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**STUDIES ON SELECTED WATER QUALITY PARAMETERS AND
HEAVY METALS IN PULP AND PAPER EFFLUENTS IN RELATION TO
THE POLLUTION OF THE RIVER NZOIA AT WEBUYE.**

BY

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ABSTRACT

This work describes the results of a study on selected water quality parameters and heavy metal pollution of the River Nzoia following waste water discharges from the Pan Paper Mill (PPM) at Webuye. The study was carried out between November 1998 and April 1999.

The concentration of the metals zinc, cadmium, chromium, copper, lead, calcium, sodium and potassium in both water and sediments was determined by the Atomic Absorption Spectrophotometer (AAS). The Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), sulphate, chloride and nutrients concentration were determined by the standard methods. It was found that the highest mean temperature was determined for wastewater at station S2 (40.58±0.57°C). Temperatures decreased significantly as waste water flowed through the aerated ponds ($t_{22} = 72.2$, $p = 0.0004$) and shallow ponds ($t_{22}=10.35$, $p<0.0001$) by 39.76% and 29.52% respectively. Highest mean DO was determined in station S1 (6.38±0.78 mg/I) while lowest mean DO was determined at station S3 (0.58±0.57 mg/I). DO showed significant drop in wastewater as it flowed through the aerated ponds ($t_{22}= 4.22$, $p= 0.0014$) by 58.83% and DO significantly increased for wastewater that flowed through the shallow ponds ($t_{22} = 3.76$, $p = 0.0011$) by 42.6%. There was significant drop in both BOD₅ ($t_{22} = 5.17$, $p < 0.0001$) and COD ($t_{22} = 6.89$, $p < 0.0001$) for waste water that flowed through the lagoons (aerated ponds) by 34.44% and 35.71% respectively. There was no significant increase in both PH ($t_{22}= 5.46$, $p<0.0001$) and EC ($t_{22}=13.71$, $p<0.0001$) for effluent that flowed through the shallow ponds. An increase in both these parameters was reported for effluent that flowed through the lagoons; EC ($t_{22}=6.68$, $p< 0.0001$), PH ($t_{22}=8.49$, $p<0.0001$)

The highest mean TSS was determined in station S5 (6830.5±2452.0 mg/I) and this significantly dropped for waste water that flowed through the aerated ponds ($t_{22} = 2.70$, $p < 0.0013$) and shallow beds by 42.87% and 56.98% respectively. The TDS increased both in at lagoons and shallow ponds by 23.04% and 14.8% respectively. Both hardness and alkalinity increased in wastewater as it flowed through shallow ponds by 40.12% and 76.3% respectively. There was a significant increase in hardness, TSS and TDS downstream due to effluent discharge from the PPM. The mean levels of all the major ions in effluent were higher than the levels in River Nzoia water. The levels of all the major ions significantly increased for wastewater that flowed through the shallow ponds. Potassium concentration increased by 46.85% in aerated ponds and by 126.8% in the shallow ponds. There was a significant decrease in Zn level and a significant increase in both Cr and Pb levels downstream. There was no significant variation in Zn, Cd and Cr level for effluent through the lagoons. There was no significant drop in Zn, Cd, Pb and Cu for effluent through the shallow ponds. Metal pollution in river Nzoia was revealed from high sediment concentration down stream. Waste water discharged into the River Nzoia either through station S3 or S6 had most of the selected water quality parameters above the recommended values by the Ministry of Reclamation Regional and Water Development (1994) for waste water discharge into public courses.