

## Analyzing the climate variability and reforestation activities in the areas adjacent to internally displaced camps in Darfur

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### INTRODUCTION & AIM

**Introduction:** Throughout the past century, the world has witnessed numerous civil and interstate wars, many of which continue to this day. These conflicts often arise from disputes over scarce resources, such as fertile farmland in densely populated regions, many of these conflicts have drastic environmental consequences, including biodiversity loss, and increased pressure on various natural resources (Chowdhury et al., 2023; Reuveny et al., 2010; Sidel, 2013).

**Aim:** This research is shedding lights on the best practices of plantation activities and assessing the changes in vegetation cover adjacent to the El-Salam IDPs camp, leveraging the remote sensing high spatial resolution imagery and earth observation technique, aligning with the SDG 15 Life on land.

### METHOD

**Study Area:** El-Salam IDPs camp is in South Darfur, Sudan between 11°54' and 12°2' North 24°51' and 25°4' East just to the southeast of Nyala—the largest town in Darfur Fig 1.

**Methods:** The research utilized PlanetScope time-series imagery and Object-based image classification methods (OBIA)-Orfeo ToolBox 8.1.2. within QGIS 3.28.6. software. Fig 2.

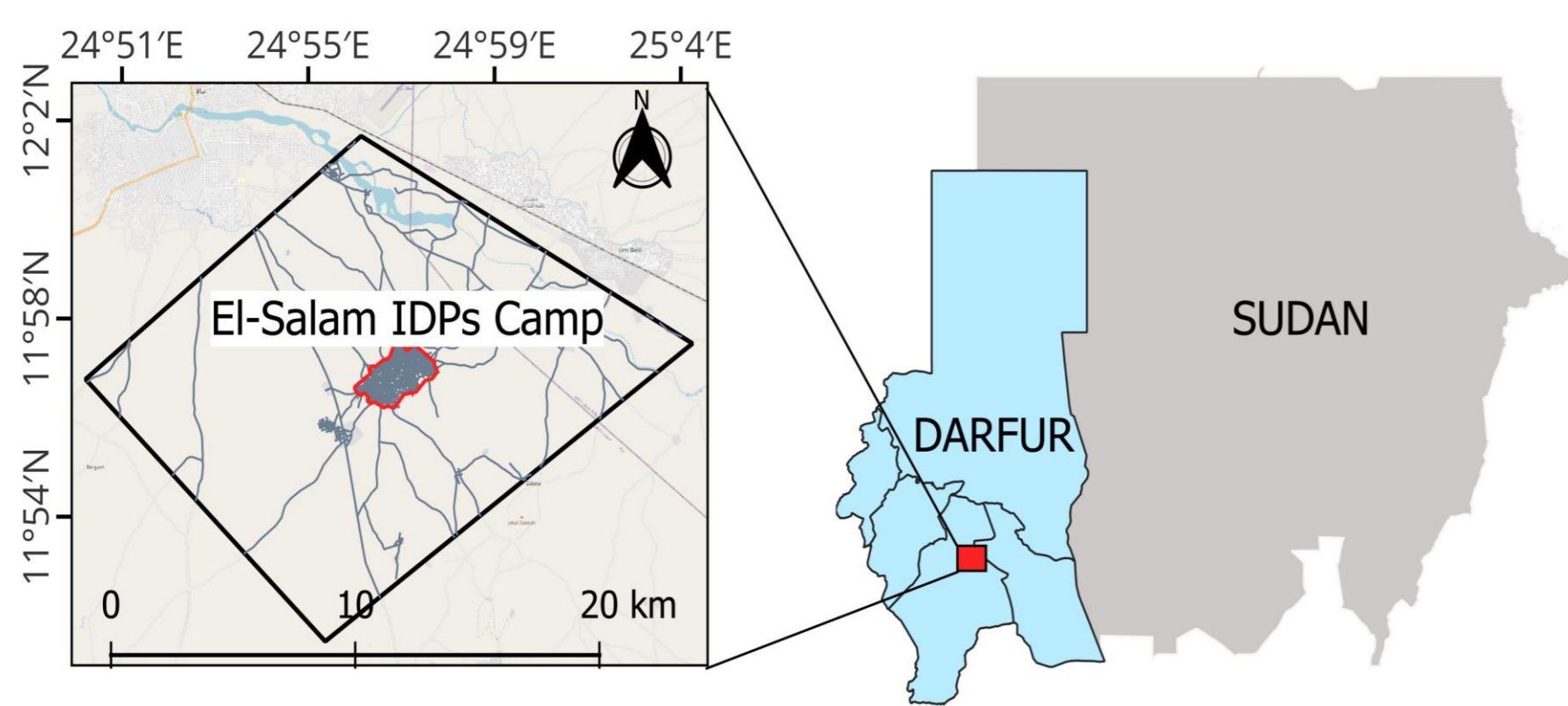


Fig 1. Study Area

Table 1. Area statistics and LULC from 2010 to 2017 and 2024

| LULC classes      | 2010     |           | 2017     |           | 2024     |           |
|-------------------|----------|-----------|----------|-----------|----------|-----------|
|                   | Area (%) | Area (ha) | Area (%) | Area (ha) | Area (%) | Area (ha) |
| Agricultural land | 45.38    | 11091.25  | 48.19    | 11778.49  | 61.02    | 14913.73  |
| Bareland          | 49.53    | 12104.79  | 46.54    | 11373.76  | 31.56    | 7713.85   |
| Water bodies      | 0.00     | 0.00      | 0.001    | 0.38      | 0.01     | 3.46      |
| Vegetation cover  | 0.76     | 184.45    | 0.79     | 191.92    | 2.48     | 606.99    |
| Built up          | 1.14     | 278.40    | 1.68     | 411.09    | 1.86     | 455.13    |
| Wadi              | 3.20     | 781.28    | 2.80     | 684.53    | 3.06     | 747.00    |
| Total             | 100.00   | 24440.17  | 100.00   | 24440.17  | 100.00   | 24440.17  |

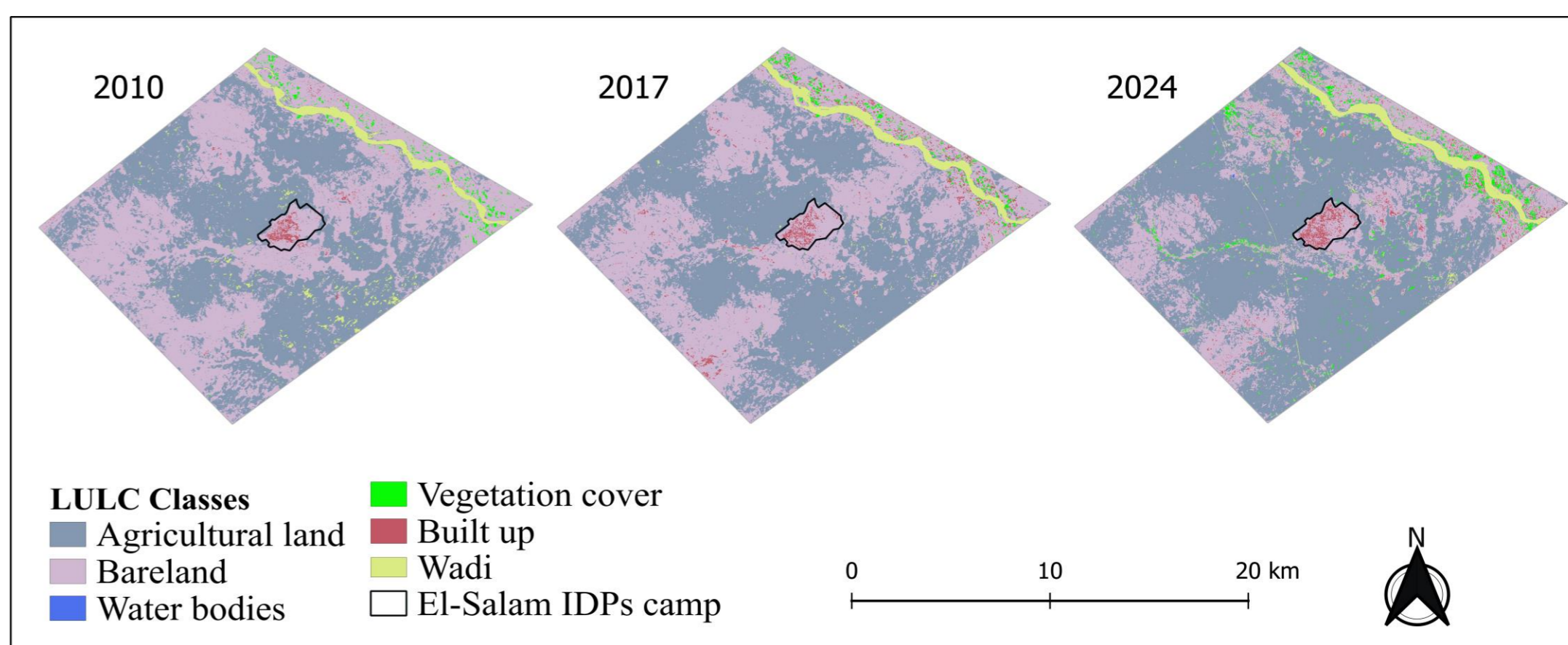


Fig 3. Land use and land cover Map of 2010, 2017, and 2024

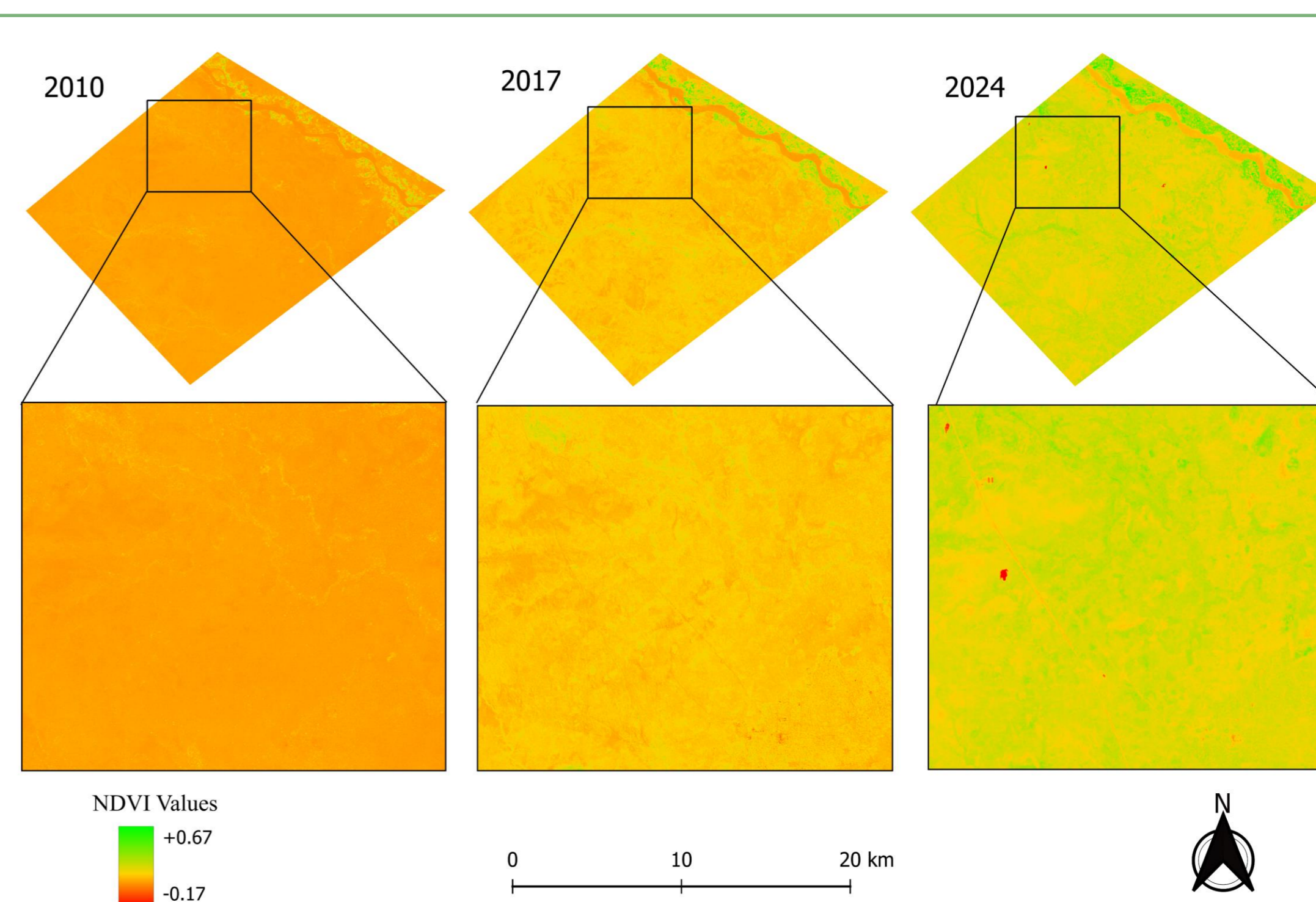


Fig 4. NDVI Map of 2010, 2017, and 2024

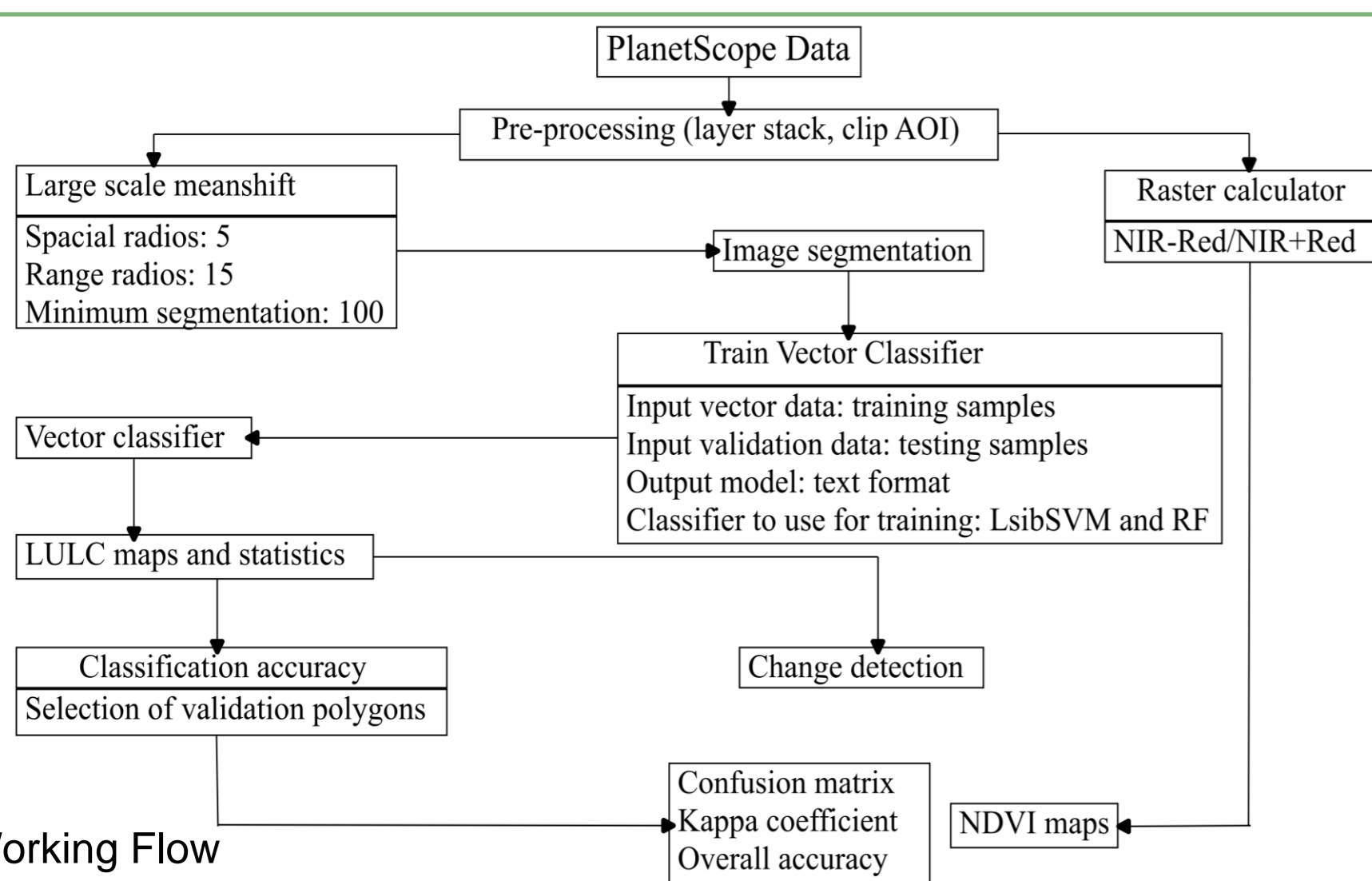


Fig 2. Working Flow

### RESULTS & DISCUSSION

The study identified major land use and land cover (LULC) classes, including agricultural land, built-up areas, vegetation cover, bareland, water bodies, and Wadi, with an overall accuracy of 90.66% to 95.14% through supervised classification.

Key findings include:

**Vegetation cover:** increased from 1.48% in 2010 to 2.33% in 2024, a rise of 0.85%.

**Water bodies:** emerged from 0% to 0.03% (6.08 hectares).

**Bareland areas:** decreased significantly from 58.43% to 42.40%.

**Agricultural land:** expanded from 45.38% to 61.02%.

**Built-up areas:** grew from 1.14% to 1.86%.

**Wadi areas:** slightly reduced from 3.20% to 3.06%.

These changes are attributed to reforestation initiatives, the construction of artificial water harvesting aquifers, Overall, the reduction in bareland facilitated the expansion of both agricultural and built-up areas, contributing to more productive land use and urban development Table 1, Fig 3, and Fig 4.

The research findings agreed with (Karamalla-Gaiballa & El-Kafafi, 2021) that various factors play a vital role in the availability of natural resources, which is the main reason sides other reasons flaring conflicts in the Darfur region in Sudan. These factors are related to climate change, destruction of ecosystems, immigration, demographic change, and political changes.

### CONCLUSION

The study demonstrates significant positive changes in vegetation cover around the El-Salam internally displaced persons (IDP) camps, driven by increased rainfall, improved land management, and reforestation efforts

### FUTURE WORK / REFERENCES

Recommendations for future studies: include a detailed social survey and key informant interviews in the study area, when peace returns, to establish the other underlying factors contributing to LULC changes.

**Reference:**

- 1-Chowdhury, P. R., Medhi, H., Bhattacharyya, K. G., & Hussain, C. M. (2023). Severe deterioration in food-energy-ecosystem nexus due to ongoing Russia-Ukraine war: A critical review. In *Science of the Total Environment* (Vol. 902). Elsevier B.V. <https://doi.org/10.1016/j.scitotenv.2023.166131>
- 2-Karamalla-Gaiballa, N., & El-Kafafi, S. (2021). The Impact of Conflicts on Natural Resources – The Case of Sudanese Darfur Region. *Polish Political Science Yearbook*, 50(4), 7–18. <https://doi.org/10.15804/pps202144>
- 3-Reuveny, R., Mihalache-O'Keef, A. S., & Li, Q. (2010). The effect of warfare on the environment. *Journal of Peace Research*, 47(6), 749–761. <https://doi.org/10.1177/0022343310382069>
- 4-Sidel, V. W. (2013). Airpower and the Environment e Ecological Implications of Modern Air Warfare.

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