ISSN: 3067-2406
Research Article
Annals of Marine Science Research

Utilization of Water Quality Index in the Water Quality Analysis of the Goreangab Dam to Determine Suitability of Potential Aquaculture Site

Aina Nuugulu*

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of science (honours) in Fisheries and Aquatic Sciences of The University of Namibia

***Corresponding author:** Aina Nuugulu, A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of science (honours) in Fisheries and Aquatic Sciences of The University of Namibia.

Submitted: 07 March 2025 **Accepted:** 113 March 2025 **Published:** 19 March 2025

https://doi.org/10.63620/MKAMSR.2025.1012

Citation: *Nuugulu, A. (2025). Utilization of Water Quality Index in the Water Quality Analysis of the Goreangab Dam to Determine Suitability of Potential Aquaculture Site. A of Mar Sci Res, 2(2), 01-09.*

Abstract

The aim of this study was to explore the utilization of the Water Quality Index (WQI) in analyzing the water quality of Goreangab Dam in Windhoek, Namibia. The WQI provides an overall assessment of water quality by integrating multiple parameters and assigning a single numerical value. The primary objective was to determine the suitability of a potential aquaculture site in the area of the dam based on water quality analysis. To achieve this objective, water samples were collected from two sampling locations (P1 and P9) within Goreangab Dam. These samples were analyzed for various physical, chemical, and biological parameters, including temperature, pH, dissolved oxygen, nutrients, and salinity using standard laboratory techniques. The collected data was then used to calculate the WQI for each sampling point using a software called "Know Your H2O." The results of the analysis showed that the water quality varied at the two sampling points. Samples collected on May 16, 2023, at point 1 had a WQI score of 37, indicating poor water quality, while point 9 had a WQI score of 60, indicating medium water quality. On August 24, 2023, both points (1 and 9) had a WQI score of 42, indicating bad water quality. Based on these findings, it can be concluded that the water in Goreangab Dam is not suitable for use in an aquaculture facility without proper treatment. The results highlight the importance of regular monitoring and mitigation measures to maintain suitable water quality for aquaculture practices. This study's findings have the potential to contribute to the development of sustainable aquaculture practices and the efficient utilization of water resources in the country.

Introduction

The Goreangab Dam is an artificial lake located in Namibia. It is a large water body, covering an area of approximately 10 km2. The dam has been used for irrigation, recreation, and water supply since its construction in the 1970s. This study aimed to analyze the water quality of the Goreangab Dam in order to determine its suitability as a potential aquaculture site. The project involved the collection and analysis of physical and chemical parameters of the water. Physical parameters measured included temperature, total dissolved solids and pH. The chemical parameters assessed included pH, Iron, Nitrite, Total Nitrate, chlorine and dissolved oxygen. The results of the analysis were used to determine the suitability of the site for aquaculture and the potential for sustainable production. The study also provided valuable information on the ecological health of the dam and the surrounding environment.

Quality of water within a geographical location and source can be assessed using physical, chemical and biological parameters, whose values when found to exceed defined limits are harmful to human and environmental health [1]. Fishes are totally dependent on water and so information on water quality (physicochemical) and quantity of source water are indispensable in choosing a location for an aquaculture facility [2]. Water quality in aquaculture refers to anything in the water, be it physical, chemical or biological that affects the fish normal health and production performance [3].

Water quality index (WQI) provides a single number that expresses the overall water quality at a certain location and time based on several water quality parameters. WQI is basically a mathematical means of calculating a single value from multiple test results, as it has been realized that the use of individual water quality variable in order to describe the water quality for common public is not easily understandable [4]. The main physical/ chemical parameters that are typically measured in water- quality studies are electrical conductivity, pH, temperature, suspended solids and nutrients [5].Water both in quantity and quality is a serious factor in commercial aquaculture site selection.

The research draws upon previous studies that have emphasized the importance of water quality in aquaculture. Fishes are highly dependent on water, making it crucial to consider the physicochemical properties and quantity of the water source when selecting an aquaculture facility. The utilization of a water quality index allowed for a more comprehensive assessment of the water conditions, providing a single value that expresses the overall water quality. By utilizing the water quality index in the analysis of the Goreangab Dam, this research aimed to contribute to the understanding of the dam's suitability for aquaculture and its potential for sustainable production. The findings will not only inform decision-making regarding aquaculture site selection but also provide insights into the overall health of the dam and its surrounding environment.

Problem Statement

Aquatic pollution has increasingly threatened fish production from inland water resources e.g., rivers, lakes and streams [6]. Many mankind activities directly affect the quality of water sources. Hence the need to apply the water quality index for the assessment of the factors that affect water quality in Goreangab Dam, Windhoek and quantify all appropriate parameters to determine suitability for aquaculture site. This study helps to lead or provide an assessment of the quality of Goreangab Dam and provide guidelines to make plans. This helps to create awareness among the people for the use of dam as a fresh water source in commercial aquaculture facilities and to choose appropriate purification and treatment techniques of water.

Objectives

The objective of water quality assessment using water quality index of the Goreangab Dam Windhoek was to obtain quantitative information on the physical, chemical, and biological characteristics of water via statistical sampling. To use the water quality index to assess the toxicity in the water. To assess the pollutant concentrations, physical, biological and chemical conditions of the Goreangab Dam itself, to check if the water is suitable for usage in an aquaculture facility. To provide insights and recommendations for sustainable aquaculture practices in the Goreangab Dam and broader aquaculture development in Namibia.

Literature Review

Surface water is used for a variety of purposes, including agriculture, drinking water, aquaculture and other services. Water supply is considered a fundamental requirement for human activity and socioeconomic development as well as an essential condition of the natural world and human life equilibrium, and it is essential for human well-being. Dams suffer significant environmental pressures associated with contamination from intensive agricultural pesticides runoff and effluent from manufacturing processes, sewage, and other urban waste sources and this are considered as human effects. In addition to natural causes such as air pollution deposition and climate change. Therefore, the assessment of dam's water quality is a practical approach to determining surface water suitability for aquaculture. The traditional approaches to water quality determination are time consuming and human resource intensive. Water quality is evaluated using physical and chemical properties that indicate water characteristics and variables that impact water quality according to international standards [7].

Water quality indices (WQIs) are among the better approaches for explaining water quality and have been developed by many authors since Horton's work, as they convert original data from many water quality parameters into a single number to understand water quality [8]. The main concept in the development of WQIs is to combine several variables into a single numerical value. The goal of the water quality indices is to identify the waters in relation to their potential uses and chemical and physical characteristics. Preceding studies have used the WQI to determine surface water quality, for example Gad et al., reported that DWQI values of the two Nile (Egypt) branches revealed that 53% of samples varied from excellent to good water, 43% of samples varied from poor to very poor water, and 4% of samples were unsuitable for consumption (2022) [9].

Commonly, water quality models involve four consecutive stages; these are selection of the water quality parameters, generation of sub-indices for each parameter, calculation of the parameter weighting values, and aggregation of sub-indices to compute the overall water quality index [10]. Some problems of the WQI model are that they are usually developed based on site-specific guidelines for a particular region, and are therefore not generic and they produce uncertainty in the conversion of large amounts of water quality data into a single index. The assessment of water quality is very pertinent to both public health and aquatic life. Water quality has a significant impact on water supply and often times determines supply options [11]. The understanding and monitoring of sources and quality of water used for water supply is of societal, economic and conservational importance since per capita water demand is increasing while accessibility to freshwater availability is continuing to decline.

The utilization of the water quality index for the water quality assessment of the Goreangab Dam Windhoek to determine suitability for potential aquaculture site is necessary as water quality management in aquaculture is vital, as farmed fish are highly sensitive to changes in parameters such as toxic substances, pH, temperature and presence of gas. The water quality must therefore be consistently monitored and controlled for the fish to maintain optimum health, productivity and quality. Water quality testing is a critical component of environmental monitoring. When water quality is poor, it has an impact not only on aquatic life but also on the surrounding ecosystem. Different fish species require a unique set of water quality parameters (temperature, pH, oxygen concentration, salinity and hardness) to survive, grow, and reproduce. Each species has its own optimum range, or the range in which it performs best, within the tolerance limits. Hence the critical need for fish producers to ensure that the physical and chemical conditions of the water always remain as close to the optimum range of the fish under culture as possible.

Aquaculture is a rapidly growing industry that requires suitable water quality conditions for successful operations [12]. The utilization of a Water Quality Index (WQI) can provide a comprehensive assessment of water quality and its suitability for aquaculture (Carpenter et al. 1998). Water Quality Index (WQI) is a useful tool for assessing water quality by integrating multiple physical, chemical, and biological parameters [13]. The selection of appropriate parameters for WQI calculation is crucial in determining the suitability of water bodies for aquaculture [14]. Studies have shown that WQI can effectively evaluate the water quality of potential aquaculture sites [15, 16].

Methods

For the Laboratory Analysis Method, Clear and Detailed Steps for Each Procedure Were Followed:

Sampling site: The samples were taken from the Goreangab Dam at two points, point 1 (GD0010) and Point 9 (GD0090). Sampling was conducted quarterly in (16th) May and (24th) August 2023, following the protocols set by the City of Windhoek Sampling department [17].

Sample Collection Procedures

1. **Bottles:** Mineral water bottles (1 liter) were used for sample collection. Prior to filling, the bottles were washed with water from the sampling site. This step ensures that any contaminants or residues from previous use are removed, preventing any interference with the water sample's quality.
2. **Collection:** The bottles were submerged in the water with the mouth facing upstream against the flow direction. The neck of the bottle was slightly tilted to allow it to fill before replacing the cap and cover. This method of collection ensures that the water sample is representative of the specific location and minimizes the introduction of air bubbles or contaminants during the collection process.

Figure: A. Student Sampling at

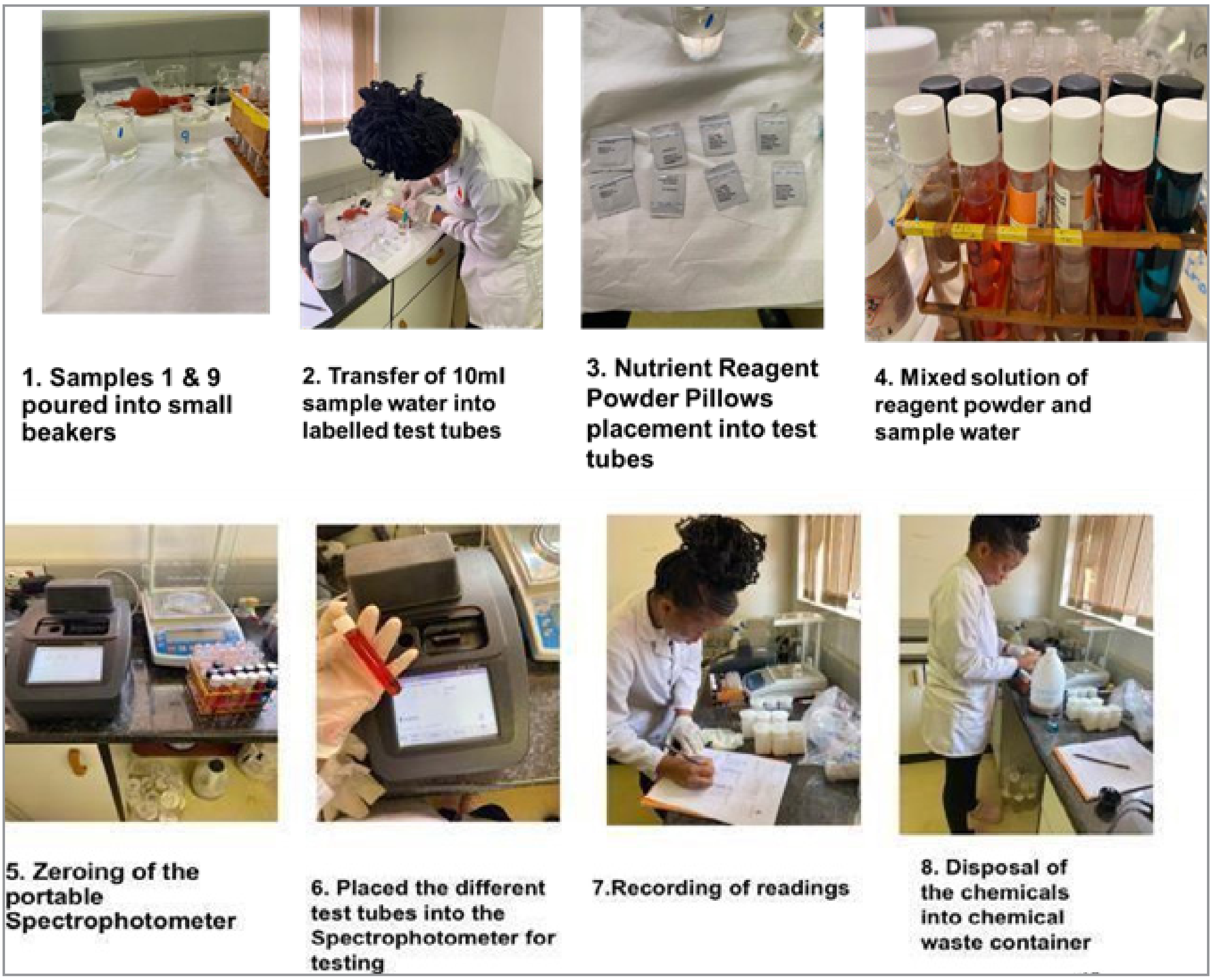
Figure: B. 1L Bottle Being Submerged Into the Water. Goreangab Dam

Sample Preservation and Handling

The collected water samples were kept in an icebox to maintain temperature and prevent any changes in the water quality during transportation to the laboratory. This step is crucial to maintain the temperature and prevent any changes in water quality that may occur due to exposure to external factors. By preserving the samples in an icebox, the integrity of the water quality is maintained until it can be analyzed in the laboratory.

Parameter Analysis Method

1. **Personnel:** The analysis was carried out by the student under the supervision of an authorized lab analyst. This ensures that the analysis is conducted by trained individuals who can accurately perform the required procedures and interpret the results.
2. **Parameters:** The following physical parameters were assessed: temperature, electrical conductivity, total hardness, salinity and total dissolved solids. The chemical parameters assessed included pH, Iron, Nitrite, Total Nitrate, chlorine and dissolved oxygen. By assessing these parameters, a comprehensive understanding of the water quality can be obtained, allowing for an evaluation of its suitability for potential aquaculture.
3. **Equipment:** A multi-parameter sonde and spectrophotometer was used for analyzing the water samples. These instruments are specifically designed to measure and analyze the various parameters of interest accurately. They provide reliable and precise data, ensuring the accuracy of the analysis.
4. **Analysis:** The student followed established methods and procedures for each parameter analysis, as directed by the lab analyst. This step ensured consistency and comparability of results. By following established methods, any potential biases or errors in the analysis process are minimized, ensuring the reliability of the data obtained.



Measurement of Physical Parameters

Temperature, electrical conductivity, total hardness, and salinity were measured using a multiparameter sonde.

1. **Temperature:** The sonde was immersed in the water sample and the temperature was recorded after the reading stabilized.
2. **Electrical Conductivity:** The sonde was rinsed with distilled water and then immersed in the sample. The conductivity value on the sonde was recorded once it stabilized.
3. **Total Hardness:** The water sample was titrated with a standard solution of ethylenediaminetetraacetic acid (EDTA) until the color changed. The volume of EDTA used was then used to calculate the hardness.
4. **Salinity:** The sonde was rinsed and then immersed in the sample. The salinity value was recorded once it stabilized.

Measurement of Chemical Parameters

pH, Iron, Nitrite, Total Nitrate, chlorine, dissolved oxygen, and total dissolved solids were measured using a spectrophotometer.

1. **pH:** The pH meter was calibrated using standard buffer solutions. Then, the electrode was rinsed and immersed in the sample. The pH value was recorded once it stabilized.
2. **Iron, Nitrite, Total Nitrate, Chlorine:** These parameters were measured using nutrient powder pillows. The powder was added to a 10 ml sample of water, mixed until the powder was completely dissolved, and then the solution was transferred to a cuvette. The cuvette was then placed in the spectrophotometer and the absorbance was measured. The concentration of each parameter was calculated using a standard curve.
3. **Dissolved Oxygen:** The dissolved oxygen was measured using a dissolved oxygen meter. The meter was calibrated and then the probe was immersed in the sample. The value was recorded once it stabilized.

Water Quality Index (WQI)

The software utilizes a standardized methodology to calculate the WQI. Here is an in-depth explanation of how the software works:

1. **Data Input:** The software requires input data for various water quality parameters. These parameters are selected based on their relevance to aquaculture and their standard limits prescribed by the World Health Organization. Examples of such parameters may include dissolved oxygen levels, pH, temperature, turbidity, total dissolved solids, and various nutrient concentrations.
2. **Data Collection:** The required water quality parameters are measured or obtained from reliable sources for the specific

sampling locations in the Goreangab Dam. The data should be collected following standard protocols to ensure accuracy and consistency.

3. **Data Validation:** The software performs data validation to check for any errors or inconsistencies in the input data. It may include checks for outliers, missing values, or data entry errors. This step ensures that the calculated WQI is based on reliable and accurate data.
4. **Normalization:** The software normalizes the water quality parameter values to a common scale using subjective rating curves. This step involves assigning a numerical value to each parameter based on its deviation from the desired or standard limits. The rating curves are established based on expert opinions and scientific literature.
5. **Weighting:** The software applies weightage factors to each parameter based on their relative importance to aquaculture. This step allows for the customization of the WQI calculation based on specific goals or requirements. For example, parameters like dissolved oxygen or nutrient concentrations may have higher weights due to their significant impact on aquatic life.
6. **Calculation:** The software performs the actual calculation of the WQI by combining the normalized values of each parameter using appropriate mathematical equations. The result is a dimensionless number that represents the overall water quality of the Goreangab Dam.
7. **Interpretation:** The software provides an interpretation of the calculated WQI value. It may include categorizing the water quality as excellent, good, fair, poor, or very poor based on predefined ranges or thresholds. This interpretation helps in determining the suitability of the dam for potential aquaculture activities.

Results

DATA COLLECTION FORM-WATER QUALITY
Mineralization (glass and bottle)
Location: Goreangab Dam

Date of collection: 16 May 2023
Time : 11:30
Sampler /recorder : Aina Nuugulu

And

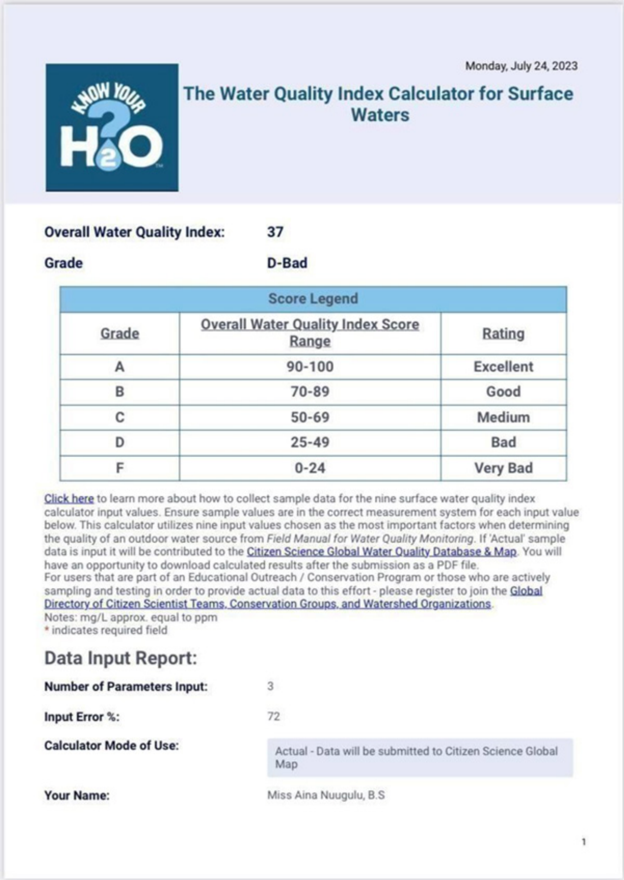
Date of collection: 24 August2023.

Time : 12:50
Sampler /recorder : Aina Nuugulu

KEY :

16 May Samples	(blue)
24August Samples	(green)

PARAMETER	SAMPLE POINT 1		SAMPLE POINT 9	
Temperature °C	17.9	21.0	17.7	19.2
pH	6.42	8.15	7.22	8.07
DO (mg/L)		8.29		8.95
Conductivity (uS/cm)	824	1080	879	1078
NACL/Salinity (ppt %)	0.39	0.53	0.42	0.53
TDS (mg/L)	419	530	438	530
Nitrate(mg/L NO_3^- -N)	0.10	0.39	0.03	0.48
Nitrite (mg/L NO_2^- -N)	0.054	0.488	0.031	0.526
Chlorine (mg/L Cl_2)	0.61	0.16	0.32	0.16
Iron, Fe (mg/L Fe^{2+})	0.50	0.11	0.18	0.15
Fluoride, F (mg/L F^+)	F-	-2.09	F-	-2.01
Hardness (Hg/L $CaCO_3$)	4.22	2.34	3.14	2.12



Monday, July 24, 2023

The Water Quality Index Calculator for Surface Waters

Overall Water Quality Index: 37

Grade D-Bad

Score Legend		
Grade	Overall Water Quality Index Score Range	Rating
A	90-100	Excellent
B	70-89	Good
C	50-69	Medium
D	25-49	Bad
F	0-24	Very Bad

Click here to learn more about how to collect sample data for the nine surface water quality index calculator input values. Ensure sample values are in the correct measurement system for each input value below. This calculator utilizes nine input values chosen as the most important factors when determining the quality of an outdoor water source from *Field Manual for Water Quality Monitoring*. If 'Actual' sample data is input it will be contributed to the Citizen Science Global Water Quality Database & Map. You will have an opportunity to download calculated results after the submission as a PDF file.
For users that are part of an Educational Outreach / Conservation Program or those who are actively sampling and testing in order to provide actual data to this effort - please register to join the Global Directory of Citizen Scientist Teams, Conservation Groups, and Watershed Organizations.
Notes: mg/L approx. equal to ppm
* indicates required field

Data Input Report:

Number of Parameters Input: 3

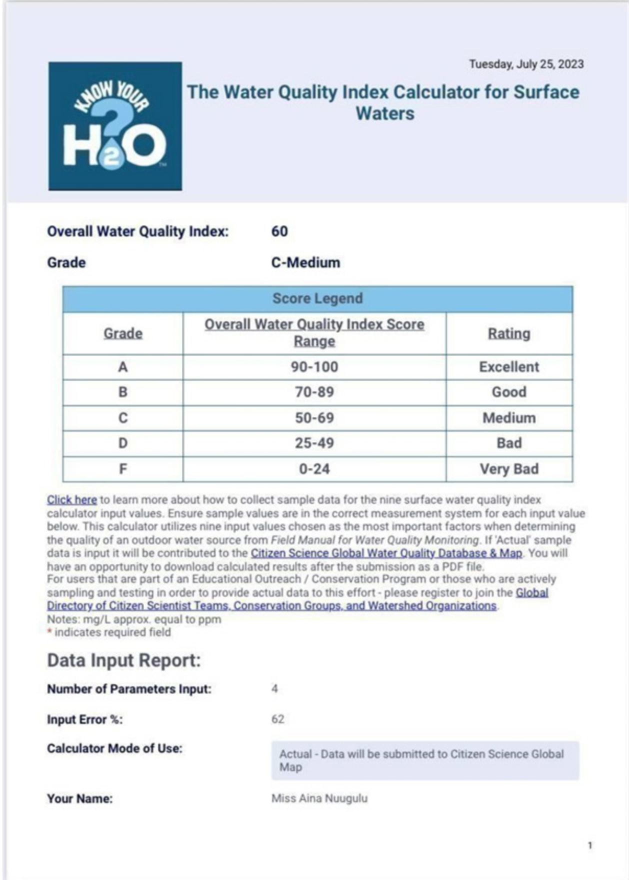
Input Error %: 72

Calculator Mode of Use: Actual - Data will be submitted to Citizen Science Global Map

Your Name: Miss Aina Nuugulu, B.S

1

Figure 1: Goreangab Dam Point 1 Sample Collected (16th May) Water Quality Index Results.



Tuesday, July 25, 2023

The Water Quality Index Calculator for Surface Waters

Overall Water Quality Index: 60

Grade C-Medium

Score Legend		
Grade	Overall Water Quality Index Score Range	Rating
A	90-100	Excellent
B	70-89	Good
C	50-69	Medium
D	25-49	Bad
F	0-24	Very Bad

Click here to learn more about how to collect sample data for the nine surface water quality index calculator input values. Ensure sample values are in the correct measurement system for each input value below. This calculator utilizes nine input values chosen as the most important factors when determining the quality of an outdoor water source from *Field Manual for Water Quality Monitoring*. If 'Actual' sample data is input it will be contributed to the Citizen Science Global Water Quality Database & Map. You will have an opportunity to download calculated results after the submission as a PDF file.
For users that are part of an Educational Outreach / Conservation Program or those who are actively sampling and testing in order to provide actual data to this effort - please register to join the Global Directory of Citizen Scientist Teams, Conservation Groups, and Watershed Organizations.
Notes: mg/L approx. equal to ppm
* indicates required field

Data Input Report:

Number of Parameters Input: 4

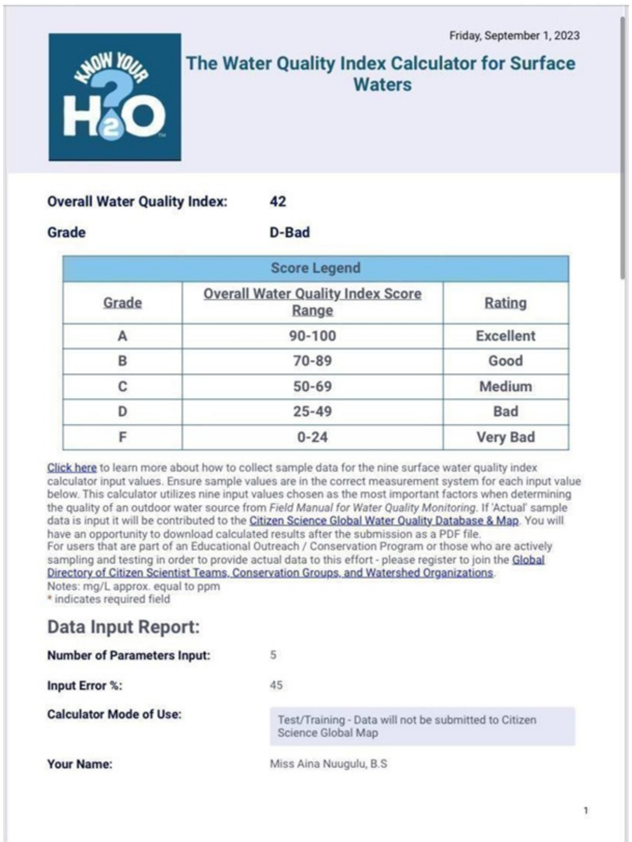
Input Error %: 62

Calculator Mode of Use: Actual - Data will be submitted to Citizen Science Global Map

Your Name: Miss Aina Nuugulu

1

Figure 2: Goreangab Dam Point 9 Sample collected (16th May) Water Quality Index Results.



Friday, September 1, 2023

The Water Quality Index Calculator for Surface Waters

Overall Water Quality Index: 42

Grade D-Bad

Score Legend		
Grade	Overall Water Quality Index Score Range	Rating
A	90-100	Excellent
B	70-89	Good
C	50-69	Medium
D	25-49	Bad
F	0-24	Very Bad

Click here to learn more about how to collect sample data for the nine surface water quality index calculator input values. Ensure sample values are in the correct measurement system for each input value below. This calculator utilizes nine input values chosen as the most important factors when determining the quality of an outdoor water source from *Field Manual for Water Quality Monitoring*. If 'Actual' sample data is input it will be contributed to the Citizen Science Global Water Quality Database & Map. You will have an opportunity to download calculated results after the submission as a PDF file.
For users that are part of an Educational Outreach / Conservation Program or those who are actively sampling and testing in order to provide actual data to this effort - please register to join the Global Directory of Citizen Scientist Teams, Conservation Groups, and Watershed Organizations.
Notes: mg/L approx. equal to ppm
* indicates required field

Data Input Report:

Number of Parameters Input: 5

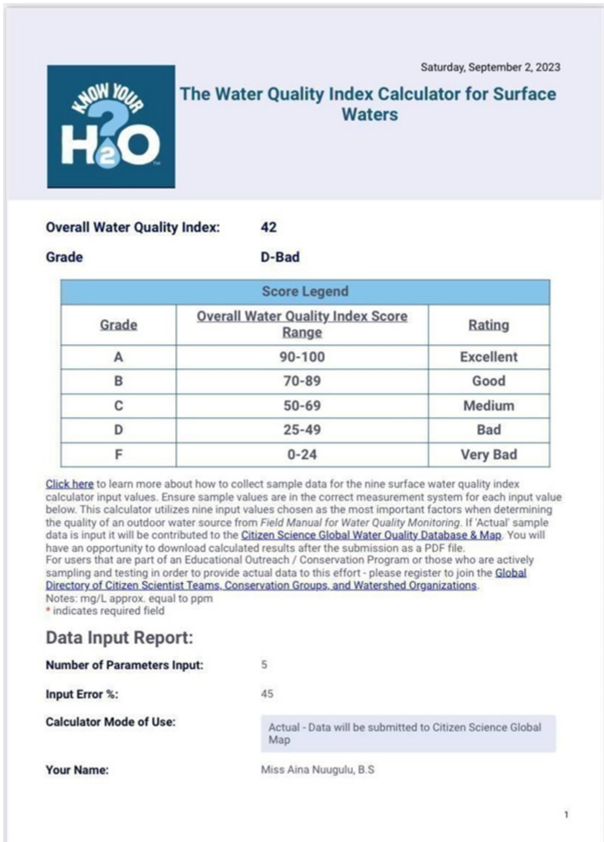
Input Error %: 45

Calculator Mode of Use: Test/Training - Data will not be submitted to Citizen Science Global Map

Your Name: Miss Aina Nuugulu, B.S

1

Figure 3: Goreangab Dam Point 1 Sample collected (24th August) water quality index results



Saturday, September 2, 2023

The Water Quality Index Calculator for Surface Waters

Overall Water Quality Index: 42

Grade D-Bad

Score Legend		
Grade	Overall Water Quality Index Score Range	Rating
A	90-100	Excellent
B	70-89	Good
C	50-69	Medium
D	25-49	Bad
F	0-24	Very Bad

Click here to learn more about how to collect sample data for the nine surface water quality index calculator input values. Ensure sample values are in the correct measurement system for each input value below. This calculator utilizes nine input values chosen as the most important factors when determining the quality of an outdoor water source from *Field Manual for Water Quality Monitoring*. If 'Actual' sample data is input it will be contributed to the Citizen Science Global Water Quality Database & Map. You will have an opportunity to download calculated results after the submission as a PDF file.
For users that are part of an Educational Outreach / Conservation Program or those who are actively sampling and testing in order to provide actual data to this effort - please register to join the Global Directory of Citizen Scientist Teams, Conservation Groups, and Watershed Organizations.
Notes: mg/L approx. equal to ppm
* indicates required field

Data Input Report:

Number of Parameters Input: 5

Input Error %: 45

Calculator Mode of Use: Actual - Data will be submitted to Citizen Science Global Map

Your Name: Miss Aina Nuugulu, B.S

1

Figure 4: Goreangab Dam Point 9 Sample collected (24th August) water quality index results

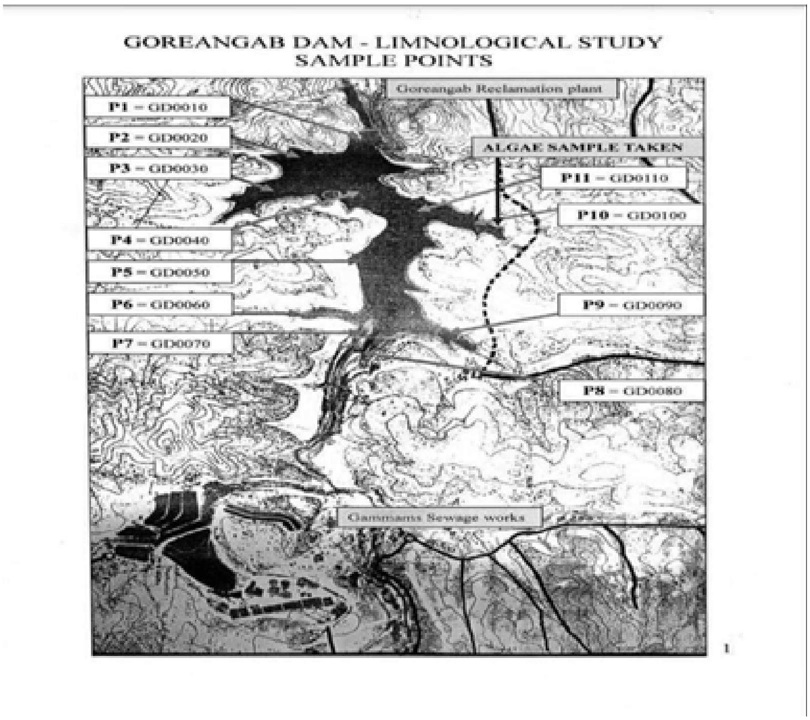


Figure 5: Depicting the Goreangab Dam Sampling Points, Points that Were Sampled in this Study are P1=GD0010 and P9=GD0090

Figure 6: An Image of the Goreangab Dam Taken by the Researcher During Site Evaluation.

Discussion

The Goreangab Dam was sampled on the 16 of May 2023 and 24 August 2023 in accordance with the sampling protocols of the City of Windhoek sampling department. The points sampled were point 1 and point 9 as shown in the Goreangab DamLimnological study sample points. The samples were analysis on the 26 of May and 29 August respectively in the University of Namibia Sam Nujoma campus water quality laboratory with the supervision of a lab analyst (Mrs Amaliya). The physical and chemical parameters were tested and due to lack of some nutrient reagents in the laboratory only Nitrate, Nitrite, Chlorine, Iron and Fluoride were tested, the physical parameters tested were temperature, pH, conductivity, salinity, total dissolved solids and hardness.

The results of the tests were inputted into a water quality index calculator software to generate a water quality index. This calculator is based on the original WQI Calculator that was developed through a consensus method in the 1970s by the National Sanitation Foundation (NSF). The utilization of the water quality index (WQI) in the water quality analysis of the Goreangab Dam can be highly significant in determining the suitability of a potential aquaculture site. It provides the overall assessment of water quality, the WQI provides a comprehensive evaluation of the overall water quality of the dam. It takes into account various parameters such as pH, temperature, dissolved oxygen, turbidity, and nutrient levels. By considering multiple parameters, the WQI can give a holistic understanding of the water quality, which is essential for assessing the suitability of an aquaculture site.

The WQI allows for a comparison of the water quality parameters to regulatory or recommended water quality standards. This helps in determining if the water quality meets the required standards for the successful rearing of aquatic organisms. Aquaculture species have specific tolerance levels for different water quality parameters, so the WQI helps to ensure that the water quality is within suitable limits for the intended aquaculture activity. As shown in figures 1 and 2 the overall WQI for point 1 is 37 which is a grade D (Bad) and point 9 is 60 which is grade c (medium). And as shown in figure 3 and 4 the overall WQI for point 1 and point 9 was calculated as grade D (42).

By calculating the WQI, any deviations from optimal water quality conditions can be identified. For example, if the WQI indicates high levels of suspended solids or nutrients, it can suggest the presence of pollution sources or eutrophication in the dam. Identifying these issues is crucial in ensuring the proper management and suitability of an aquaculture site. The WQI can be used for regular monitoring of water quality in the Goreangab Dam. By measuring and calculating the WQI at regular intervals, changes in water quality trends can be observed. This allows for the early detection of any deterioration in water quality, ensuring the suitability and sustainability of the aquaculture site in the long run.

In summary, the utilization of the water quality index in the analysis of the Goreangab Dam's water quality is significant in determining the suitability of a potential aquaculture site. It provides a comprehensive assessment, allows for comparison to standards, identifies issues, enables monitoring over time, and helps in implementing appropriate mitigation measures. The study aimed to assess the suitability of Goreangab dam as a potential aquaculture site by utilizing the water quality index. The water quality index generated using the Know Your Water software indicated a grade D, suggesting that the water may not be suitable for fish farming without treatment.

Possible water treatment recommendations for utilizing the water to farm fish may include, implementing aeration systems to enhance oxygen levels in the water, as low dissolved oxygen can be detrimental to fish health. Installing filtration systems to remove suspended solids and contaminants, ensuring improved water quality for fish. Conducting regular monitoring and testing of water parameters such as pH, temperature, ammonia, and nitrate levels, and implementing appropriate treatments to maintain optimal conditions for fish growth. Considering the use of UV sterilizers or ozone generators to eliminate potential pathogens or harmful microorganisms in the water. And lastly, collaborating with water treatment experts or aquaculture consultants to develop a comprehensive water treatment plan tailored to the specific needs of the aquaculture operation.

Statement of Ethics

This research project was conducted in an ethical manner, upholding scientific integrity and social responsibility. Permission was obtained prior to collecting water samples from the Goreangab Dam. Proper protocols were followed for sample handling and laboratory analysis under supervision. Data was recorded accurately without manipulation or falsification. The findings have been presented transparently, acknowledging limitations. Confidentiality of any sensitive information was maintained. There was no fabrication, plagiarism or conflicts of interest. All sources have been appropriately cited and credited. The wellbeing of the environment, aquatic organisms and human society were prioritized. The research aims to promote sustainable aquaculture practices through responsible water quality assessment. This statement affirms that ethical considerations were integral to the project.

Conclusion

In conclusion, the utilization of the Water Quality Index (WQI) in the water quality analysis of the Goreangab Dam has provided valuable insights into the suitability of the dam as a potential aquaculture site. The WQI allowed for a comprehensive evaluation of the water quality, considering multiple parameters such as temperature, pH, dissolved oxygen, turbidity, and nutrients. The findings of the study indicated variations in water quality at different sampling points, with some points showing poor water quality and some showing medium water quality. The use of the WQI also allowed for comparison to regulatory or recommended water quality standards, enabling the identification of deviations from optimal conditions and suggesting appropriate mitigation measures. Additionally, the WQI can be used for regular monitoring to detect changes in water quality trends and ensure sustainable aquaculture practices. Overall, the utilization of the WQI in the analysis of the Goreangab Dam's water quality has provided practical and actionable insights for the potential development of aquaculture in the area. It is hoped that the findings of this study will contribute to the development of sustainable aquaculture practices in Namibia and the broader promotion of environmental sustainability in aquaculture operations.

Competing Interest

Main Supervisor: Mrs Nakwaya Co-Supervisor: Mr Akawa

References

1. World Health Organization (WHO). (2012). Guidelines for Drinking-water Quality, Fourth
2. Egun, N. K., Oboh, I. P. (2022). Freshwater Source Suitability for Aquaculture. Ikpoba Reservoir, Edo State, Nigeria. International Science and Technology Journal of Namibia, 15, 50-56
3. Balogun, J. K. (2015). Basic Aquaculture. Zaria, Nigeria: Ahmadu Bello University Press Ltd.
4. Katyal, D. (2011). Water quality indices used for surface water vulnerability assessment. International journal of environmental sciences, 2(1).
5. Bharti, N., Katyal, D. (2011).Water quality indices used for surface water vulnerability assessment.

6. Zhang, Y., Wang, W., Liu, Y., Cai, Y. (2020). Using water quality index to assess the water quality of the Lijiang River Basin, China. Environmental Monitoring and Assessment, 192(6), 1-11.
7. Gupta, M. V. (2006). Challenges in sustaining and increasing fish production to combat hunger and poverty in Asia, 29(1), 4-10.
8. Kikuda, R., Pereira Gomes, R., Rodrigues Gama, A., De Paula Silva, J. A., Pereira Dos Santos, A., Rodrigues Alves, K., ... & De Jesus Pires, D. (2022). Evaluation of water quality of Buritis Lake. Water, 14(9), 1414. https://doi.org/10.3390/w14091414.
9. Akhtar, N., Ishak, M. I. S., Ahmad, M. I., Umar, K., Md Yusuff, M. S., Anees, M. T., ... & Ali Almanasir, Y. K. (2021). Modification of the water quality index (WQI) process for simple calculation using the multi-criteria decision-making (MCDM) method: a review. Water, 13(7), 90. https://doi.org/10.3390/w13070905.
10. Gad, M., Saleh, A. H., Hussein, H., Farouk, M., & Elsayed, S. (2022). Appraisal of surface water quality of nile river using water quality indices, spectral signature and multivariate modeling. Water, 14(7), 1131. https://doi.org/10.3390/w14071131.
11. Uddin, M. G., Nash, S., & Olbert, A. I. (2021). A review of water quality index models and their use for assessing surface water quality. Ecological Indicators, 122, 107218. https://doi.org/10.1016/j.ecolind.2020.107218
12. Ouyang, Y. (2005). Evaluation of river water quality monitoring stations by principal component analysis. Water Research AQ, 39, 2621-2635.
13. Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., ... & Corner, R. (2010). Aquaculture: global status and trends. Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), 2897-2912. https://doi.org/10.1098/rstb.2010.0170
14. Brown, R. M., Short, R. T. (2004). Water quality indices–a survey of indices used in the United States. Water Science and Technology, 49(2), 1-10.
15. Håkanson, L. (2005). The importance of water quality variables for fish production-A review. Ecological Bulletins, 3-16.
16. Nasir, N. A., Yusoff, M. K., Othman, M. R. (2019). Water quality assessment using water quality index (WQI) approach: Case study of Sungai Pusu. IOP Conference Series: Earth and Environmental Science, 220(1), 012042.
17. Mutea, F.G., Nelson, H. K., Au, H. V., Huynh, T. G., Vu, U. N. (2021) Aquaculture in Hau River, Mekong Delta, Vietnam Using Multivariate Statistical Analysis. Water, 13(22), 3307.