

A Snap-shot of Water Quality Along the Tonle Sap, Mekong, and Bassac Rivers Near Phnom Penh, Cambodia

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Introduction

A water quality and Geographic Information System (GIS) workshop was held July 5-9, 2004 in the village of Kean Svay, Cambodia, located 15 km southeast of the capital city of



Workshop Instructors and Participants

Phnom Penh. Workshop participants included personnel from different government agencies and faculty from the Royal University of Phnom Penh.

The purpose of this poster is to report on the water quality values monitored during the workshop, as well as to demonstrate the utility of water

monitoring kits as used by participants in a developing country, in a complex hydrologic environment..

River Hydrology

The Mekong River flows 4,200 km from its source in China (Qinghai Province near the border with Tibet) to the South China Sea (see map insert). The area around Phnom Penh sees the convergence of the Mekong, Tonle Sap, and Bassac rivers. During the dry season the Tonle Sap river flows south from the largest lake in Southeast Asia (Tonle Sap lake) During the wet season the high waters of the Mekong reverse the flow of the Tonle Sap river, such that the river flows north into Tonle Sap Lake. The in-flowing waters increasing the size of the lake four fold. A return to the dry season sees a flow reversal, where the Tonle Sap River drains the lake and ensures a sufficient flow of fresh water down the Mekong river.

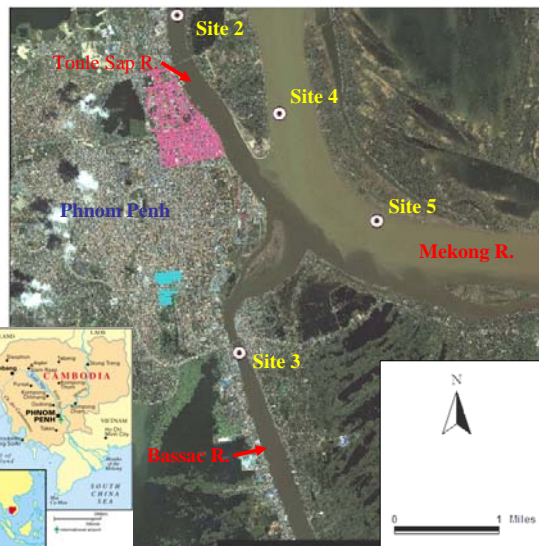
An examination of the convergence of the three rivers near Phnom Penh (Figure 1) shows limited mixing of the Tonle Sap and Mekong River waters, hinting at possibly some interesting river dynamics.



Aerial photograph showing the southern end of Tonle Sap lake flowing into the Tonle Sap River



Scenes along the Tonle Sap River at Phnom Penh



Ikonos image taken during the wet season. Shows convergence of the Mekong, Tonle Sap, and Bassac rivers near Phnom Penh. Sampling Site 1 is located along the Tonle Sap River north of Site 2. Insert shows location of study area in Cambodia and Southeast Asia..

Sampling Methodology

Water quality samples were collected on July 6, 2004 (dry season) at five selected sites (Figure 1) from aboard a boat. Sample analysis was done using a kit approach (developed under the Buffalo State's Aquanaut Program). Kit parameters included dissolved oxygen, BOD₅ (a measure of oxygen demand), *e-coli*, nutrients, pH, hardness, temperature and total solids. Sampling involved the collection of surface water samples, with analysis and sample preparation conducted on board the boat.



The use of kits was augmented by the use of a higher tech approach, Hydrolabs (probes and a datalogger). Hydrolab parameters included dissolved oxygen, pH, temperature, conductivity, and turbidity.

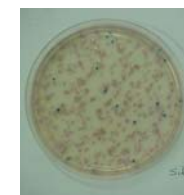


The boat used for sampling; sampling turbidity using a sechi disk; and sample analysis on board the boat

Sampling Results

An examination of the water quality values (see below) are somewhat consistent over the five sites. Water column profiling, using the Hydrolabs, showed little variability with depth. The rivers appeared well mixed at the time of sampling. There does appear to be an increase in dissolved oxygen and percent saturation values from Site 1 to Site 5, as well as an increase in suspended solids between Site 1 and Site 5. Collected bacterial samples (petri dish shown for Site 2) indicate a high *e-coli* and general coliform count. The lower values reported for Sites 1,4 and 5 are believed to have been compromised by exposure to sunlight and high temperatures on board the boat.

Analytes	Site 1	Site 2	Site 3	Site 4	Site 5
DO (ppm)	5.5	6	6.5	7	7
DO (% saturation)	70	75	83	95	90
(BOD) ₅ (ppm)	3	3	2	3	3
Water Temperature (°C)	30.4	32.1	32	32.5	30.5
Acidity (pH)	7	7	7	7.5	7
Hardness (ppm)	107	54	72	54	54
Secchi Depth (feet)	0.5	0.5	0.5	0.3	0.5
NTU	100	100	100	125	100
Suspended Solids (ppm)	89	192	190	188	254
Dissolved Solids (ppm)	80	80	80	80	90
Total Solids (ppm)	169	272	270	268	344
Nitrate	0.2	0.1	0.1	0.2	0.2
Phosphate	0.15	0	0	0.1	0.1
E-coli (colonies/100mL)	100	3300	1700	0	200



Bacteria incubated from a 1 mL water sample. Blue colonies are *e-coli*. Pink colonies are general coliform

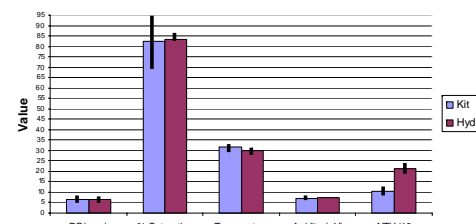


Figure 2: Comparison of kit versus Hydrolab values. NTU values were divided by 10. Bars indicate the range of reported values. Kit "percent saturation" was calculated, while NTU values were converted from secchi depths.

A comparison of parameters measured by the kit approach and Hydrolab show good overall agreement (Figure 2). Temperature values are slightly higher using the kit as water samples were taken out of the river. The Hydrolab values are reported with a higher degree of accuracy (e.g. kit pH is reported as a whole number while hydrolab reports values to two significant figures). The largest discrepancies occurred where kit values were either calculated or converted using guides taken from the literature.

Water Quality Index

The water quality parameters were used to calculate a Water Quality Index (WQI), that classifies the state of the water on a scale from 0 to 100. Parameters used were dissolved oxygen (% saturation), BOD₅, pH, NTU, total solids, nitrate, phosphate, and *e-coli*. Results gave scores ranging from 67.85 to 74.26 (fair to good water quality). Concentrations of nutrients do not appear a problem. The problem parameters (lowest scores) were associated with the high *e-coli* counts, turbidity, and to a lesser degree, associated BOD₅ and total solids.

Site	WQI
1	70.52
2	67.85
3	70.78
4	74.26
5	72.32

Conclusion

Water quality is reported in the fair to good range, with problems associated with bacteria and turbidity. The kits have shown themselves to be an easily managed and reliable sampling protocol, comparable to higher tech sampling/analysis methods.