

EAC

DE LA SALLE UNIVERSITY

A Biophysico-chemical Study of a Segment
of Chico River Receiving Sugar Processing
Waste water

A Thesis
Presented to
the Faculty of Biology Department
De La Salle University

11111111

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Biology

by
Roger Asuncion Pua

May 1990



DE LA SALLE UNIVERSITY

ABSTRACT

This study was conducted between May and July 1989 in order to assess the polluting effect of the effluents coming from Cagayan Sugar Corporation (CASUCO) to a segment of the Chico River that is directly receiving its effluents. Three sampling stations were chosen over a distance of approximately 5 kilometers. A number of physical, chemical, and biological parameters were analyzed. Statistical tests were used to evaluate water quality variation among stations and sampling periods. The results showed that the effluents of CASUCO discharged in Chico River caused considerable changes in the physico-chemical and biological characteristics of the river ecosystem. The observed changes noted in the station (Station II) that directly received the effluents were: higher water temperature; lower dissolved oxygen (DO); higher biochemical oxygen demand (BOD); acidic pH and higher ortho-P. Since the effluents of CASUCO affected the physical and chemical aspects of the water quality of the segment of Chico River that directly received it, this in turn disrupted the normal equilibrium of the flora and fauna or the biological factors as evidenced by growth of blue-green algae, diatoms and lower algal density in the area. Results of investigation on community similarity showed that the characteristics of Station III which was located below the outfall of CASUCO closely approached the characteristics of the control station (Station I) which was located above the outfall. Such result simply suggests that there was some recovery in the degree of pollution in Station III which can be attributed to the distance that the water travelled coming from Station II and the dilution effect of unpolluted water coming from other tributaries of the Chico River. A number of physical and chemical parameters showed tendency to vary directly and indirectly with each other. Results of this study also showed that the significant variation in all parameters noted in all stations as sampling progressed (sampling period) can be attributed to the dilution and flushing effect of precipitation.

In conclusion, the effluents of CASUCO altered the area (Station II) that directly received its effluents. This alteration caused this segment of the Chico River to be in its early state of deterioration.



DE LA SALLE UNIVERSITY

TABLE OF CONTENTS

	PAGE
Acknowledgement	ii
List of Tables	iv
List of Figures	v
List of Plates	vi
List of Appendices	viii
CHAPTER	
I. Introduction	
A. Statement of the Problem	7
B. Objectives of the Study	9
C. Significance of the Study	10
D. Scope and Limitations of the Study	11
II. Review of Literature and Related Studies	13
III. Experimental Design and Methodology	
A. Sampling Methodology	33
B. Sampling Technique	33
C. Analytical Technique	37
a. Water Quality (Physico-Chemical Parameters)	
b. Epilithic Algal Community	
D. Statistical Procedures	41
IV. Results	
A. Physical Parameters	42
B. Chemical Parameters	50
C. Biological Parameters	54
V. Discussion	
A. Physical Parameters	73
B. Chemical Parameters	78
C. Biological Parameters	86
VI. Conclusion and Recommendation	
Conclusion	91
Recommendation	94
Literature Cited	96
Appendices	102



LIST OF TABLES

Table		Page
1	Monthly means with standard deviation of Physico-Chemical and Biological Parameters	44
2	Correlation Summary Table	46
3	Stations means with standard deviation of Physico-Chemical and Biological Parameters	47
4	Total number of genera and species in each division of algae collected in the 3 sampling stations	55
5	Summary table of algal density and occurrence in the 3 sampling stations during the 3 months sampling period. Values are represented in units/ml.	57
6	Index of species diversity for each station per sampling	71
7	Index of community similarity between sampling stations per sampling month	72



LIST OF FIGURES

Figures	Page
1 Diagramatic presentation of three sampling stations along Chico River	6
2 Location of sampling stations	34
3 Air and H ₂ O Temperature vs. Sampling Period vs. Sampling Stations	43
4 Velocity of flow, Transparency and Total Suspended Solid vs. Sampling Period vs. Sampling Stations	43
5 DO, BOD and pH vs. Sampling Period vs. Sampling Stations	52
6 Orthophosphate-phosphorous, Nitrate vs. Sampling Period vs. Sampling Stations	52
7 Algal Density, Species Abundance vs. Sampling Period vs. Sampling Stations	56



LIST OF PLATES

Plates		Page
1	Cagayan Sugar Corporation (CASUCO)	102
2	Cachaza Pond (Stabilization Pond)	102
3	Cachaza Pond (closer view)	103
4	Station II (outfall station)	103
5	2,500 cm ² string quadrat used in the collection of algae	104
6	2,500 cm ² string quadrat and plastic bottles used in the collection of algae and water samples	104
7	The canal that receives directly the effluents of CASUCO	105
8	Station I (right bank)	105
9	Station I (middle and left bank)	106
10	Station II	106
11	Station II	107
12	Station III	107
13	Station III (right bank)	108
14	Station III (middle and left bank)	108
15	Determination of Dissolved Oxygen (Part I)	109
16	Determination of Dissolved Oxygen (Part II)	109
17	Determination of Total Suspended Solids	110



18	Algae collected in the 3 sampling stations during the 3 months sampling period	110
19	Samples of algae collected and to identified during the 3 months sampling period	111
43		122



LIST OF APPENDICES

Appendices	Page
1 Summary of measurements and methods performed in this study	123
2 Air temperature ($^{\circ}\text{C}$) of the 3 sampling stations during the 3 months sampling period	124
3 H_2O temperature ($^{\circ}\text{C}$) of the 3 sampling stations during the 3 months sampling period	125
4 Velocity of flow (sec./m/) of the 3 sampling stations during the 3 months sampling period	126
5 Total Suspended Solids (g/ml) of the 3 sampling stations during the 3 months sampling period	127
6 Transparency (cm.) of the 3 sampling stations during the 3 months sampling period	128
7 D.O. (Dissolved Oxygen) (mg/li) of the 3 sampling stations during the 3 months period	129
8 BOD (Biological Oxygen Demand) (mg/li) of 3 sampling station during the 3 months sampling period	130
9 pH of the 3 sampling stations during the 3 months sampling period	131
10 Orthophosphate-phosphorous concentration (mg/li) of the 3 sampling stations during the 3 months sampling period	132
11 Nitrate-N concentration (mg/li) of the 3 sampling stations during the 3 months sampling period	133



12	Algal density (units/ml) in the 3 sampling stations during the 3 months sampling period	134
13	Species abundance of algae collected in the sampling stations during the 3 months sampling period	135
14	Analysis of variance for air temperature	136
15	Analysis of variance of H ₂ O temperature	137
16	Analysis of variance for velocity of flow	138
17	Analysis of variance for transparency	139
18	Analysis of variance for dissolved oxygen	140
19	Analysis of variance for biological oxygen demand	141
20	Analysis of variance for pH	142
21	Analysis of variance for Ortho-P	143
22	Analysis of variance for Nitrate-N	144
23	Analysis of variance for total suspended solids	145
24	Analysis of variance for species abundance	146
25	Analysis of variance for algal density	147
26	Mean, standard deviation and range of water temperature taken at 3 subsampling sites across each sampling station	148
27	Mean, standard deviation and range of air temperature taken at 3 subsampling sites across each sampling station	149



DE LA SALLE UNIVERSITY

x

28	Mean, standard deviation and range of velocity of flow taken at 3 subsampling sites across each sampling station	150
29	Mean, standard deviation and range of transparency taken at 3 subsampling sites across each sampling station	151
30	Mean, standard deviation and range of dissolved oxygen taken at 3 subsampling stations across each sampling station	152
31	Mean, standard deviation and range of biological oxygen demand, taken at 3 subsampling sites across each sampling period	153
32	Mean, standard deviation and range of total suspended solid taken at 3 subsampling sites across each sampling station	154
33	Mean, standard deviation and range of Ortho-P taken at 3 subsampling sites across each sampling station	155
34	Mean, standard deviation and range of Nitrate-N concentration taken at 3 subsampling sites across each sampling period	156
35	Mean, standard deviation and range of pH taken at 3 subsampling sites across each sampling station	157
36	Algal density for every sampling period during the 3 months sampling	158
37	Summary table of Physico-Chemical and Biological factors prevailing and obtained respectively in the study sites throughout the sampling period	159
38	Determination of Dissolved Oxygen	160
39	Determination of Biochemical Oxygen Demand	165



40	Ortho-P Determination	166
41	Nitrate-N Determination	171
42	Total Suspended Solids Determination	175
43	Epilithic Algal Community Analysis	179

