*Indonesian Journal of Limnology*
**Vol. 06 No. 01, 2025 (39-50)**
**E-ISSN :2774-2571**

# Comparison of Interpolation Methods for Mapping Water Quality in Seloromo Reservoir

**Rofiana Budi Ayumi Sita Dewi [a]***

[a] Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia

*Corresponding author: rofiana.b.a@mail.ugm.ac.id

Received 15 April 2025 Accepted 27 May 2025 Published 1 August 2025

DOI: 10.51264/inajl.v6i1.85

**Abstract**

Spatial interpolation is GIS modeling to estimate the value of an unmeasured location point based on measurements at another location. However, research on choosing the best interpolation method for a sample to become a continuous map is still limited. The main objective of this study is to compare three interpolation methods to show the spatial distribution map of water quality in Seloromo Reservoir, Pati Regency. Water quality measurements in terms of pH, EC, and TDS parameters consist of 50 sample points for each parameter. Water sampling was conducted in February 2023 from morning to afternoon. The three interpolation methods include inverse distance weighting (IDW), Gaussian kriging (GK), and spline. The results show that each interpolation method used will result in different interpolation maps. The best interpolation method in this study is inverse distance weighting (IDW). The IDW method has the best R-Square (pH 0.824; EC 0.85; TDS 0.873) and RMSE (pH 0.146; EC 0.93; TDS 0.563) values compared to the other two methods. This research is limited to comparing the results of mapping water quality distribution.

**Keywords:** Interpolation, Inverse distance weighting, Kriging, Spline.

**To cite this article:** Dewi, R. B. A. S. (2025). Comparison of interpolation methods for mapping water quality in Seloromo Reservoir. *Indonesian Journal of Limnology*, 6(1), 39–50.



## 1. Introduction

As a freshwater ecosystem, reservoirs are artificial waters formed by damming rivers (Nurruhwati *et al.*, 2017). Reservoirs have economic value for fishery, tourism, sports, and other activities. Therefore, reservoir water is vulnerable to pollution because of use in various dynamic activities (Srinidhi *et al.*, 2022). The degradation of reservoir water quality can occur from anywhere, either due to human activities or water sources that cause effluents to flow into the reservoir waters (Soeprobowati *et al.*, 2019). Because of that, information about reservoir water quality must be identified by conducting reservoir water quality monitoring. Water quality monitoring involves collecting water samples at various locations that are spatially distributed (Ogbozige *et al.*, 2018). A spatial distribution approach will help in representing distribution of sample point through mapping (Prasetyo *et al.*, 2022). Water quality mapping is useful for formulating relevant regulations (Wu *et al.*, 2021).

The interpolation method is one of the GIS models of surface water to predict unknown values (Gong *et al.*, 2014). There are many methods that have been designed, including statistical methods for example kriging and deterministic methods for example IDW. Interpolation accuracy refers to a measure that determines the degree of similarity between the predicted and actual measured values. As a result, boundaries and areas of contamination are created and affect the accuracy assessment (Mirzaei & Sakizadeh, 2016). Many research studies have explored spatial interpolation methods for various purposes, but results are not conclusive. Some studies suggest that kriging is the best method (Kimleang *et al.*, 2017; Li & Heap, 2011; Murphy *et al.*, 2010), while others showed that IDW has the lowest prediction bias among other methods (Gong *et al.*, 2014; Khouni *et al.*, 2021). In addition, other studies have showed the advantages of interpolation methods such as Ordinary kriging and RBF-IMQ (Xie *et al.*, 2011), Empirical Bayesian kriging (Mirzaei & Sakizadeh, 2016), and Co-kriging (Belkhiri *et al.*, 2020). Performance of spatial interpolation methods not only depends on the parameters used, but also other factors such as data variation and sampling design (Li & Heap, 2011).

Specifically, this paper describes a comparison between three interpolation methods, including IDW, kriging, and spline. This research produces water quality distribution maps with different interpolation methods. Comparing the accuracy of the interpolation method requires water quality parameters, such as degree of acidity (pH), total dissolved solids (TDS), and Electrical Conductivity (EC). This study's novelty is the determination of the spatial distribution of reservoir water quality parameters using the IDW, kriging, and spline interpolation methods at locations that have never been research sites. Based on the measurement of physical water quality parameters, limitations may exist regarding measurement outputs that are influenced by the season at the time.

## 2. Methods

### 2.1 Study area

Seloromo Reservoir is located at the eastern foothills of Mount Muria, specifically in Gembong District, Pati Regency, Central Java. This reservoir has a water catchment area of 15 km$^2$ (Fig. 1). The average rainfall in the Seloromo Reservoir watershed is 1,703 mm/year (BBWS Pemali Juana, 2019). Topographically, the area around the Seloromo Reservoir is a low to highland which is wide enough with the highest field elevation ± 159,500 (BBWS Pemali Juana, 2019). Land use in the research location is dominated by settlement areas, rainfed rice fields, and moorland, while forest and grassland use only cover a small area of the site. Seloromo Reservoir receives water input from four sub-watersheds that supply the river, namely the Wuni, Lampeyan, Jering and Sentul sub-watersheds.

### 2.2 Data Collection and Sampling

The survey was conducted on 11 February 2023 from morning to afternoon. This study uses primary data obtained from collecting and measuring water samples using water checker (PCSTestr 35 Multi-Parameter) to determine the condition of water quality parameters such as acidity/pH (unitless), total dissolved solid/TDS (mg/L), and electrical conductivity/EC (µS/cm).

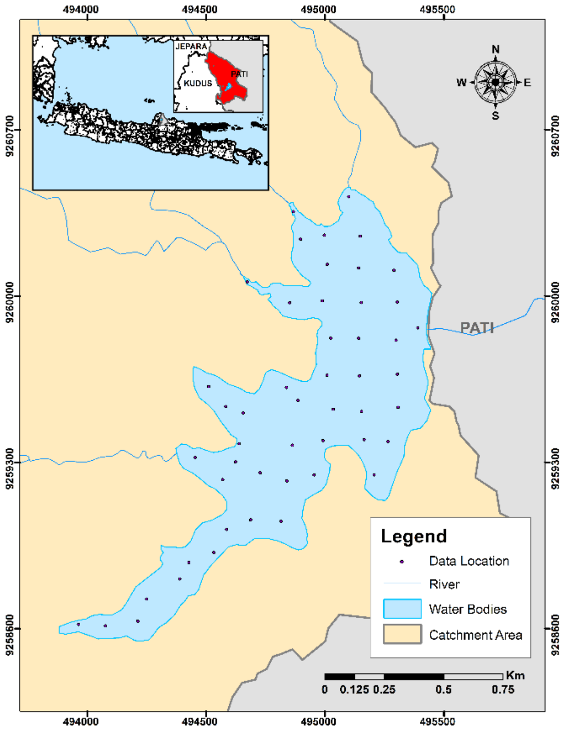



**Figure 1.** Catchment Area of Seloromo Reservoir

The number of water samples taken is determined using systematic random sampling method with a grid size of 150m × 150m. After the grid is created, sampling locations are determined randomly within each grid (Sejati, 2017). Ideally, one observation point represents a grid of 2.25 hectares with a mapping scale of 1: 15,000 (Triadi *et al*., 2016). Sampling was carried out at the surface until a depth of 5 meters which is considered representative of these waters (Indriani *et al.*, 2016). Based on the grid system, it was assumed that 50 samples were sufficiently representative of the reservoir by considering the water surface area of approximately 1.61 $km^2$. Water sampling is also recommended in all sections of the reservoir to validate the results (Santoso *et al.*, 2017). Water samples are composite, which is a combination of temporary samples collected.

### 2.3 Mapping by Interpolation Method

To map the spatial distribution of reservoir water quality, first, prepare water quality data such as water quality coordinates of sampling locations and values of each parameter. Some 70% of the data was analyzed using the IDW, kriging, and spline interpolation methods. After that, interpolation was performed by inputting water quality point data, then processing and waiting for the results. Especially for the kriging interpolation method, it is required to do spatial correlation using Integrated Land and Water Information System (ILWIS) application to calculate the semi-variogram value at a certain distance so that a suitable semi-variogram model can be found. There are three semi-variogram parameters, namely sill, nugget effect, and range. After knowing the suitable semi-variogram model, then process the water quality data in ArcGIS (ArcMap 10.4). The final result of data processing is a spatial distribution map of water quality for each measured variable.

### 2.4 Interpolation Method Validation

As much as 30% of the 50 data samples were processed as validation points, outside of the points processed by the interpolation method (Hasan *et al.*, 2020). Accuracy tests for the IDW, kriging, and spline methods are carried out by determining the value r-square ($R^2$) and Root Mean Square Error (RMSE).

*R-Square* ($R^2$)

Value of $R^2$ to determine the accuracy of the use of the interpolation method. This method can be used to determine the best method by comparing the value results (Soraya, 2021). The formulation function is as follows:

$$r = \frac{n\,(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n^*(\sum x^2 - (\sum x)^2)] * [n^*(\sum y^2 - (\sum y)^2)]}} \quad (1)$$

Where, *r* is the correlation coefficient, *n* is the number in the given dataset, *x* is the first variable, and *y* is the second variable.

*Root Mean Square Error (RMSE)*

RMSE measures how much error there is between two data sets (Murphy *et al.*, 2010). RMSE is a measure that is often used to determine the difference between the value estimated by the model and the actual value observed. The smaller the RMSE value, the fewer errors that occur between the two data sets.

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}[Z(x_i) - Z^*(x_i)]^2} \quad (2)$$

where, *z(xi)* and *z*(xi)* are the measured and interpolated of the observed values of water quality index, while *n* is the sample size (Xie *et al.*, 2011).

## 2.4 Analytical Method

Regression and graphical analysis used to determine the best method of a model by comparing the results of the $R^2$ value. Table 1 shows the classification of $R^2$ values. Graphical analysis includes a semivariogram graph specifically for the kriging method and an $R^2$ graph. This analysis is used to make it easier for readers to understand the results of a model validation test. Meanwhile, a descriptive - quantitative method was conducted to explain the differences results of the spatial distribution maps for pH, DHL, and TDS parameters. This study also uses a cross-sectional method with an observation of interpolation patterns on the map.

**Table 2.** Classification of R-Square ($R^2$) Values

| Value | Classification[1] |
|---|---|
| 0 | None |
| 0.01 – 0.49 | Weak |
| 0.5 | Moderate |
| 0.51 – 0.99 | Strong |
| 1 | Perfect |

[a]Ghozali, I. (2016). *Aplikasi Analisis Multivariete dengan Program IBM SPSS 23, Edisi 8*. Badan Penerbit Universitas Diponegoro.

In summary, the steps in this research can be seen in Figure 2.

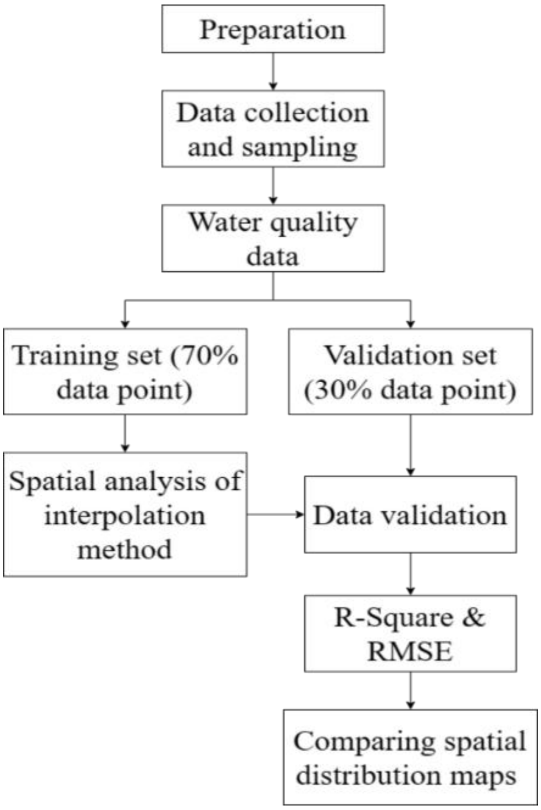
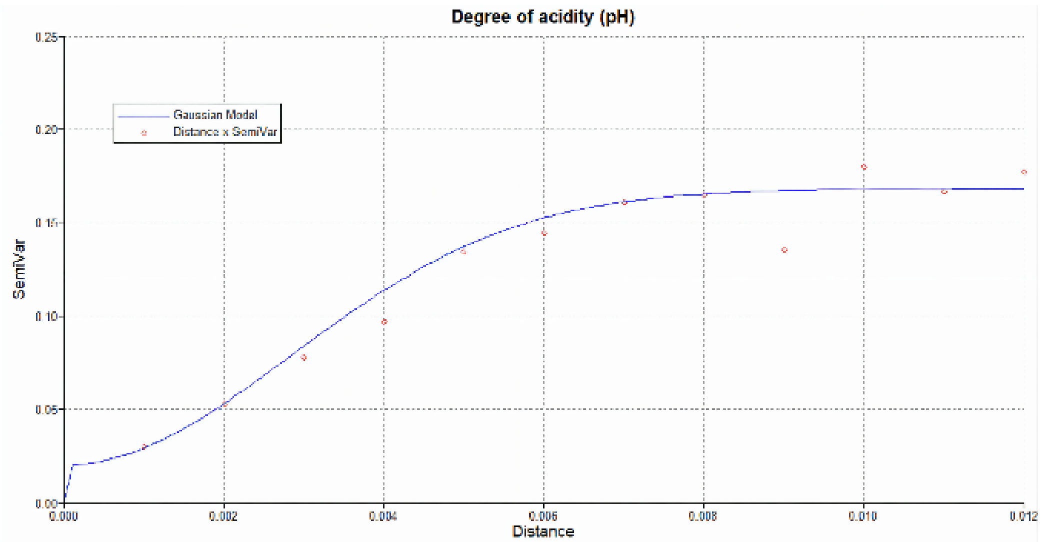



**Figure 1.** Data Processing Flowchart

## 3. Results and Discussion

### 3.1 Selecting the Best Fitted Semi-variogram Models for Kriging Method

Map design for the IDW and Spline methods uses the default reference provided by ArcGIS 10.4, while the kriging method needs to specify a semi-variogram model to indicate the weights used in interpolation. The semi-variogram provides information about the structure of spatial variation and input parameters for kriging (Belkhiri *et al.*, 2020).



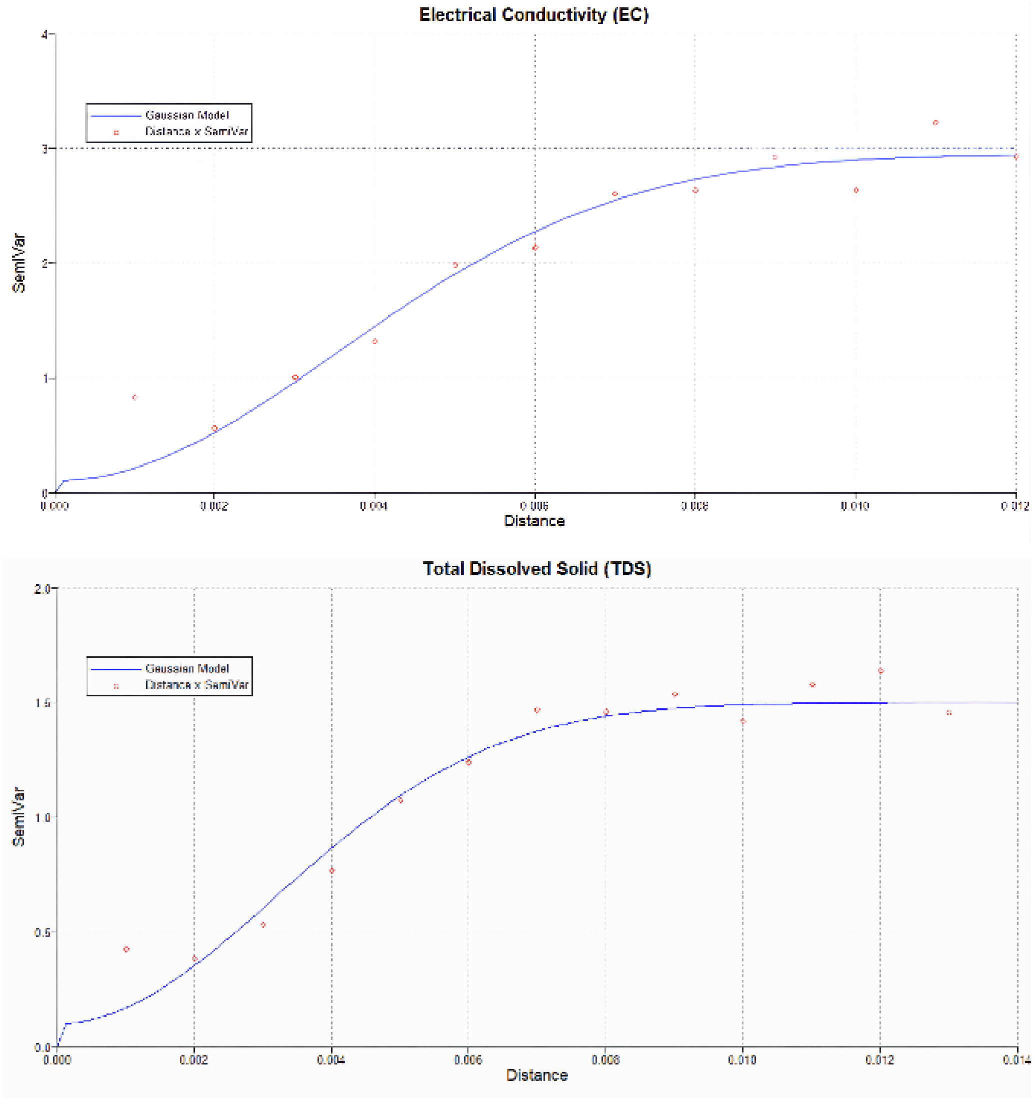



**Figure 2.** Fitted Semi-variogram Models

Using a semi-variogram to indicate the weights used in interpolation, the kriging method is a geostatistical technique. Creating maps for the kriging method is performed by inputting data samples and semi-variogram values that have been analyzed with the ILWIS application. In theory, the semi-variogram model for interpolation is the spherical model. The semi-variogram graph shows the nugget effect, sill, and range values for each water quality parameter (Table 2).

**Tabel 2.** Gaussian Model Analysis

| Parameter | Nugget Effect | Sill | Range |
|---|---|---|---|
| pH | 0.02 | 0.168 | 0.004 |
| EC | 0.1 | 2.95 | 0.005 |
| TDS | 0.1 | 1.5 | 0.0045 |

The pH parameter has the lowest nugget effect value, while the nugget effect on EC and TDS is higher (Table 2). This indicates that EC and TDS have more variable values than pH parameter. The range value in semi-variogram analysis represents the range of zones between observation points that are still correlated. The range value of the EC is slightly larger than that of pH and TDS, indicating that the measurements are correlated. The Gaussian model is the best model because the graphics can represent the entire data sample (Fig. 3). Next, this model will be used for kriging interpolation, namely Gaussian Kriging (GK).

### 3.2 Performance of Interpolation Method Maps

Each interpolation method will create a different output, even though the input data used is the same (Prasetya *et al.*, 2021). It is because each interpolation model has different mathematical algorithms when performing the interpolation process. An isnterpolation method's results are influenced by various factors such as scope of the study area, spatial sampling patterns, and statistical distribution of data, even the expertise of the researcher (Mirzaei & Sakizadeh, 2016).

The spatial distribution of pH is generally lower in the southern area, especially the south-end of the reservoir which has the lowest pH value of 8.00 (Fig. 4). Differences in interpolation results exist in the north, located on the interpolated contour of the highest pH value (red color). The interpolation results of three methods generally show that the highest pH value is around some sample points. For example, point 5 and point 7 in the IDW and spline methods are included in the high pH values, as opposed to the gaussian kriging method. In contrast, point 15 in the gaussian kriging method is included in high pH values, different from the IDW and spline methods. Based on that, the distribution of high pH values using the gaussian kriging method shows a different contour shape from the other methods (Fig. 5).

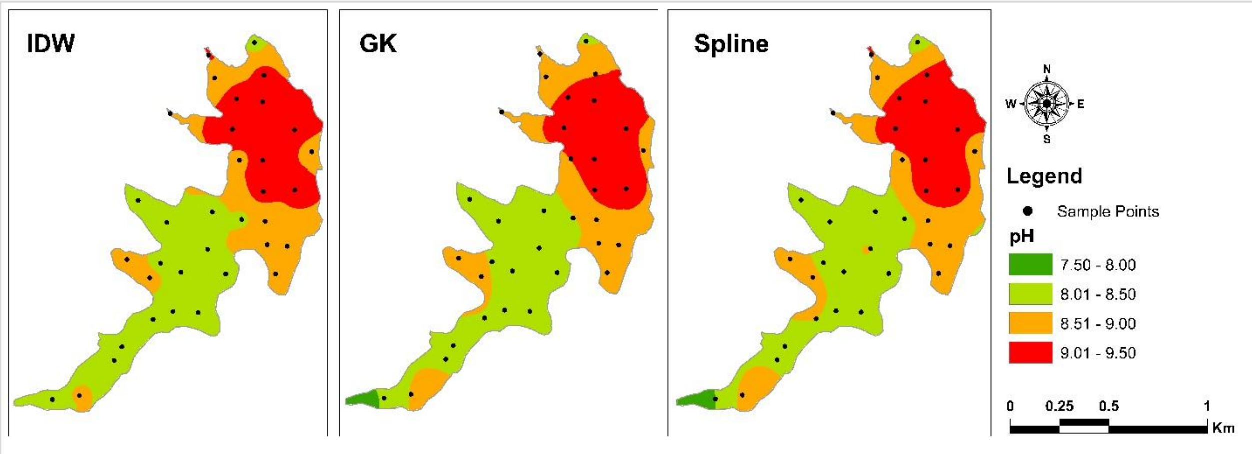



**Figure 3**. Spatial Distribution of pH for Different Interpolation Methods

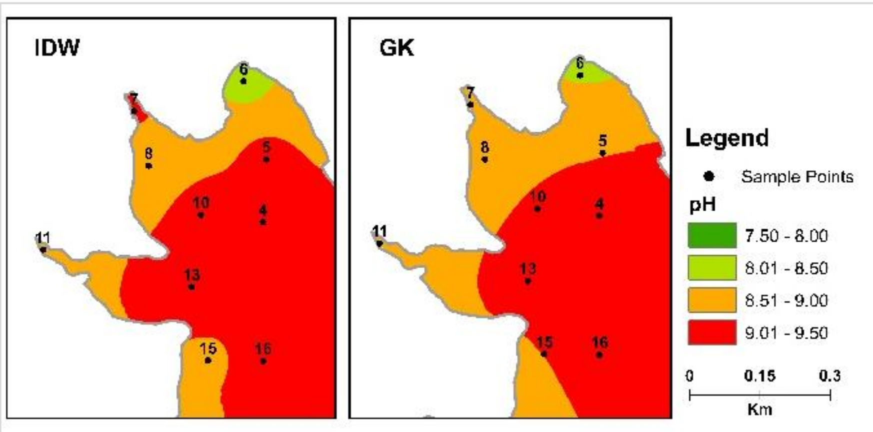



**Figure 4.** Zoomed region of Fig. 4 showing differences IDW and GK Interpolation

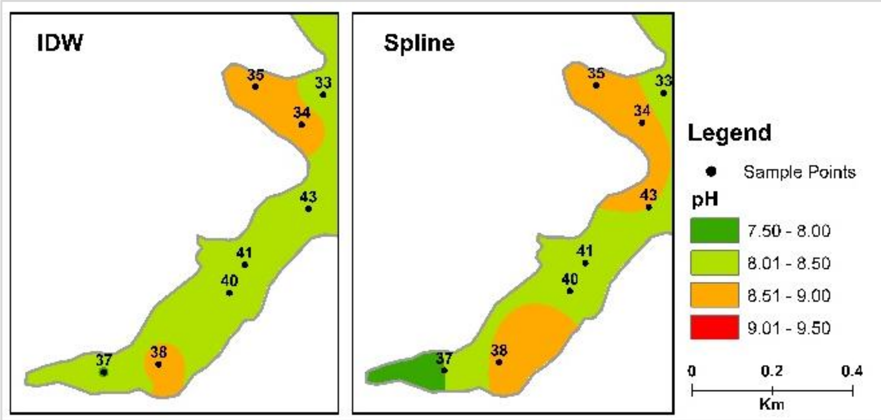



**Figure 5**. Zoomed region of Fig. 4 showing differences IDW and Spline Interpolation

Contour shapes of pH in the southern area of the reservoir between the spline method and the IDW and gaussian kriging methods differed at point 43 (Fig. 6). Both methods did not include point 43 in the classification of the range 8.51 - 9.00 (yellow color). The spline method clipped the point into the yellow color classification. In addition, point 37 in the IDW and spline methods was classified in the 7.50 - 8.00 range (dark green color). However, the gaussian kriging method is different from both. Based on the sample value of the measurement results, point 37 has a pH value of 8.00 so it should fall within the range of 7.50 - 8.00 like the results of the IDW and spline methods.

**Tabel 3.** Parameter Statistics of pH

| Method | Maximum | Minimum |
|---|---|---|
| IDW | 9.34 | 8.00 |
| Gaussian Kriging | 9.32 | 7.89 |
| Spline | 9.43 | 7.82 |

The maximum and minimum values of the raster cells from these methods in Table 3 show that IDW interpolation results are similar to sample data values. Meanwhile, the interpolation results of gaussian kriging and spline show that the maximum and minimum values are close to the sample data values. This represents that there are no interpolated values which are negative or too large. The validation results for the IDW method have the highest $R^2$ value of 0.824 with the lowest RMSE value of 0.146 (Table 6). It means that the IDW method for pH is more accurate than the gaussian kriging and spline methods. In addition, a low RMSE value of the IDW method indicates that the value variation generated by the method is close to the value variation of the data sample.

IDW and gaussian kriging methods have similar interpolation patterns for EC, while the spline method was different from both (Fig. 8).

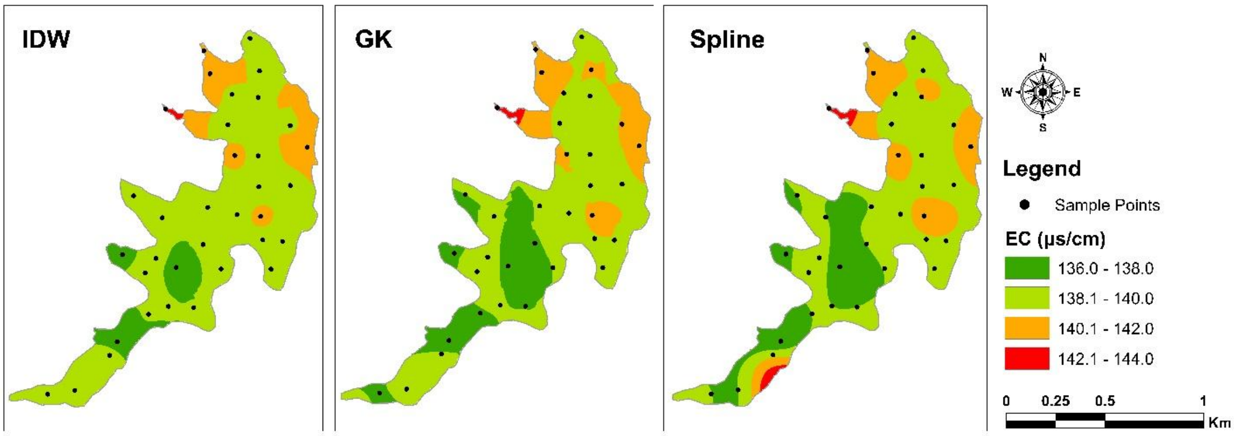



**Figure 6.** Spatial Distribution of EC for Different Interpolation Method

Distribution of EC values in the northern area of the reservoir was dominated by the ranges 138.1 - 140.0 µs/cm and 140.1 - 142.0 µs/cm. In the southern area of the reservoir, the distribution of EC was dominated by the ranges of 136.0 - 138.0 µs/cm and 138.1 - 140.0 µs/cm. Generally, contour shapes for the northern area of the reservoir using three methods are almost similar, while significant differences are found in interpolation results at the southern area.

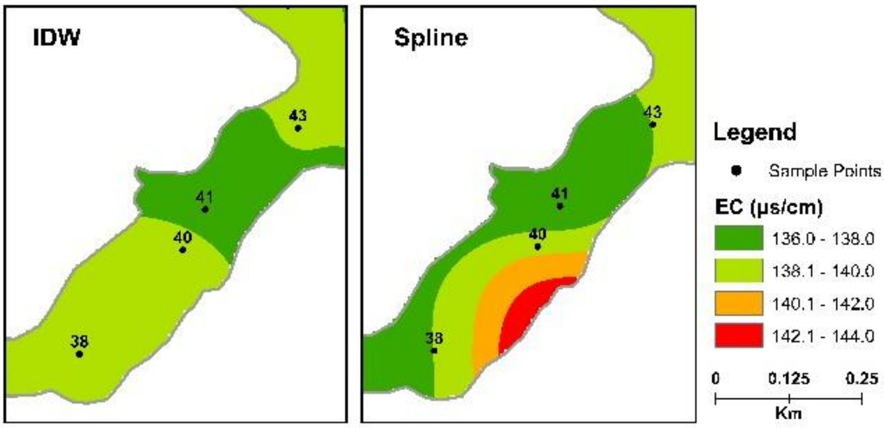



**Figure 7.** Zoomed region of Fig. 8 showing differences IDW and Spline Interpolation

Based on Figure 7, the contour shapes of the IDW and gaussian kriging methods are almost the same, different from the contour shape of the spline method which intersects through point 38 and point 43. Differences in contour shapes at the southern tip of the reservoir using the spline method are very different compared to other two methods, but the classification for point 40 remains the same as the other two methods.

**Tabel 4.** Parameter Statistics of EC

| Method | Maximum | Minimum |
|---|---|---|
| IDW | 143.8 | 136.0 |
| Gaussian Kriging | 143.7 | 136.1 |
| Spline | 143.9 | 133.2 |

Minimum values of the IDW and Gaussian kriging models for EC are close to or equal to the sample data values, while the spline model has a minimum value that is much different from the sample data values. However, the maximum values of the three interpolation models are similar and close to the maximum values of the sample data (Table 4). But, the maximum value of the spline method is slightly higher than that of the sample data. Therefore, the difference in classification range of the spline model is different from the other two models. IDW method has the highest $R^2$ value of 0.85 and the lowest RMSE value of 0.93 (Table 6). Meanwhile, the spline method is opposite to the IDW method, where the lowest $R^2$ is 0.571 and the highest RMSE is 1.15. This means that the largest prediction error value of the resulting model is obtained from the spline method. This shows that IDW interpolation modeling of EC parameters in the study area is the best.

Distribution of TDS obtained from all three interpolation methods showed similar patterns in general (Fig. 9).

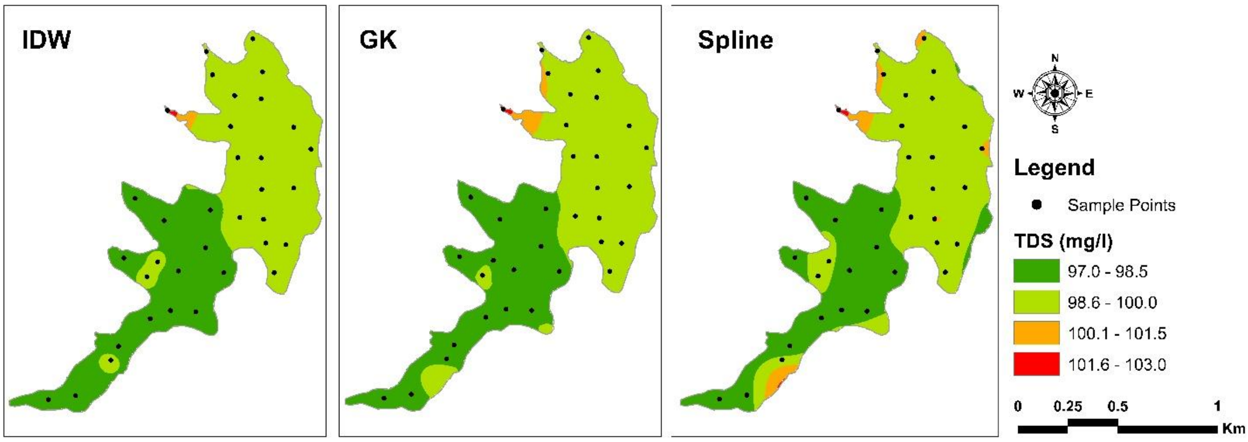



**Figure 8.** Spatial Distribution of TDS for different Interpolation Methods

Results of interpolation in the northern area of the reservoir are dominated by the classification between 98.6 - 100.0 mg/l (light green color), while in the southern area of the reservoir mostly around 97.0 - 98.5 mg/l (dark green color). Third interpolation method illustrates that the highest TDS value is only at point 11. Contour shape of interpolation results looks slightly different at some points. For example, point 33 and point 34 using IDW and spline results are similar because they are classified in the same range, but in gaussian kriging method only point 34 which has the same classification with both methods (Fig. 10).

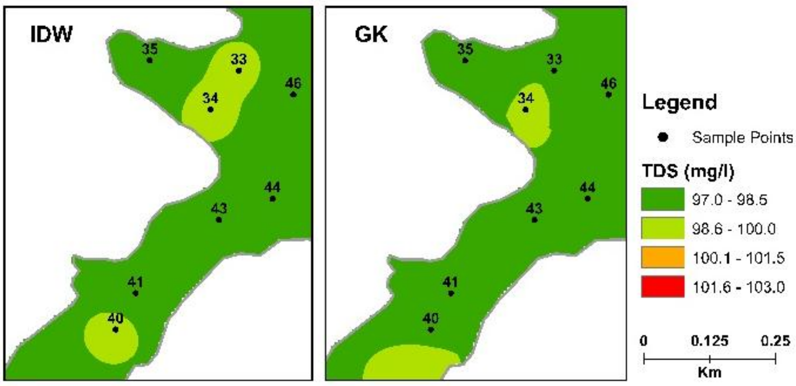



**Figure 9.** Zoomed region of Fig. 9 showing differences IDW and GK Interpolation

Moreover, IDW and spline methods also interpolate point 40 over 98.5 - 100.0 mg/l, while the kriging method is classified over 97.0 - 98.5 mg/l. Differences of contour shapes at point 40 are obviously different using the spline method, while the IDW method looks centered and slightly enlarged around that spot.

**Tabel 4.** Parameter Statistics of EC

| Method | Maximum | Minimum |
|---|---|---|

| | | |
|---|---|---|
| IDW | 101.99 | 97.00 |
| Gaussian Kriging | 101.82 | 96.42 |
| Spline | 102.11 | 95.11 |

Based on the maximum and minimum values (Table 5), IDW has the closest value to the sample data value. The maximum value of pixel cells from all three methods is close to the sample data value. However, only the minimum value of IDW has an interpolated value equal to the sample data value, while gaussian kriging and spline are below the sample data value. IDW has the best $R^2$ value for TDS accuracy of 0.873 as compared to the gaussian kriging and spline methods (Table 6). Also, the RMSE value of the IDW method is also the lowest at 0.563, meaning that the value variation obtained is closest to the data sample value variation. This value is better than the other two methods.

The results of $R^2$ and RMSE show that the three interpolation methods are accurate enough for spatial analysis. IDW method has the best accuracy as compared to the other methods. This is because the $R^2$ value of the method is closest to 1, meaning that the ability of the independent variable (prediction model) to explain the dependent variable (sample data) is quite large (Hasan *et al.*, 2020). Meanwhile, the lowest RMSE value of the IDW indicates a low predicted error value. Value of the predicted error depends on the distance between the two measurement point locations. Unmeasured data at a location far from the measurement point creates an inaccurate value (Kimleang *et al.*, 2017). Also, the maximum or minimum value indicates the uncertainty associated with the sample location so there are different ranges of values in each method (Xie *et al.*, 2011).

**Table 6.** Validation Result by Three Interpolation Methods

| Parameter | Method | $R^2$ | RMSE |
|---|---|---|---|
| pH | IDW | 0.824 | 0.146 |
| | GK | 0.724 | 0.204 |
| | Spline | 0.659 | 0.239 |
| EC | IDW | 0.85 | 0.93 |
| | GK | 0.664 | 1.05 |
| | Spline | 0.571 | 1.15 |
| TDS | IDW | 0.873 | 0.563 |
| | GK | 0.686 | 0.638 |
| | Spline | 0.552 | 0.74 |

Accuracy of the IDW to show the spatial distribution of water quality in Seloromo Reservoir is compatible with studies by Gong *et al.* (2014), Pankalakr and Jarag (2016), and Khouni *et al.* (2021). According to Gong *et al.* (2014), IDW is more accurate than the gaussian kriging method due to the influence of data values in a particular region. Calculation of accuracy for spline method is the lowest for studies in Seloromo Reservoir so that these results are congruent with research conducted by Jaffar *et al.* (2022). Based on research by Pasaribu and Haryani (2012), the spline method is less accurate than the IDW method because it is influenced by different weighting values and input data from each method. Weighting affects the determination of the value for each interpolated point based on sample points in one region.

## 4. Conclusion

After the comparison between IDW, Gaussian Kriging, and Spline interpolation, there is difference of characteristics among the three methods. An interpolation method for the three parameters is strongly recommended using IDW that best interpreted the spatial distribution of water quality in Seloromo Reservoir. The $R^2$ value of the IDW method for pH, DHL, and TDS parameters is nearly 1 and classified as strong. Meanwhile, the RMSE value of the IDW method for pH, DHL, and TDS parameters in contrast to the $R^2$ value shows the lowest value, meaning that the error rate of the IDW method is less than the other two methods. Using the interpolation technique succeeded in providing the best match between the reading value and the expected value.

This was limited by the water quality parameters measured. It is recommended that future research should explore the water quality of Seloromo Reservoir with more complex parameters. In another case, it can be supported by making a bathymetry map to show the depth of the water

## 5. Acknowledgements

The authors are grateful for the help of BBWS Pemali Juana for access to and valuable support; several anonymous people who helped with data collection; and BPBD Pati District for providing technical support.

## 6. References

BBWS Pemali Juana. (2019). *SID Rehabilitasi Daerah Irigasi Gembong*.

Belkhiri, L., Tiri, A., & Mouni, L. (2020). Spatial Distribution of The Groundwater Quality Using Kriging and Co-kriging Interpolations. *Groundwater for Sustainable Development*, *11*(August). https://doi.org/10.1016/j.gsd.2020.100473

Gong, G., Mattevada, S., & O'Bryant, S. E. (2014). Comparison of the Accuracy of Kriging and IDW Interpolations in Estimating Groundwater Arsenic Concentrations in Texas. *Environmental Research*, *130*, 59–69. https://doi.org/10.1016/j.envres.2013.12.005

Hasan, M., Kurnia Sunaryo, D., & Jasmani. (2020). *Pemodelan Potensi Air Tanah Untuk Pengelolaan Sumber Daya Air Menggunakan Sistem Informasi Geografis: Studi Kasus di Daerah Pasigala (Palu, Sigi dan Donggala)*. Institut Teknologi Nasional Malang.

Indriani, W., Hutabarat, S., & A'in, C. (2016). Status Trofik Perairan Berdasarkan Nitrat, Fosfat, dan Klorofil-a di Waduk Jatibarang, Kota Semarang. *Diponegoro Journal of Maquares*, *5*(4), 258–264.

Jaffar, A., M. Thamrin, N., Amin Megat Ali, M. S., Farid Misnan, M., Mohd Yassin, A. I., & Mohamed Zan, N. (2022). Spatial Interpolation Method Comparison for Physico-chemical Parameters of River Water in Klang River using MATLAB. *Bulletin of Electrical Engineering and Informatics*, *11*(4), 2368–2377. https://doi.org/10.11591/eei.v11i4.36155

Khouni, I., Louhichi, G., & Ghrabi, A. (2021). Use of GIS Based Inverse Distance Weighted Interpolation to Assess Surface Water Quality: Case of Wadi El Bey, Tunisia. *Environmental Technology and Innovation*, *24*, 101892. https://doi.org/10.1016/j.eti.2021.101892

Kimleang, C., Sok, T., Chan, R., Sokly, S., Heejun, Y., Chihiro, Y., Layheang, S., & Chantha, O. (2017). Assessment of Spatial Interpolation Methods to Map Water Quality in Tonle Sap Lake. *The 2nd International Symposium on Conservation and Managment of Tropical Lakes*, *October*, the 2nd International Symposium on Conservation an.

Li, J., & Heap, A. D. (2011). A Review of Comparative Studies of Spatial Interpolation Methods in Environmental Sciences: Performance and Impact Factors. *Ecological Informatics*, *6*(3–4), 228–241. https://doi.org/10.1016/j.ecoinf.2010.12.003

Mirzaei, R., & Sakizadeh, M. (2016). Comparison of Interpolation Methods for the Estimation of Groundwater Contamination in Andimeshk-Shush Plain, Southwest of Iran. *Environmental Science and Pollution Research*, *23*(3), 2758–2769. https://doi.org/10.1007/s11356-015-5507-2

Murphy, R. R., Curriero, F. C., & Ball, W. P. (2010). Comparison of Spatial Interpolation Methods for Water Quality Evaluation in the Chesapeake Bay. *Journal of Environmental Engineering*, *136*(2), 160–171. https://doi.org/10.1061/(asce)ee.1943-7870.0000121

Nurruhwati, I., Zahidah, & Sahidin, A. (2017). Kelimpahan Plankton di Waduk Cirata Provinsi Jawa Barat. *Jurnal Akuatika Indonesia*, *2*(2), 102–108.

Ogbozige, F. J., Adie, D. B., & Abubakar, U. A. (2018). Water Quality Assessment and Mapping using Inverse Distance Weighted Interpolation: A Case of River Kaduna, Nigeria. *Nigerian Journal of Technology*, *37*(1), 249. https://doi.org/10.4314/njt.v37i1.33

Pankalakr, S. S., & Jarag, A. P. (2016). Assessment of Spatial Interpolation Techniques for River Bathymetry Generation of Panchganga River Basin Using Geoinformatic Techniques. *Asian Journal of Geoinformatics*, *15*(3), 9–15. http://203.159.29.7/index.php/journal/article/view/240

Pasaribu, J. M., & Haryani, N. S. (2012). Perbandingan Teknik Interpolasi DEM SRTM dengan Metode Inverse Distance Weighted (IDW), Natural Neighbor dan Spline. *Jurnal Penginderaan Jauh*, *9*(2), 126–139.

Prasetya, D. A., Santikayasa, I. P., & Azizi, I. H. (2021). Analisis Indeks Pencemaran Airtanah di DKI Jakarta dengan Interpolasi Spasial. *Jurnal Teknik Sipil Dan Lingkungan*, *6*(3), 177–186. https://doi.org/10.29244/jsil.6.3.177-186

Prasetyo, B. A., Muawanah, M., Mardianto, L., & Lubis, M. Z. (2022). Distribusi Spasial Kualitas Perairan dan Hubungannya dengan Aktifitas Budidaya Perikanan di Teluk Lampung. *Journal of Science and Applicative Technology*, *6*(1), 1. https://doi.org/10.35472/jsat.v6i1.897

Santoso, A. A., Sudarsono, B., & Sukmono, A. (2017). Analisis Pengaruh Tingkat Bahaya Erosi Daerah Aliran sungai (DAS) Bengawan Solo Terhadap Total Suspended Solid (TSS) di Perairan Waduk Gajah Mungkur. *Jurnal Geodesi Undip*, *6*(4), 463–473.

Sejati, S. P. (2017). Karakteristik Sumber Daya Airtanah Dangkal di Kecamatan Cangkringan Kabupaten Sleman Provinsi Daerah Istimewa Yogyakarta. Media Komunikasi Geografi, *18*(2), 166–177.

Soeprobowati, T. R., Jumari, Hariyati, R., & Gell, P. (2019). Paleolimnology Record of Human Impact on a Lake Ecosystem: The Case of Shallow Lakes in Central Java. *IOP Conference Series: Earth and Environmental Science*, *276*(1), 0–8. https://doi.org/10.1088/1755-1315/276/1/012015

Soraya, A. (2021). Pengelompokan Kualitas Air di Kota Pontianak menggunakan Metode Ward dan Single Linkage. *Jurnal Buletin Ilmiah Mat. Stat. Dan Terapannya (Bimaster)*, *10*(1), 19–24.

Srinidhi, N. S., Reddy, M. P., & Reddy, A. M. (2022). GIS based approach for the Assessment of Water Quality of the Biodiversity Heritage Site of India-the Ameenpur Lake, Hyderabad. *Research Journal of Chemistry and Environment*, *26*(4), 152–162. https://doi.org/10.25303/2604rjce152162

Triadi, L. B., Adji, F. F., & Dhiaksa, A. (2016). Dampak Dinamika Muka Air Tanah Pada Laju Dan Waktu Subsiden Lahan Rawa Gambut Tropika. *Jurnal Teknik Hidraulik*, *7*(2), 163–178.

Wu, Z., Lai, X., & Li, K. (2021). Water Quality Assessment of Rivers in Lake Chaohu Basin ( China ) Using Water Quality Index. *Ecological Indicators*, *121*, 107021. https://doi.org/10.1016/j.ecolind.2020.107021

Xie, Y., Chen, T. Bin, Lei, M., Yang, J., Guo, Q. J., Song, B., & Zhou, X. Y. (2011). Spatial Distribution of Soil Heavy Metal Pollution Estimated by Different Interpolation Methods: Accuracy and Uncertainty Analysis. *Chemosphere*, *82*(3), 468–476. https://doi.org/10.1016/j.chemosphere.2010.09.053