Scholar Publishing Group
Academic Journal of Environmental Biology
https://doi.org/10.38007/AJEB.2021.020206
ISSN 2789-8407 Vol. 2, Issue 2: 47-55

Health Status of Water Quality of Ganjiang River System by Fuzzy Set Processing Method of Biological Index

Gopal Kamakshi*

Univ Roma Tor Vergata, I-00133 Rome, Italy

**corresponding author*

Keywords: Biological Index, Fuzzy Set Processing, Ganjiang River System, Water Quality Health

Abstract: Water is the source of life and one of the basic substances for human life and production. Therefore, water quality affects people's production and living standards, and water sources are the main sources of drinking water for urban residents and industrial enterprises. The role is self-explanatory. The purpose of this paper is to study the health status of water quality in the Ganjiang River system using the fuzzy set processing method of biological indicators. Based on the monitoring of water pollutants in the water source and the analysis of pollution sources, the Ganjiang River system, a typical water source, was analyzed using the relevant health risk assessment theory. To determine the evaluation indicators, in addition to consulting the literature to understand the main local pollution sources, it is also necessary to conduct field research to determine the main local pollution sources and provide a basis for determining the evaluation indicators. A total of 900 water samples from the Ganjiang River were tested, and 629 water samples met the monitoring indicators, with a pass rate of 96.11%. There was no significant difference in the pass rate in different years ($\chi 2$=2.546, P=0.278).

1. Introduction

With the rapid development of my country's social economy, environmental pollution has become increasingly serious, which has caused many environmental problems, such as major environmental problems occur from time to time, new and old pollution incidents continue to appear, and environmental pollution problems such as PM2.5, heavy metals, and acid rain are all over the country. The ecological environment is severely damaged, and human health and survival are threatened [1]. Health Risk Assessment (HRA) can quantitatively evaluate the probability of water environmental pollutants causing health hazards to the human body, and propose an effective method for reducing, controlling, and adapting to risks and countermeasures. Based on this, this paper selects the Ganjiang River system as the research object, carries out water quality health risk assessment, correctly grasps the characteristics of the water environment, pollution sources and diseases, and finds out the reasons for the formation of water quality health risks in the water source [2].

Research in the field of water quality and health status has been highly valued at home and abroad. Kandlikar A aimed to assess some selected physicochemical (especially nutrient) parameters of Dhanora Reservoir to investigate its status in relation to water quality. Also, it will correlate parameters across the water body to generate baseline data. The focus is on water quality maintenance and management. Assessment of water quality and its care for drinking, agricultural and other purposes will play an important role in healthy aquatic ecosystems and their conservation. Water samples are taken monthly from four different sampling points in the dam and brought into the laboratory for systematic analysis. From June 2016 to May 2018, a continuous survey was conducted for nearly two years. Water-soluble nutrients play a vital role in reservoirs. Water samples were analyzed using standard APHA procedures. In conclusion, the water quality in relation to nutrition is optimal and within allowable levels, with only a few exceptions. The reservoir is surrounded by mountains and the soil is fertile. Ecologically, it is a healthy body of water that is not polluted by enrichment of nutrients and other sources [3]. Bamberger M analyzed surface and groundwater samples collected throughout Susquehanna County using complementary bioassays and high-resolution mass spectrometry. Ah receptor activity was found to be associated with proximity to damaged gas wells, and certain chemicals, including disclosed hydraulic fracturing fluid additives, were also found in samples near damaged gas wells or exhibiting biological effects. In addition to the correlation to drilling activities, bioanalysis and high-resolution mass spectrometry also detected material from other anthropogenic sources. Its complementary approach provides a more comprehensive picture of water quality by considering biological effects and extensive screening of chemical contaminants [4]. Kanoti JR collected a total of 275 water samples from 22 sites in informal settlements between December 2016 and December 2017. The samples were analyzed for bacterial contamination and physicochemical quality. Heat-resistant coliform counts were used as surrogate indicators of bacterial contamination, and pH, turbidity, dissolved oxygen, activity, salinity, and temperature were used as chemical indicators of contamination. The results showed that groundwater coliforms in the Kisumu pipeline did not meet the groundwater contamination limits recommended by WHO and local KEBS standards. Results also showed that bacterial contamination levels varied by water type, with shallower wells having higher bacterial loads [5]. To sum up, there are many researches on water quality health risk assessment at home and abroad, and most of them focus on urban drinking water and water environment in river basins.

This paper selects the Ganjiang River system as the research object, carries out water quality health risk assessment, correctly grasps the characteristics of water environment, pollution sources and diseases, finds out the causes of water quality health risks in water sources, constructs water quality health risk assessment procedures, establishes a database of exposure parameters, and identifies and It is crucial to quantify uncertainties and ensure the safety of drinking water. By assessing the health risks of source water quality, we can understand the impact of source water quality on the health of the population, and at the same time, we can improve the source water according to the assessment results. If the assessment results show that a certain substance may affect the health of local residents, we can take a A series of measures are taken to improve; and the water quality health risk assessment of water source can provide management and legislative basis for water source management departments and legislative departments. Therefore, the health risk assessment of water source water quality provides theoretical support for improving water quality, strengthening water source management, and implementing water source legislation.

2. A Study on the Health Status of Water Quality of Ganjiang River System by Fuzzy Set Processing Method of Biological Index

2.1. Calculation Method of Biological Index

(1) BMWP Index

The index was marked on a scale of 1-10 from least sensitive to most sensitive according to differences in macrobenthos anti-pollution characteristics, and the sum of the family-level sensitivity values for the species at the sample points was the score for the BMWP checkpoint. The higher the value, the smaller the impact of human intervention on the sample. The index uses the species sensitivity value of family-level taxa to reflect the water quality level in a water body, but it needs to be corrected for different family-level sensitivity values of macrobenthos during the application process [6-7].

(2) Macrobenthos Integrity (B-IBI) Index

The B-IBI index is a multi-parameter assessment method, which is widely used in river health assessment in my country. This study also compared the relationship between the BMWP index and the B-IBI index. When calculating the B-IBI index, its basic principle and calculation formula refer to the relevant research data of other scholars in the monitoring area [8-9].

2.2. Water Quality and Health Risk Assessment Procedures for Urban Water Sources

(1) Hazard identification

Hazard identification is the first step in water quality health risk assessment in urban water sources, and it is carried out simultaneously with the selection of water quality indicators. Mainly by consulting the relevant epidemiological and toxicological data, we can identify the toxic effects of possible pollutants in the source water on human health, and determine the risk factors that need to be evaluated according to the identification results. Among them, it is very important to determine whether the pollutants in the water have a carcinogenic risk (in the form of genotoxic substances), a non-carcinogenic risk (in the form of somatic toxic substances), or both carcinogenic and non-carcinogenic risks [10-11].

(2) Exposure assessment

Exposure assessment is an important part of health risk assessment, which reflects the dose of pollutants entering the human body through various ways, that is, the exposure dose. And for people in different regions, different ages and different lifestyles, the exposure doses show a certain difference. For water source water, the main way of entering the human body is drinking water and skin absorption, so the exposure to water quality in water source areas is very important. Two routes of exposure need to be considered in the evaluation [12-13].

(3) Evaluation of dose-effect relationship

The evaluation of dose-effect relationship is used to measure the degree of damage caused by pollutants entering the human body. In general, it can be assessed through epidemiological studies or toxicological experiments. The toxicological data included in the human health risk assessment include carcinogenic factors (when assessing carcinogenic risk) and reference doses (when assessing non-carcinogenic risk). Toxicological information is mainly are USEPA toxicology data from the IRIS toxicology database on carcinogenic and non-carcinogenic effects [14-15].

2.3. Distribution of Ganjiang Water System

The Ganjiang River Basin is a rectangular area composed of the main stream of the Ganjiang River and a series of asymmetrical rivers. The Ganzhou Mountains are the first river, and the Gongshui is the first river; the upstream is the upstream river, which is a typical radial waterway; the main tributaries are divided from northeast to northwest: Pingjiang, Meijiang, Qinjiang, Jinshui, Xiangshui, Lianjiang, Taojiang, Zhangjiang, Shangyoujiang, Longhuajiang. The middle section of the Ganjiang River starts from Ganzhou City, Xing'an County, and there are large tributaries on both sides of the east and west banks [16-17]. From south to north, the west bank is mainly divided into Chuan River, Shushui, Niuhou River, Weishui and Lushui, and the east bank is mainly divided into Fushui, Gujiang and Wujiang from south to north. Below the Xing'an River is the lower reaches of the Ganjiang River, with no major tributaries on the east bank and Yuanhe River and Jinjiang River on the west bank. The right branch is divided into the middle branch and the south branch, and the four branches are injected into Poyang Lake. The river reaches Wangjiang Pavilion in Wucheng and flows into Poyang Lake. The Ganjiang River has a developed water system, bounded by Ganzhou and Xing'an, and divided into upper, middle and lower reaches [18].

3. Detection of Water Quality and Health Status of Ganjiang Water System

3.1. Survey Sampling

Practical experts and technicians will conduct surveys and sampling during the dry and rainy seasons of 2020. The information collected through the survey includes water supply, quantity, population covered, determination of water supply capacity, treatment method, disinfection method and type of water source. The collection, storage and transportation of water samples were carried out in accordance with the "Standard Test Methods for Drinking Water".

3.2. Inspection Items

After the samples are received, they are tested according to the common water quality indicators in the Regulations on the Management of Domestic Drinking Water and Wastewater. The testing items are divided into microbial indicators, toxicity indicators, sensory properties and general chemical indicators. Microorganisms include total colony count, total coliform; toxicity indicators include arsenic, cadmium, chromium (hexavalent), lead, mercury, selenium, cyanide, fluorine, salt, chloroform, carbon tetrachloride; organoleptic properties and general chemical indicators Includes: Color, Turbidity, Odor and Taste, pH, Aluminum, Iron, Manganese, Copper, Zinc, Chloride, Sulfate, Total Dissolved Solids, Total Hardness, Oxygen Capacity, Variable Phenols, and Anionic Synthetics. The water samples were inspected according to the wet season and the dry season, and the inspection work was completed by the CDCs in various cities.

3.3. Evaluation Method

(1) Water quality sanitation evaluation method

All water quality indicators are evaluated in accordance with the "Drinking Water Pollution Standards". If one of the test indicators is negative, it means that the water sample is not good, and the residual amount of disinfectant is not included in the calculation of the water sample ratio.

(2) Health risk assessment model

As general chemical indicators and microbiological indicators do not usually pose health risks, indicators include 17 chemical pollutants including arsenic, chromium (hexavalent), lead, chloroform, carbon tetrachloride, cadmium, mercury, cyanide, fluorine and salt . Conversion of selenium, copper, manganese, iron, zinc, aluminum and phenol (as phenol).

carcinogenic risk assessment model:

$$R_i^c = (SF_i \cdot CDI)/74.8 \tag{1}$$

In the formula, R_i^c is the average annual carcinogenic health risk of individuals caused by chemical substances (=1,2,…,i) through drinking water.

Non-carcinogenic risk assessment model:

$$R_j^n = [(\frac{CDI}{RfD_j}) \cdot 10^{-6}]/74.8 \tag{2}$$

R_j^n is the average annual non-carcinogenic risk to human health caused by chemical substance j through drinking water.

4. Analysis of Water Quality Health Status Test Results

4.1. General Situation of Water Quality

A total of 900 water samples from the Ganjiang water system were tested, and 629 water samples were qualified for the monitoring indicators, with a pass rate of 96.11%. See Table 1 for details.

Table 1. Qualification of water sample testing

Year	Qualified water quality test			χ^2	P
	Detection number	The number of qualified	Pass rate(%)		
2018	300	289	96.33	2.546	0.278
2019	300	291	97.00		
2020	300	285	95.00		
total	900	865	96.11		

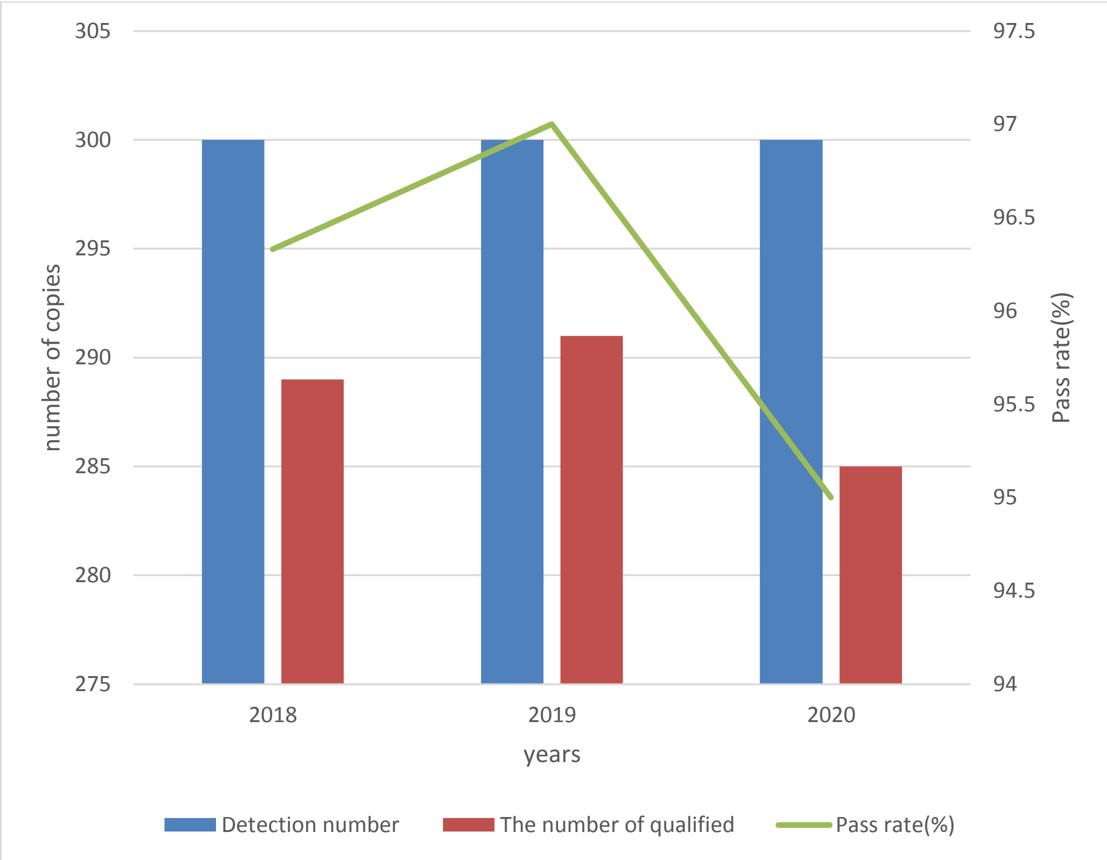

Figure 1. The result of water sample testing

As shown in Figure 1, the pass rates of the Ganjiang River system in 2018, 2019, and 2020 were 96.33%, 97%, and 95%, respectively, and there was no significant difference in the pass rates in different years (χ^2=2.546, P=0.278).

4.2. Water Quality in Different Years in the Same Water Period

During the wet season, a total of 600 water samples of the Ganjiang water system were tested, and 553 water samples were qualified for the monitoring indicators, with an overall pass rate of 93.5%. 93.5%, 90.5%, and 92.5%, there was no significant difference in the pass rate of different years in the wet season (χ^2=0.749, P=0.701), see Table 2 for details.

Table 2. The qualified rate of water samples in each year during the wet season

Years	Detection number	The number of qualified	Pass rate(%)	χ^2	P
2018	200	187	93.50	0.749	0.701
2019	200	181	90.50		
2020	200	185	92.50		
total	600	553	92.17		

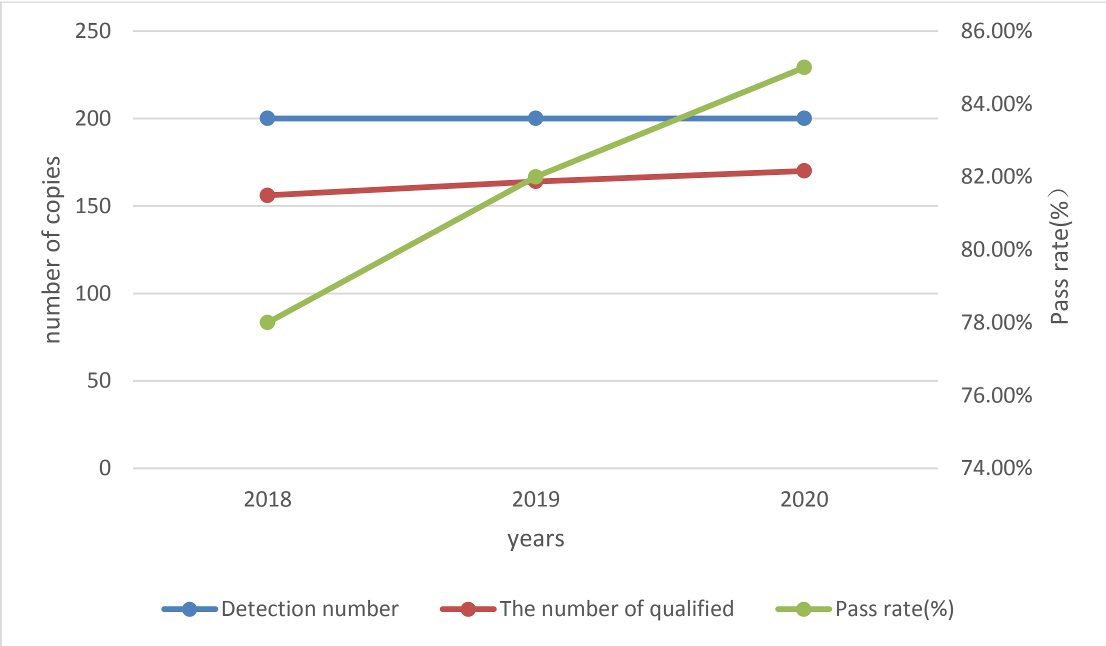

Figure 2. The qualified rate of water samples in each year during the dry season

As shown in Figure 2, in the dry season, a total of 600 water samples from the Ganjiang River were tested, and 490 were qualified, with an overall pass rate of 81.67%.

4.3 Water Quality in Different Water Periods

During the rainy season from 2018 to 2020, a total of 300 water samples from the Ganjiang River system were tested, and 206 were certified, with a pass rate of 68.67%. There was no significant difference in the pass rate (χ^2=3.263, P=0.074), see Table 3 for details.

Table 3. Qualification of water quality in different water periodss

Water Period	Detection number	The number of qualified	Pass rate/%	χ^2	P
Wet Season	300	206	68.67	3.263	0.074
Dry Season	300	256	85.33		
Total	600	462	77		

5. Conclusion

In this paper, the biological index fuzzy set processing method is used to study the water quality and health status of the Ganjiang River system, and the research on the water quality health risk assessment of the water source can enable us to have a clearer grasp of the water quality of the water source, understand the main pollutants, the main human health risks, and then According to the evaluation results, from the perspective of ensuring the health of residents, it is more pertinent to focus on the treatment and improvement of water source water, and the proposed water source environmental protection measures are more feasible, which is conducive to promoting the improvement of water source water quality and making water source water more feasible. The water quality is more in line with the requirements of human health, and has played a role in preventing water pollution of water sources.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Ervinia A, Huang J, Huang Y, et al. Coupled effects of climate variability and land use pattern on surface water quality: An elasticity perspective and watershed health indicators. The Science of the Total Environment, 2019, 693(Nov.25):133592.1-133592.12. https://doi.org/10.1016/j.scitotenv.2019.133592

[2] Kar S S, Maity S P . Gradation of Diabetic Retinopathy on Reconstructed Image using CompressedSensing. IET Image Processing, 2018, 12(11):1956-1963. https://doi.org/10.1049/iet-ipr.2017.1013

[3] Kandlikar A, Bhosle A . A Study On Water Nutrient Content Of Dhanora Reservoir - Ecological And Pollution Investigation. Indian Journal of Environmental Protection, 2019, 39(4):364-368.

[4] Bamberger M, Nell M, Ahmed A H, et al. Surface water and groundwater analysis using aryl hydrocarbon and endocrine receptor biological assays and liquid chromatography-high resolution mass spectrometry in Susquehanna County, PA. Environmental Science: Processes & Impacts, 2019, 21(7):988-998. https://doi.org/10.1039/C9EM00112C

[5] Kanoti J R, Olago D, Opiyo N, et al. Microbial and Physical Chemical Indicators of Groundwater Contamination in Kenya: A Case Study of Kisumu Aquifer System, Kenya. Journal of Water Resource and Protection, 2019, 11(4):404-418. https://doi.org/10.4236/jwarp.2019.114024

[6] Debbeler L J, Gamp M, Blumenschein M, et al. Polarized but illusory beliefs about tap and bottled water: A product- and consumer-oriented survey and blind tasting experiment. Science of The Total Environment, 2018, 643(DEC.1):1400-1410.

[7] Nguyen T T, Ban V D, Truong C N, et al. Clustering and Query Optimization in Fuzzy Object-Oriented Database. International journal of natural computing research, 2019, 8(1):1-17. https://doi.org/10.4018/IJNCR.2019010101

[8] Krochmal-Marczak B, Tobiasz-Salach R, Kaszuba J . The effect of adding oat flour on the nutritional and sensory quality of wheat bread. British Food Journal, 2020, 122(7):2329-2339.

[9] Meuleman W, Muratov A, Rynes E, et al. Index and biological spectrum of human DNase I hypersensitive sites. Nature, 2020, 584(7820):1-8. https://doi.org/10.1038/s41586-020-2559-3

[10] Ghosh S, Hoshalli M M, Mamidi S, et al. Reproductive and feeding biology of unicorn leatherjacket, Aluterus monoceros from the Bay of Bengal, Northern Indian Ocean. Journal of the Marine Biological Association of the United Kingdom, 2021, 101(5):839-851.

[11] Miller R K, Martin F H . Dynamic versus static indicators of threat: N2 and LPC modulation index attack intent and biological relevance during an affective Flanker task. International Journal of Psychophysiology, 2020, 158(1):158-171.

[12] Tseng Y T, Kawashima S, Kobayashi S, et al. Forecasting the seasonal pollen index by using a hidden Markov model combining meteorological and biological factors. The Science of the Total Environment, 2020, 698(Jan.1):134246.1-134246.10. https://doi.org/10.1016/j.scitotenv.2019.134246

[13] Zald D, Lahey B, Woodward N, et al. Breadth of Psychiatric Symptoms: A Phenotypic Index Associated With Grey Matter Volume Reductions. Biological Psychiatry, 2020, 87(9):S26-S27. https://doi.org/10.1016/j.biopsych.2020.02.092

[14] Cassidy C, Celebi S, Savard M, et al. Neuromelanin-Sensitive MRI as an Index of Norepinephrine System Integrity in Healthy Aging, Mild Cognitive Impairment, and Alzheimer's Disease. Biological Psychiatry, 2020, 87(9):S424-S425.

[15] Skca B, Jyf B, Mhz A, et al. Optimisation and biological evaluation of palm glyceryl monocaprylate antimicrobial nanoemulsion for combating S. aureus wound infection. Journal of Materials Research and Technology, 2020, 9(6):12804-12817. https://doi.org/10.1016/j.jmrt.2020.09.027

[16] Hlel T B, Belhadj F, F Gül, et al. The Molecular Characterization and Biological Assessment of the Leaves Extracts of Loofah Reveal their Nutraceutical Potential. Recent Patents on Food Nutrition & Agricultureе, 2021, 12(1):63-72.

[17] Heepngoen P, Thoumazeau A, Renevier M S, et al. Relationships between physico-chemical, biological and functional approaches for soil quality assessment. A case study along a gradient of disturbance. European Journal of Soil Biology, 2021, 104(2):1164-5563. https://doi.org/10.1016/j.ejsobi.2021.103300

[18] Park Y G, Ha C W, Yoo J H, et al. Intra-Articular Injection of a Novel DVS Cross-Linked Hyaluronic Acid Manufactured by Biological Fermentation (YYD302) in Patients With Knee Osteoarthritis: A Double-Blind, Randomized, Multicenter, Noninferiority Study. Clinical Therapeutics, 2021, 43(11):1843-1860. https://doi.org/10.1016/j.clinthera.2021.09.005