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INTERPRETATION OF WATER QUALITY OF KAVERI RIVER IN MOHANUR, TAMIL NADU BY MUTIVARIATE TECHNIQUE

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Abstract: In this study, ten water quality parameters of the river Kaveri observed at Mohanur for six years were collected and subjected to principal component analysis. The data were fed to a computational program in order to process and understand the data as a cluster. Then the outputs were analyzed for possible linear and or non-linear relationships between the water quality parameters and the years of analyses. The results showed interesting correlations between the qualities of water at different year.
Keywords: Principal component analysis, water quality, Kaveri, Mohanur.

Introduction

Rivers are important resources water for domestic, industrial, and agricultural purposes. Indeed, river water is polluted by the wastewater and effluent coming out of the anthropogenic activities. Therefore it is important to monitor the quality of the river water. Generally, the water quality is indicated by its physical, chemical, and microbiological properties. Regular monitoring of river water quality paves way to prevention of outbreak of any diseases and also a check for further deterioration of water. This also helps to understand the level of pollution in the water.

Certainly, the quality of water is not determined based on single parameter. Consideration of several water quality characteristics such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), concentration of chloride, nitrite, sulphate, ammonia, total coli and etc, is important for determining the quality of the water. Assessment of these parameters over a long term leads to large databases that increase more complexity towards the understanding of the water quality.

Preceding researchers suggested several methods such as water quality indices, dynamic models, fuzzy logical models, Bayesian models, principal component analysis (PCA), etc [1-14]. Among them, PCA is an efficient tool to provide information for

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interpretation of the parameters that are important to describe the quality of water through reduction of dimension. In view of evaluating the relationship between the water quality parameters, in this study, the water quality parameters of Kaveri river at Mohanur was subjected to principal component analysis.

Experimental

At first the water quality parameters such as pH, chloride, sulphate total hardness, dissolved oxygen, nitrate, fecal coli, and total coli (Table 1) were collected from the database of Government of Tamil Nadu [15]. A separate program was prepared. Arbitrary values were taken for those missing parameters for certain years. The collected data were fed to PCA using Scilab program to get output.

Table 1. Water quality parameter observed at Mohanur, Tamil Nadu.

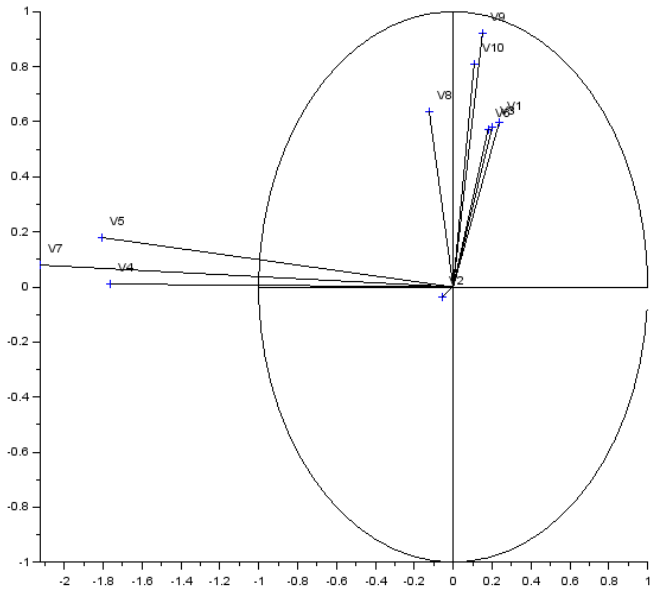
Year	pH	D.O mg/l	B.O.D mg/l	Cl mg/l	Sulphate mg/l	Nitrate mg/l	Total hardness mg/l	Fecal coli MPN/100ml	Total coli MPN/100ml	DBU Rank
2004-2005	8.15	6.9	2.4	0	0	0.66	0	202	911	3
2005-2006	8.25	7.2	2.2	81	29	0.14	156	323	786	3
2006-2007	7.74	7.7	2.0	68	29	0.169	192	155	324	2
2008-2009	7.86	7.5	0.71	155	48	0.28	210	274	465	3
2009-2010	8.15	7.4	1.3	172	18	0.17	172	143	329	2
2010-2011	7.83	6.43	1.0	158	44	0.17	231	182	172	2

Results and Discussion

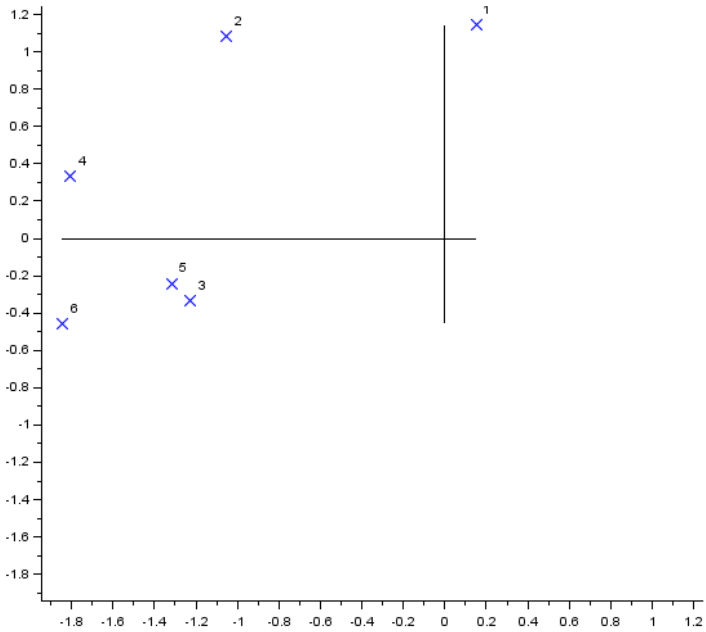
The quality of water is ranked between A and E in general. For computation, these alphabets were converted to numerical values ranging from 1 to 5. The water quality parameters observed at Mohonur over six years are summarized in Table 1. In this study, the water quality parameters along with ranking are considered as variables from V1 to V10. Whereas the years are considered as constants. These variables and constants were fed into the Scilab program to get Figures 1a&b.

Figure 1a showed that there are just three groups of variables such as group 1 (V1, V3, V6, V8, V9, V10), group 2 (V2), and group 3 (V4, V5, V7). The variable V2 is unique and different from other variables. Whereas, variables in group 1 and 3 are close to each other. Group 1 and group 3 variables are mostly perpendicular (90^o) to each other. This characteristic behavior is due to the non-linear relationship between them. The closeness of

the variables present in group 1 as well as in group 3 suggests that these particular parameters affect the water quality in a similar manner. In other words, these any of the variable within a group can be used to precisely determine the effect other variable. It is interesting to note that variables V4 (chloride), V5 (sulphate), V7 (hardness) lie in same group which is in line with the general expectation for hardness causing reagents.



(a)



(b)

Figure 1. Score plots of (a) variables – waterquality parameters and (b) constants – years for the samples collected at Mohanur, Tamil Nadu, India.

Figure 1b shows the overall quality of water over 6 years. Among them, samples collected during 2005-2006 were lesser polluted water followed by sample collected during 2006-2007. The closeness of constants 3 and 5 may be attributed to the close values of DO and others. Sample collected during 2010-2011 is the most polluted water in this study. The data of constants 4 and 6 were similar. This is due to the close values for parameters such as pH, chloride, total hardness, and others. The general trend observed from this graph is that the pollution level of the river water at this station has been increased gradually.

Conclusion

In this study, the water quality parameters of samples of Kaveri river collected at Mohanur, Tamil Nadu during 2005-2008 and 2009-2011 were subjected to principal component analysis using an open access Scilab software. The score plots were obtained for variables as well as for constants from the program after dimension reduction. The results suggested that variables such as pH, concentration of nitrate, total coli are interrelated and affect the water quality in a similar manner. The score plot of constants indicated that the pollution lever is gradually increasing year by year. This type of analysis could be very useful to build large database with many other water quality parameters observed over a period. The data could be converted to score plot to understand and identify the quality of water and its similarity with the previous years. Thus any adverse effects due to water pollution can be avoided by continuous monitoring of the quality of river water.

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