DISCUSSION

Since this study concerns about the status of wastewater treatment efficiency of the studied wetland, all the sampling sites were designed to fit the concept by placing them along the estimated flow path-way, across the wetland started from the inlet to the outlet. S1 is the main inlet near the west bank where the wastewater from pig manure biogas unit flows through to S3 and S4 in the mid-wetland sites before flooding over and flowing out at S5, the outlet. Whereas S2 is another additional inlet near the southeast bank where wastewater from cattle farm irregularly flows into the wetland and although there is no certain pattern of flow, it was assumed that the flow should pass through mid-wetland area and eventually enter the outlet site. Therefore the flow pattern shold be from S2 to S4 and S5, respectively. By this way, the studied wetland can be treated as " a natural biological wastewater treatment unit" and then some physicco-chemical parameters can be applied for the assessment. Although the actual flow pattern of wastewater in the wetland was unknown, two sampling sites in mid-wetland were designed as the passing channels of the overall flow using information obtained from the profile study.

Having two different functional inlets, sites selection for water sampling was then laid out in two different channels; one is along the flow from S1 to S3, S4 and S5 designated " channel-1345 "; another is along the flow from S2 to S4 and S5 designated " channel-245. " Graphs produced from the acerage values of tabulated data for all studied parameters were designed to represent both flow-channels.

For physical parameters, the graph of plotting the average data of pH and water temperature versus sampling sites indicates the sharp declining trend at the beginning part of the wetland (S1 to S3), but much less declining degree (almost flat) at other later sites. (figure 17.) However, both parameters do not show any severe situation where the values became too high or low for living and other condition in the wetland. The values of pH are also within the acceptable range for surface water (pH 5 -9 : see table 5 on page 25.)

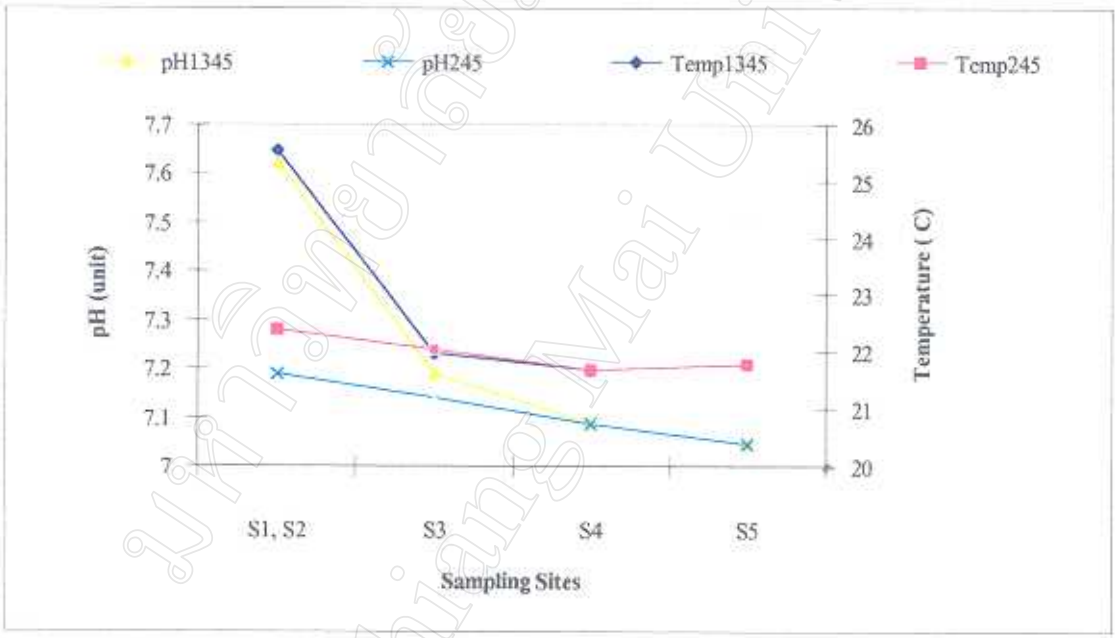

Figure 17. Graph of physical parameters vs. sampling sites.
(1345 and 245 represent two flow-channels and
average values were used.)

From the result of chemical and statistical analyses, it was indicated that there were some level of wastewater treatment capacity at the beginning part of the wetland where most chemical parameters were reduced significantly (statistically confirmed) except orthophosphate-phosphorus. However, after the wastewater entering into mid-wetland areas, there is no significant treatment (statistically confirmed). These areas somehow became like a sedimentation place for substances entering the wetland. Figure 18 was produced by plotting the average data of all chemical parameters, from the entire study period, versus sampling sites in order to clarify such situation.

However, comparing these values of all studied chemical parameters to standard values (table 5 on page 25), it is quite clear that they exceed the acceptable level for being surface water in nature. While the artificial batch-systems using aquatic plants of the other two former studies had resulted some parameters with the acceptable values compared to standard ones (table 3 on page 20, table 4 on page 21)

Concerning with the significant effect of physical change of the studied wetland caused by the construction of artificial wetland (statistically confirmed), chemical average data were separately integrated into graphs shown in figure 19 and 20. Without such effect, before physical change, the treatment trend is even clearer confirming that there is a significant level of capacity for wastewater treatment only at the beginning part of the wetland, while the rest parts are only like the sink pool for substances entering the wetland. (figure 19.)

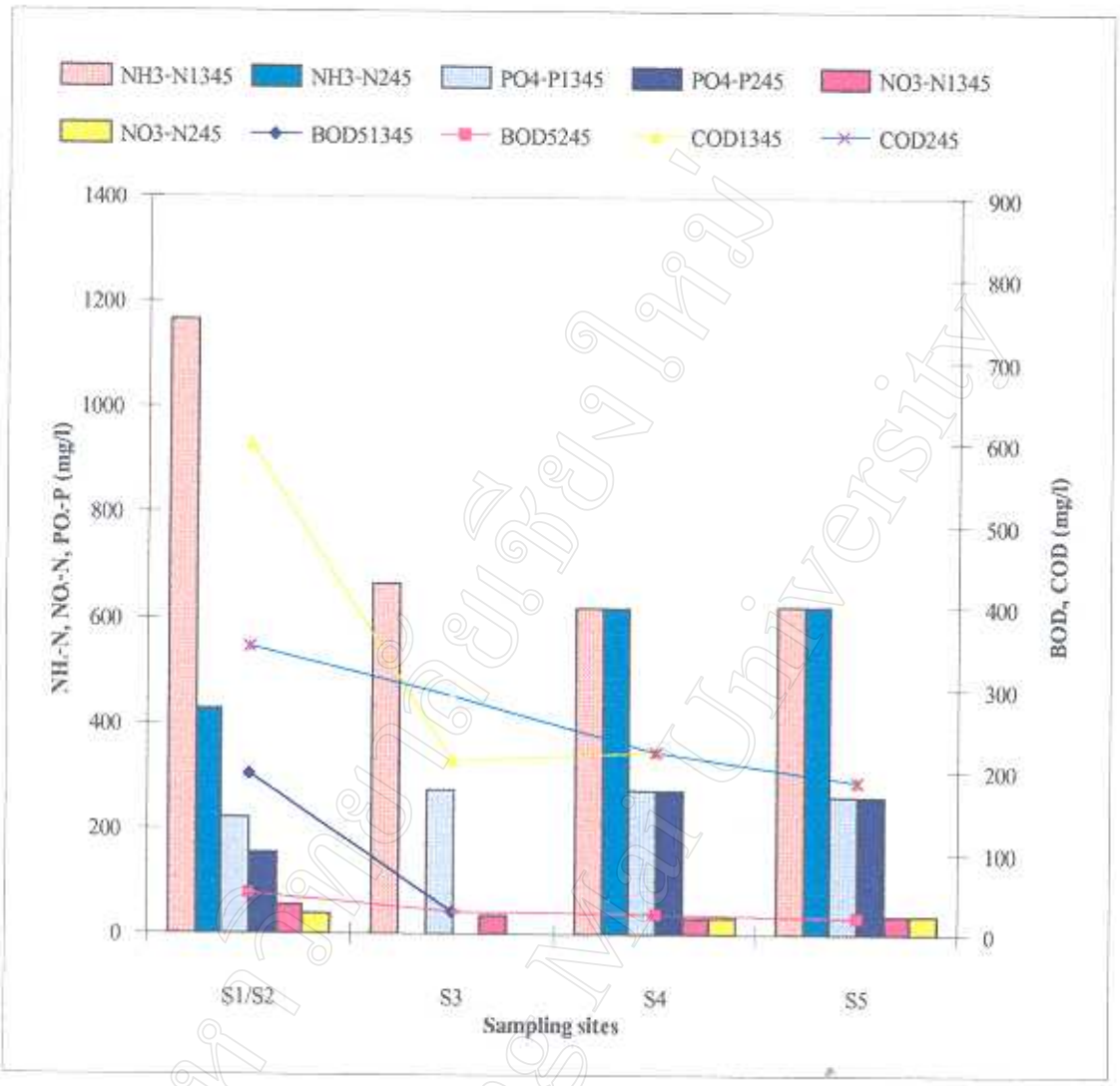

Figure 18. Graph of chemical parameters vs. sampling sites.
(1345 and 245 represent two flow-channels and
average values were used.)

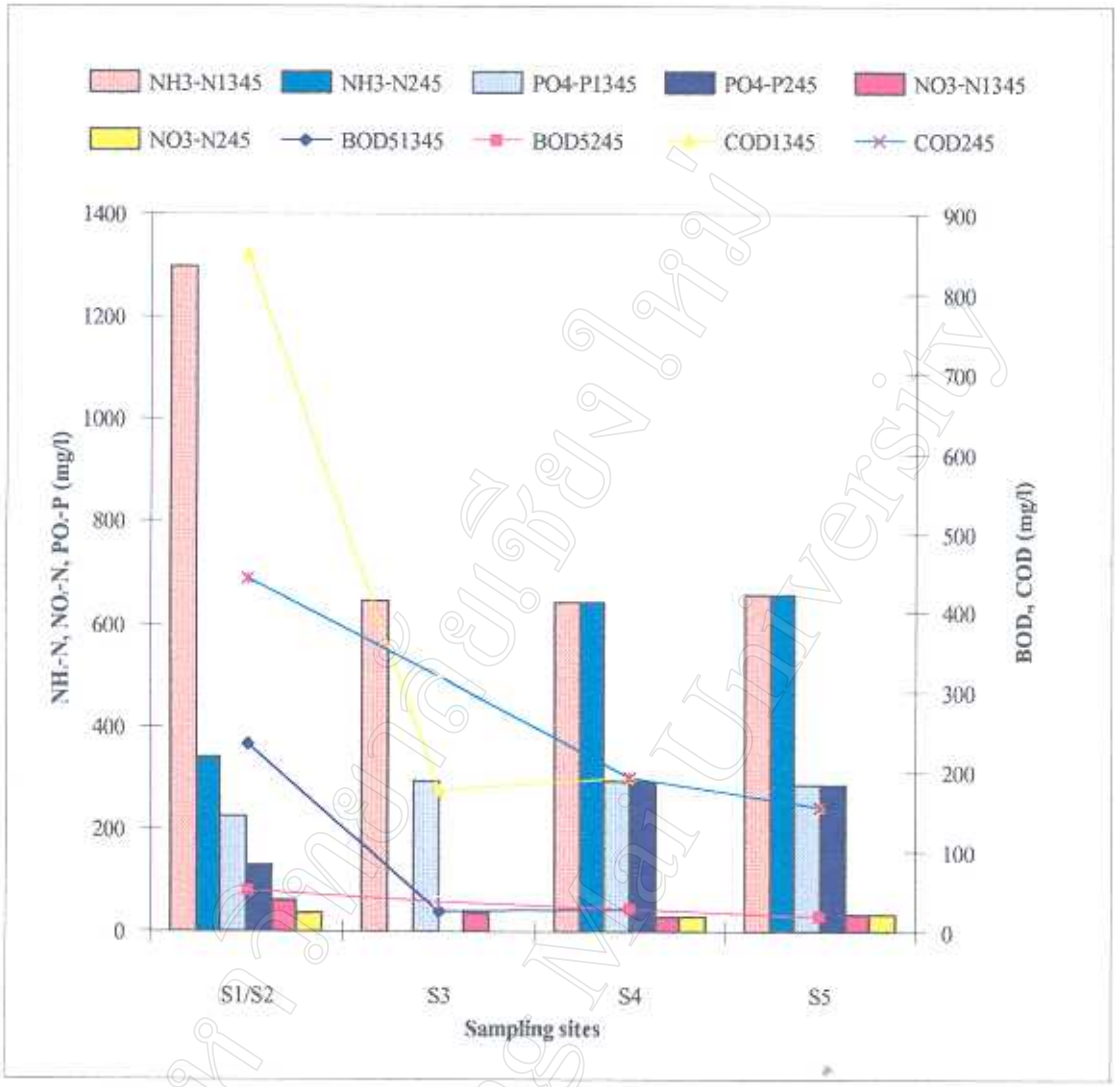

Figure 19. Graph of data before physical change.

(plotted between chemical parameters and sampling sites,

1345 and 245 represent two flow-channels and

average values were used.)

However, the situation became different after the physical change of the wetland. There are no different among the values of all chemical parameters except BOD_5 (statistically confirmed.) (figure 20.) This different situation can easily lead into a wrong conclusion, without precaution, saying that the studied wetland has no capacity for wastewater treatment. But in fact, even though the efficiency of the wetland in treating wastewater might be changed, it should still has a level of such capacity because the amount of wastewater in-flow is more or less the same, and the large size with high water volume and long (140 days) retention time of the wetland are still remained. The factor that should be responsible for the present of the trend in figure 20 is 'the improper sampling sites selection' which all of the former samplings are not lying right on the flow path-way in the wetland. In fact, at the very beginning state of being physically interfered, the actual flow pattern of wastewater in the wetland might not settle yet.

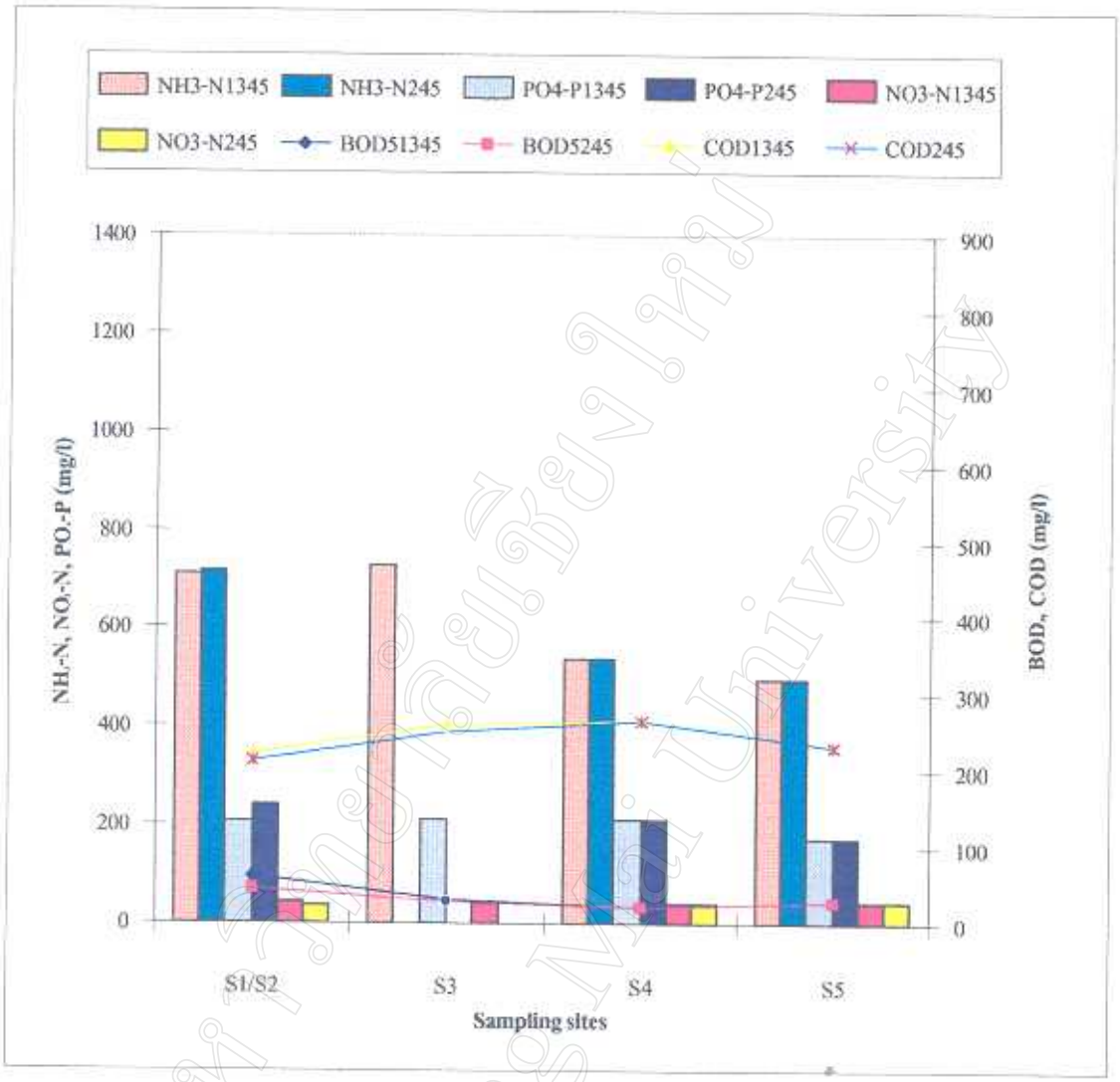

Figure 20. Graph of data after physical change

(plotted between chemical parameters and sampling sites,

1345 and 245 represent two flow-channels and

average values were used.)

Percent removals for chemical parameters which show significant trend of reduction, only in the study period before physical change of the wetland, were calculated using the values at inlet S1 and outlet S5 as original influent and final effluent of the studied wetland, respectively. (table 18.)

Table 18. Percent removal of chemical parameters.

Chemical Parameter	Percent Removal (%)
BOD_5	92.37
COD	81.66
NH_3-N	49.26
NO_3-N	48.64
PO_4-P	*

* there was no significant treatment capacity for PO_4-P

BOD_5 was removed with the comparatively highest percentage of 92.37 %, whereas COD was the second place removal percentage of 81.66 %. The removal percentages of nutrient which only occurred with NH_3-N and NO_3-N are 49.26 % and 48.64 %, respectively, while there was no significant treatment for PO_4-P. Since the studied wetland is dominantly occupied by water hyacinth, the wastewater treatment capacity of the wetland by biological factors was assumed to base on this species of aquatic plants. These results have agreed with the data of former studies (cited in literature review, see table 3 on page 20 and table 4 on page 21) about the percent removal of some parameters by water hyacinth.