Long Term Assessment and Mapping of Erosion Hotspots in South East Nigeria

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Soil Erosion in the Southeast Nigeria

- Soil erosion is a serious environmental issue in south east Nigeria
- Increase in rate of erosion
- Devastating Impacts
    - Land degradation
    - Infrastructural damage
    - Loss of lives and properties

Obijiofor, 2012

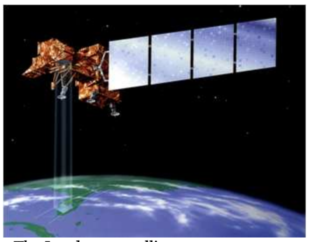
- Thus, assessment of erosion risk and mapping of hotspots
- Important step in curbing the increasing menace

Erosion hotspot identification

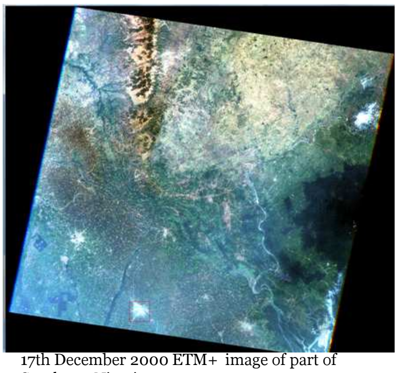
- Hotspots usually identified via
  - Field Observation
- Limitations:
  - time consuming
  - expensive
  - Tedious
- More so:
  - Current erosion studies in the region segmented
  - Focusing on different parts of the region
  - Therefore, the need for a broad regional study
- Environmental satellites to the rescue?

Erosion hotspots from satellites?

- Inputs from satellites used in erosion model
  - Cost effective
  - Quick
  - Comprehensive
  - Broader coverage
  - Can look back in time



The Landsat 7 satellite



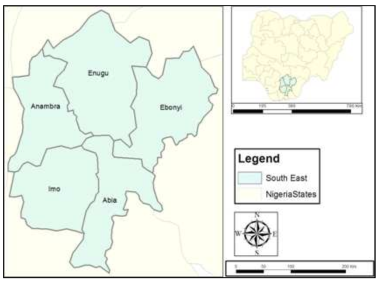
17th December 2000 ETM+ image of part of Southeast Nigeria

Revised Universal Soil Loss Equation

- A = R * K * LS * C * P
  - **A** = the predicted average annual soil loss (tons per hectare per year)
  - **R** = Rainfall-Runoff Erosivity Factor
  - **K** = Soil Erodibility Factor
  - **LS** = Slope Length and Steepness Factor
  - **C** = Cover-Management Factor
  - **P** = Support Practices Factor
- 3 study periods
  - 1986-1996
  - 1996-2002
  - 2002-2011.

Data

- 15 cloud-free Landsat images (TM and ETM+)
- 3 digital elevation models (DEM)
  - ASTER Global DEM V2
  - SRTM 90m
  - GTOPO30



- Soil map of the region
- Political map of Nigeria
- Monthly mean precipitation

The erosion model

- Action of erosion stimulated with model
- R = 38.5 + 0.35 ×Pr
  - Pr = is the annual average rainfall (mm/yr)

A = R * K * LS * C * P

- Soil erodibility factor (K)
  - empirically derived index

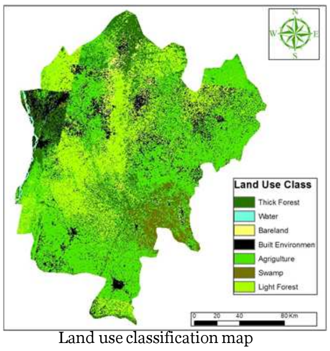
Soil Type	K factor	Soil Type	K factor
Clay Loam	0.30	Sandy Loam	0.13
Concretionary Clay	0.17	Sandy	0.02
Sandy Clay	0.20	Loamy Sand	0.04

- Slope length and slope steepness factor (LS)
  - λ = slope length in meters
  - θ = slope in degrees
  - m = a constant dependent on the value of the slope gradient (Wischmeier and Smith, 1978, Lu *et al.*, 2004)
- Aster, SRTM and GTOPO 30 DEMS used to derive the slopes

The erosion model (contd.)

- Cover and management factor (C)
  - indicates how crop management and land cover affect soil erodibility
  - dependent on landuse/landcover
- Supervised classification to delineate landuse
  - seven major land cover classes
  - Classes used to assign C values
- Support practice factor (P)
  - level of erosion control practices such as contour planting, terracing and strip cropping

Code	Land Use	C
1	Water	0.000
2	Barren	0.500
3	Developed	0.003
4	Light Vegetation	0.05
5	Agriculture	0.3
6	Thick Forest	0.004
7	Swamp/Muddy	0.002



Land use classification map

P factor values

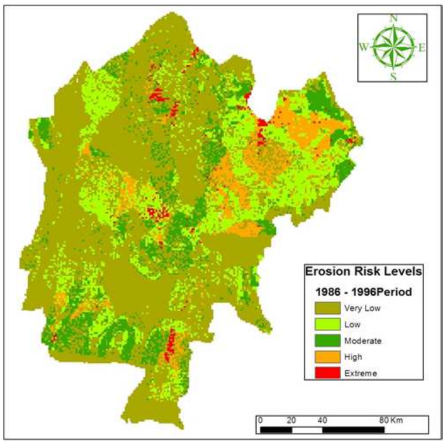
Slope	Contouring	Stripping	Terracing
0.0 -7.00	0.55	0.27	0.10
7.00 – 11.3	0.60	0.30	0.12
11.3 – 17.6	0.80	0.40	0.16
17.6 – 26.8	0.90	0.45	0.18
26.8 >	1.00	0.50	0.20

Mapping hotspots

- Average soil loss in tons per acre per year (A) estimated for each of the study period via RUSLE
- Resultant soil loss map reclassified
- 5 erosion risk level areas delineated
  - extreme
  - high
  - moderate
  - low
  - very low
- Extreme and high risk levels noted as hotspots

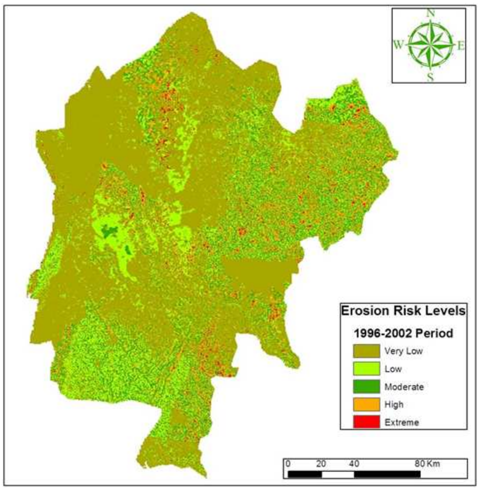
Erosion hotspots

- 1986-1996
- Hotspots denoted in red and orange



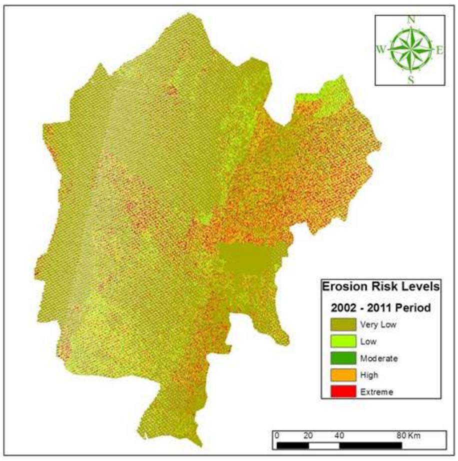
Erosion hotspots (Contd.)

- 1996-2000
- Hotspots denoted in red and orange

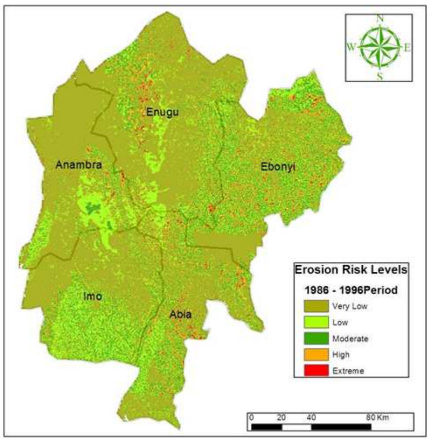


Erosion hotspots (Contd.)

- 2000-2011
- Hotspots denoted in red and orange
- Gaps due to Scan Line Correction error



Discussion



Research demonstrates that existing erosion control measures are not adequate to contain impacts of erosion

- Hotspots concentrated in most parts of Ebonyi State, Enugu State, Anambra State and Abia State
- Imo State was the least devastated by erosion
- Noticeable increasing erosion risk levels from earlier periods till present
- Ebonyi State will be severely be impacted by erosion in the next 10 years.
  - The consequences of this on food security in the region dire
- Fieldwork underway to validate result obtained

Conclusion

- Long-time assessment of areas of erosion vulnerability in the south east of Nigeria
- Mapped spatial distribution of erosion hotspots in the region over a 26 year period (1986-2011 inclusive)
  - providing a great insight of erosion impact trends in the region.
- Research clearly demonstrated the seriousness of erosion menace in the region.
- Ebonyi identified as the most impacted
- Increasing rate of erosion identified calls for urgent attention from the relevant government agencies
- Efforts to validate results ongoing
- Results expected to be relevant guide to environmental and water resources managers involved in the mitigation of the impact of erosion for urgent intervention

References

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Thank you

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