenting in low concentration. Mn concentration of 20 water samples was low , therefore it was omitted from determinant consideration. Then factor analysis was re-run and five parameters obtained from extraction process giving high correlation coefficients. The correlation coefficients indicate the importance of such parameters to the overall water quality. Therefore , it is suitable to convert correlation coefficient value to weighting factors. In this study , ammonia has the highest weighting factor due to highest correlation coefficient. The weighting factors emphasize ammonia more than BOD_5 and % of saturated oxygen. Total phosphate has lowest weight. It is opposite to the index developed in temperate country where weighting is more concentrate to dissolved oxygen and BOD_5 .

In the study of House and Eillis (1980,1987) , Tyson and House (1989) ,etc., whether the selected determinants are different in number but BOD_5 and DO also hold higher weight than ammonia. In contrast to temperate regions , in tropical regions where average temperature is always higher than 25°C , ammonia is important factor because it can dissolve very well at pH~ 8 and temperature > 25 °C (Faculty of Science, 1987). The reaction of bacteria , nitrification process changing ammonia to nitrite, occurs rapidly in tropical conditions. Therefore , if remaining concentration of ammonia is still high in water body, this water must be indicated to be high polluted.

However, in the indices developed in temperate zone, ammonia , BOD_5 and DO are the most important factors which holding high weighting.

5.4 Rating Curves Development.

Rating curves development of selected determinants used in this study , was achieved by drawing determinant concentrations from legal accepting published water quality standard and classification to the index scale. The mathematical expressions were applied in order to try to cover the drawing graph and link with the extra points .

This is a good technique to create a rating curve relating to the published standard , on the other hand, error also be produced because the mathematical function can not link all points in one equation. Anyway, the author chose the best equation which can produce the best curve similarly to the plots obtained from existing surface water quality standard and classification used in Thailand.

5.5 Water Quality Index (Chemical Index) and its performance

In adoption of a water quality index would have many advantages over the existing classification system. Although a WQI is not absolutely objective, but it is more efficient method for monitoring trend in water quality. It enables the reduction of large amounts of data to a single index value in more reproducible manner than present classification permit, in addition, time and budget can be saved. In the comparative study between developed WQIs and existing SWQC, WQI using GW formation showed consistently high agreement in both data sets compared to SWQC, although , the agreement of other two formulations were lower. One reason that causes the low agreement is the different parameters used. Conductivity and total phosphate were included in WQI but were not in SWQC. It causes , therefore , error in comparison especially for the minimum operator method which indicates water quality using the poorest characteristic.

In addition to classifying a water body to a specific class, the use of index can indicate the position to the water within the class. For example, the two sites of Mae Sa stream, June st1 and June st2, were classified into class 2 by the SWQC whilst the WQI using GW formation allocated them index scores of 74.2 and 62 respectively. Consequently, whether the results of classification saying the same class but greater detail at the water quality at there two sites on Mae Sa stream is given by the developed WQI.

5.6 Key indicator

Similarly to many international literature, DO was suggested to be key parameter according to its importance for aquatic animals. It had recommended in the report of The Studies of the Impacts of Manufactural and Agricultural Activities on the Qualities of Water in Lum Num Pong (1987) that in water condition containing DO 0.3-2.5 mg/l is too low for fishes can survive. In additioning, the SWQC mentioned that water quality will be classified to class V when DO concentration is less than 2.0 mg/l. Therefore, DO was set to be key indicator at concentration 2 mg/l.

5.7 Relationship Between Physio-Chemical Variables and Macroinvertebrates

The consequences of analyses presented clear relationship between physio-chemical factors and macroinvertebrates both by product - moment correlation between DECORANA axes and physicochemical gradients and by MDA which showed the linear-relationship between biological classification and discriminant functions derived from physicochemical variables. The product-moment correlation showed strong correlation of DECORANA axes based on macroinvertebrates to BOD_5 and NH_3 as well as MDA showed correlation of TWINSPAN sites grouping based on macroinvertebrates to BOD_5 and DO. The group of stream sites was separated from the others due to high DO and low BOD_5 as well as ammonia while the group of sewage sites was separated due to very low DO and high BOD_5 and ammonia. As similar to this work, the studies of other authors such as Wright, Moss, Armitage and Furse (1984), Ormerod and Edwards (1987), Rutt, Weatherley and Ormerod in 1990 had summarized that TWINSPAN and MDA were found to be useful approaches to the classification of running-water sites by their macroinvertebrate faunas and the prediction of community type (as indicated by the occurrence of family in the sits comprising the group) using physio-chemical data alone.