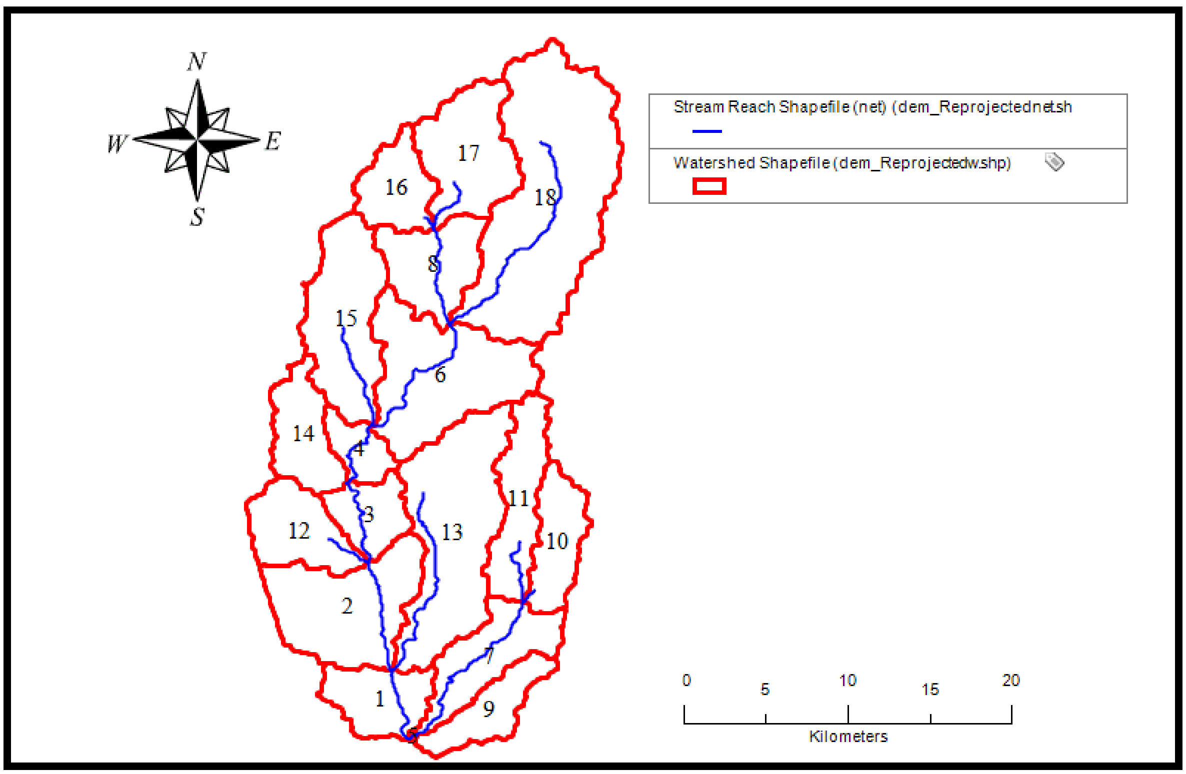
Visualization of the results is important in watershed management by enhancing understanding, facilitating communication, and guiding decision-making processes. By employing a combination of thematic mapping, GIS analysis, and remote sensing techniques, researchers can effectively visualize hydrological processes, watershed characteristics, and the impacts of management interventions, contributing to informed and evidence-based decision-making for sustainable water resource management.



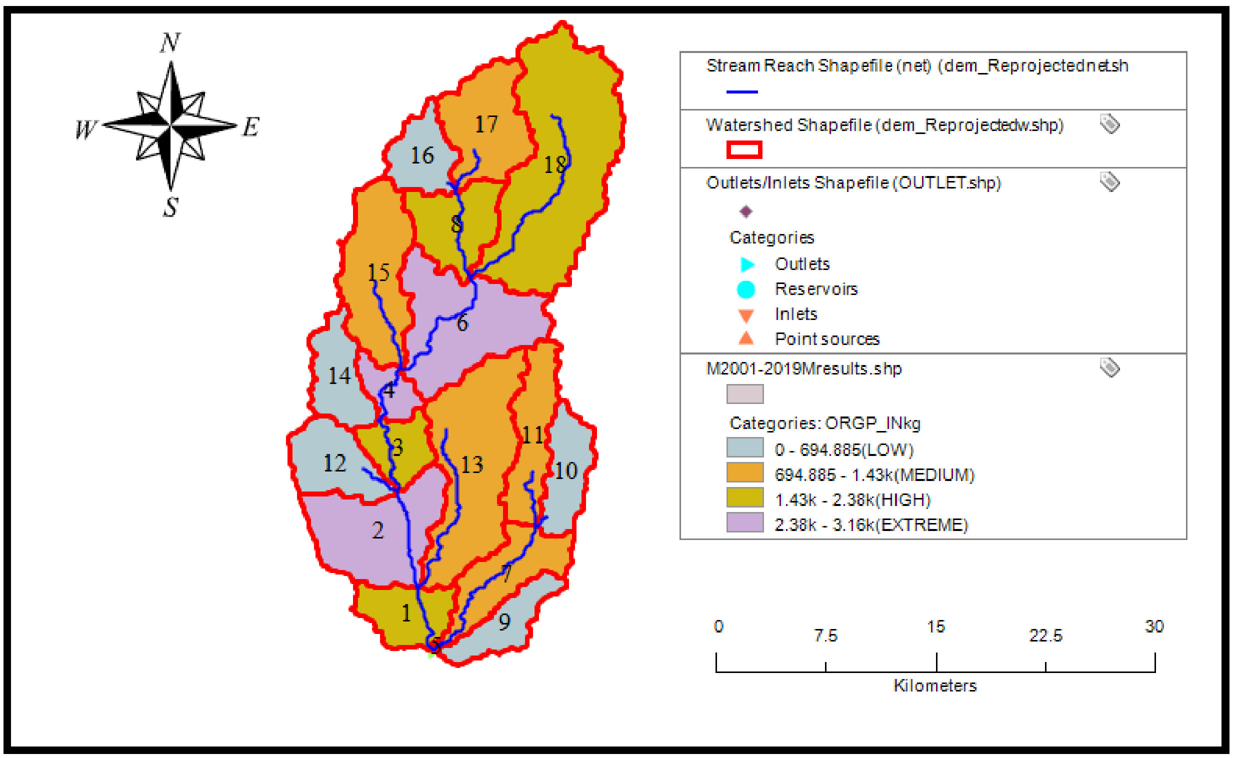
# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.1 Spatial Variations in Water Quality Parameters across the Ogunpa River Watershed

### 4.1.1 Organic Phosphorus (ORGP_IN)

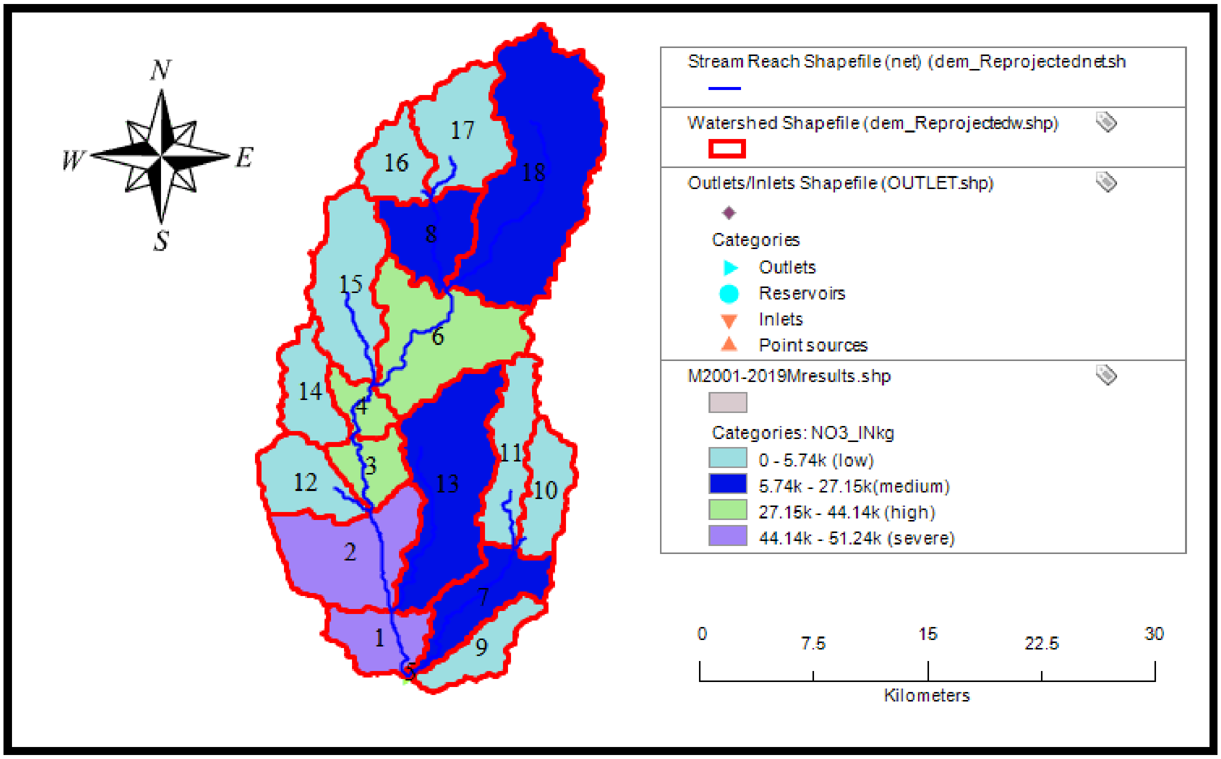
Organic phosphorus inputs vary widely across the watershed, reflecting differences in land use intensity and anthropogenic activities. Subbasins 6, 4, and 2 recorded the highest organic phosphorus inputs, with values of 3158.14 kg, 2588.27 kg, and 2383.40 kg respectively. These elevated inputs suggest significant agricultural activities or urban runoff contributing to phosphorus loading in these areas. In contrast, Subbasins 0 and 5 recorded minimal organic phosphorus inputs, likely due to their very small area or limited land use impact.




Spatial variation of organic phosphorus in the study area

### 4.1.2 Nitrate (NO3_IN)

Nitrate input exhibits a highly variable spatial pattern, indicating localized sources of nitrate pollution within the watershed. The highest nitrate concentration was recorded in Subbasin 1 (51,237.68 kg), followed by Subbasin 2 (44,138.54 kg) and Subbasin 4 (32,077.85 kg). These subbasins are likely influenced by intensive fertilizer application, sewage discharge, or urban runoff. In contrast, Subbasins 12, 14, and 16 recorded much lower nitrate inputs, suggesting less intensive land use or more natural vegetation cover that limits nitrate runoff.




Spatial variation of nitrate in the study area

### 4.1.3 Sediment (SED_IN)

Sediment load also varied significantly across the subbasins, pointing to differences in erosion rates and land cover conditions. Subbasin 1 showed the highest sediment yield at 144,087.05 tons, followed by Subbasins 2 (121,649.55 tons), 4 (88,633.26 tons), and 3 (99,020.29 tons). These results suggest that these areas are highly prone to soil erosion, likely due to factors such as bare soil surfaces, steep slopes, or poorly managed land uses. Subbasins with lower sediment inputs, such as Subbasins 9 and 14, indicate better vegetation cover or less disturbance.

### 4.1.4 Overall Spatial Patterns

From the analysis, it is evident that the northern and central subbasins, particularly Subbasins 1, 2, 3, 4, and 6, are the major contributors to organic phosphorus, nitrate, and sediment loading within the Ogunpa River watershed. These subbasins represent critical zones where water quality is most at risk and where management interventions should be prioritized.

Conversely, subbasins with smaller areas and lower input values, such as Subbasins 5, 9, 12, and 14, contribute less significantly to the overall pollutant load. However, ongoing monitoring is recommended to prevent potential degradation due to future land use changes.

This spatial analysis highlights the uneven distribution of water quality issues within the Ogunpa watershed and emphasizes the need for targeted management practices such as buffer zone establishment, erosion control measures, improved agricultural practices, and urban runoff management in the most impacted subbasins.

Table 4.1 shows the water quality parameters across the study area

| Subbasin | AREAkm2 | ORGP_INkg | NO3_INkg | SED_INtons |
|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.25 | 694.89 | 13498.38 | 26210.96 |
| 1 | 23.70 | 2012.91 | 51237.68 | 144087.05 |
| 9 | 20.21 | 311.54 | 1964.73 | 3656.28 |
| 7 | 31.45 | 1014.00 | 11623.35 | 24027.92 |
| 2 | 51.84 | 2383.40 | 44138.54 | 121649.55 |
| 12 | 27.46 | 313.72 | 1403.27 | 4882.62 |
| 3 | 18.36 | 1823.39 | 34081.26 | 99020.29 |
| 10 | 23.25 | 489.74 | 3292.77 | 8478.96 |
| 4 | 12.66 | 2588.27 | 32077.85 | 88633.26 |
| 13 | 73.67 | 1170.59 | 5742.00 | 25577.90 |

| | | | | |
|---|---|---|---|---|
| 11 | 30.52 | 705.42 | 3619.82 | 11640.16 |
| 14 | 23.94 | 349.11 | 1053.11 | 6815.23 |
| 6 | 61.55 | 3158.14 | 27148.92 | 69291.02 |
| 8 | 30.43 | 1430.02 | 8212.57 | 28908.81 |
| 15 | 48.61 | 1253.09 | 4066.80 | 19956.10 |
| 16 | 21.19 | 558.33 | 1954.52 | 6049.04 |
| 17 | 39.36 | 724.94 | 4048.31 | 6467.21 |
| 18 | 110.66 | 2113.84 | 14578.08 | 16720.26 |
| | 649.09 | 23095.35 | 263741.95 | 712072.62 |

## 4.2 Estimation of Water Quality Parameters in Oyun River Watershed

In addition to hydrological assessments, the study examined the transport of key water quality parameters across the Ogunpa River Watershed, focusing on organic phosphorus (ORGP_IN), nitrate ($NO_3$_IN), and sediment inflow (SED_IN). These constituents are significant indicators of watershed health, influencing aquatic ecosystem integrity and informing land and water management decisions.

The analysis was conducted across selected subbasins, with each subbasin contributing varying loads of pollutants depending on its area, land use, soil characteristics, and hydrologic behavior.

### 4.2.1 Organic Phosphorus (ORGP_IN)

Organic phosphorus inputs across the watershed totaled 23,095.35 kg, with notable contributions from Subbasins 6 (3,158.14 kg), 4 (2,588.27 kg), and 2 (2,383.40 kg). These elevated values are likely associated with intensive agricultural activity, livestock waste, or unbuffered surface runoff from fertilized fields. Subbasins with lower ORGP loads, such as Subbasins 12 and 14, suggest less nutrient-enriched runoff or more vegetative buffering.

### 4.2.2 Nitrate ($NO_3$_IN)

The total nitrate inflow across all subbasins was estimated at 263,741.95 kg, with the highest concentrations recorded in Subbasin 1 (51,237.68 kg), Subbasin 2 (44,138.54 kg), and Subbasin 3

(34,081.26 kg). These subbasins may be receiving excess nitrogen from fertilizers, wastewater discharge, or surface leaching. The spatial disparity in nitrate loads highlights the need for nutrient management strategies in critical source areas.

### 4.2.3 Sediment Inflow (SED_IN)

Sediment transport is a major concern in watershed management due to its impact on reservoir siltation, aquatic habitats, and pollutant loading. The total estimated sediment inflow was 712,072.62 tons, with Subbasins 1 (144,087.05 tons), 2 (121,649.55 tons), and 3 (99,020.29 tons) accounting for the highest contributions. These values suggest severe soil erosion and surface runoff intensity, possibly due to poor land cover, steep slopes, or unprotected farmlands.

The table below presents summary values for key subbasins:

| Subbasin | Area ($km^2$) | ORGP_IN (kg) | $NO_3$_IN (kg) | SED_IN (tons) |
|---|---|---|---|---|
| 1 | 23.70 | 2,012.91 | 51,237.68 | 144,087.05 |
| 2 | 51.84 | 2,383.40 | 44,138.54 | 121,649.55 |
| 3 | 18.36 | 1,823.39 | 34,081.26 | 99,020.29 |
| 4 | 12.66 | 2,588.27 | 32,077.85 | 88,633.26 |
| 6 | 61.55 | 3,158.14 | 27,148.92 | 69,291.02 |

These findings emphasize the pressing need for integrated nutrient and sediment management in high-load subbasins. The variation in pollutant loading among subbasins also supports targeted interventions, rather than a uniform watershed-wide approach.

### 4.2.4 Implications for Watershed Management

- **High nutrient zones** (Subbasins 1–4, 6) are susceptible to eutrophication risks downstream and should be prioritized for best management practices (BMPs) such as buffer strips, reduced fertilizer application, and cover cropping.
- **Critical erosion zones** may require structural measures like check dams, terracing, and gully plugging.