SATELLITE BASED DETECTION OF OIL SPILL DETECTION IN NIGER DELTA REGION

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INTRODUCTION

Oil spills in the Niger Delta have caused persistent environmental degradation, causing severe damage to water bodies, farmlands, and ecosystems. Traditional monitoring methods are often limited in coverage and speed. Synthetic Aperture Radar (SAR) provides an effective solution due to its ability to detect oil films under all weather conditions. This study uses Sentinel-1 SAR data integrated with GIS to assess oil spill impacts and environmental vulnerability in the Niger Delta.

STUDY AREA
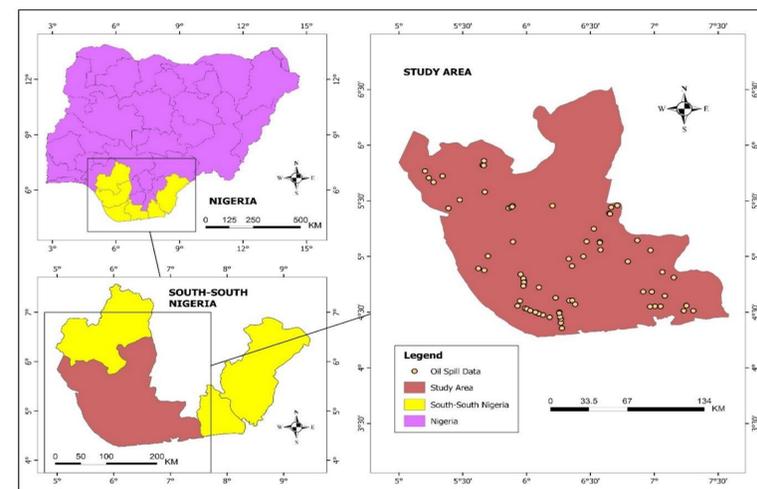
FINDINGS

Significant variations in SAR backscatter values were observed between pre and post spill images.

Oil-impacted zones were successfully delineated using backscatter difference analysis.

Weighted overlay results revealed that **21.6%** of the study area falls within high and very-high vulnerability classes.

High risk areas were concentrated in southern Rivers State (Bonny axis), central Bayelsa (Yenagoa and Ogbia LGAs), and western Delta State (Warri South and Ughelli).

Agricultural lands and wetlands accounted for over **40%** of vulnerable zones

Areas within 0–2 km of spill points and major rivers showed the highest contamination risk.

RESULT: AFFECTED RIVER NETWORK & VULNERABILITY MAP
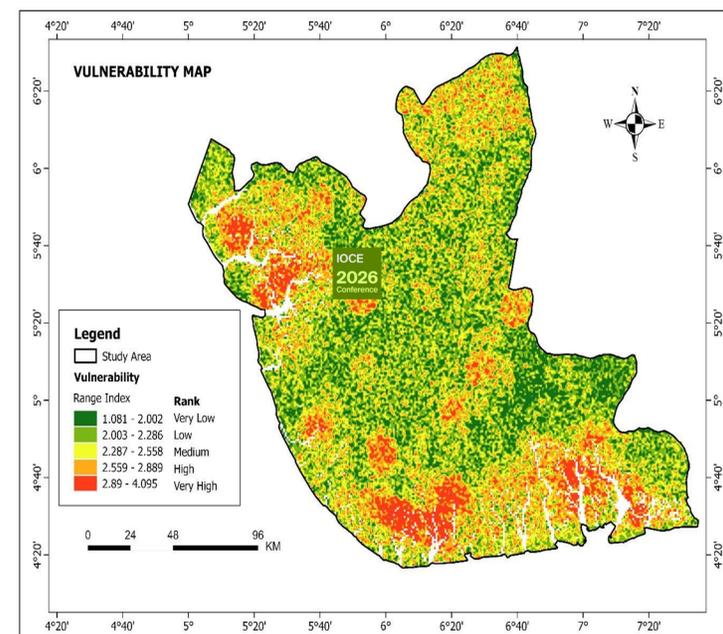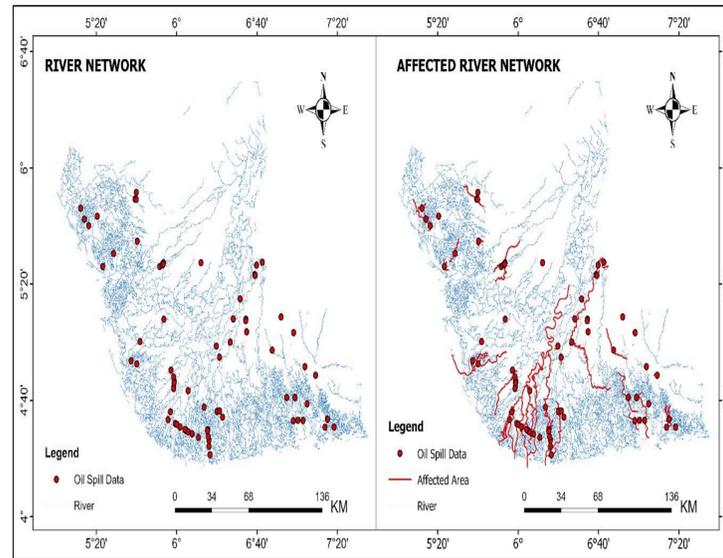
CONCLUSION

Sentinel-1 SAR proved effective in detecting oil spill impacts across the Niger Delta. The integration of the Analytical Hierarchy Process (AHP) with GIS-based vulnerability modelling successfully identified high-risk zones within the study area. The findings provide critical spatial evidence to support environmental monitoring, targeted remediation planning, and emergency response strategies. Overall, the integrated SAR-GIS approach demonstrates strong potential as a sustainable framework for oil spill risk assessment in oil-producing regions.

METHOD

• Sentinel-1 SAR images (pre-spill: 10 December 2024; post-spill: 24 December 2024) were acquired for the Niger Delta region.
• SAR data were pre-processed (radiometric calibration, speckle filtering, and terrain correction).
• Backscatter differences were analyzed to detect oil-impacted areas.
• Ancillary datasets (LULC, DEM, slope, river network, proximity to spill points and water bodies) were integrated in GIS.
• All factors were reclassified and weighted using the Analytical Hierarchy Process (AHP).
• A weighted overlay analysis was performed to generate the environmental vulnerability map.

DISCUSSION

The observed backscatter reduction confirms the sensitivity of SAR to oil films and changes in surface roughness. Areas of high vulnerability are concentrated in riverine and agricultural zones, underscoring the associated environmental and livelihood risks. Moreover, integrating SAR data with AHP-GIS enhanced the accuracy of spatial decision-making. These results are consistent with previous studies that highlight proximity to water bodies as a significant factor influencing spill impacts.

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