

ABSTRACT

Remote sensing techniques based on multispectral satellite-acquired data have demonstrated an unequalled potential to detect, quantify, monitor and map land degradation. However, remote sensing data alone do not provide information on how land degradation affects the socio-political aspects and the economics of the population living in the affected regions. The study developed the Continuous Cycle of Land Degradation (CCoLD) to quantify the severeness of the land degradation in the UER and combined that with remote sensing based on Normalized Difference Vegetation Index (NDVI), ground data, and food production data. In addition a field study was conducted in the UER of Ghana, a dry sub-humid transitional region which plays an important role in terms of food production in Ghana and compared the results with multi-temporal remote sensing imagery. In addition to the general ground measurements, the field studies included a questionnaire, asking local residents to assess the impact of land degradation on the quality of lives.

The remote sensing data shows widespread localized degradation. The field study, supported by crop production data, also suggests overall extensive land degradation. However, field evidence suggests that improvements have occurred where locally adapted horsetail grasses were displaced by environmentally efficient, short-lived, quick maturing and dense grasses.

Convergence of evidence suggests that land degradation is in the advanced stage and that more focused, community-based effort would be needed to combat land degradation and restore the ecosystems integrity.



DETECTING AND QUANTIFYING DESERTIFICATION AND ITS IMPACT ON FOOD SECURITY: A CASE STUDY OF THE UPPER EAST REGION, GHANA

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INTRODUCTION & RESEARCH QUESTIONS

The concern that the Upper East Region (UER) is rapidly experiencing desertification has been officially expressed for decades. According to Benneh (1996), severe land degradation was observed in the northern savanna region of Ghana, including the UER in the 1940s, which led to the early introduction of land planning and soil erosion measures in those regions focusing on the agricultural use of land, water, and grazing resources. Similarly, Nsiah-Gyabaah (1994 pp. 10) quoted an official statement by the Chairman of the Provisional National Defense Council (PNDC), the then ruling military government of Ghana, in 1989, that pest, drought and desertification had often devoured the hard work of African producers (Ghanaian farmers) and brought famine to large sections of the population. Currently, desertification is said to be consuming the Sahel-Sudan savannah transitional zone of the region at an alarming rate, thereby undermining livelihood supporting systems, as well as threatening food security of the area and forcing people to migrate (Nsiah-Gyabaah 1994; EPA 2005; IFPRI 2007).

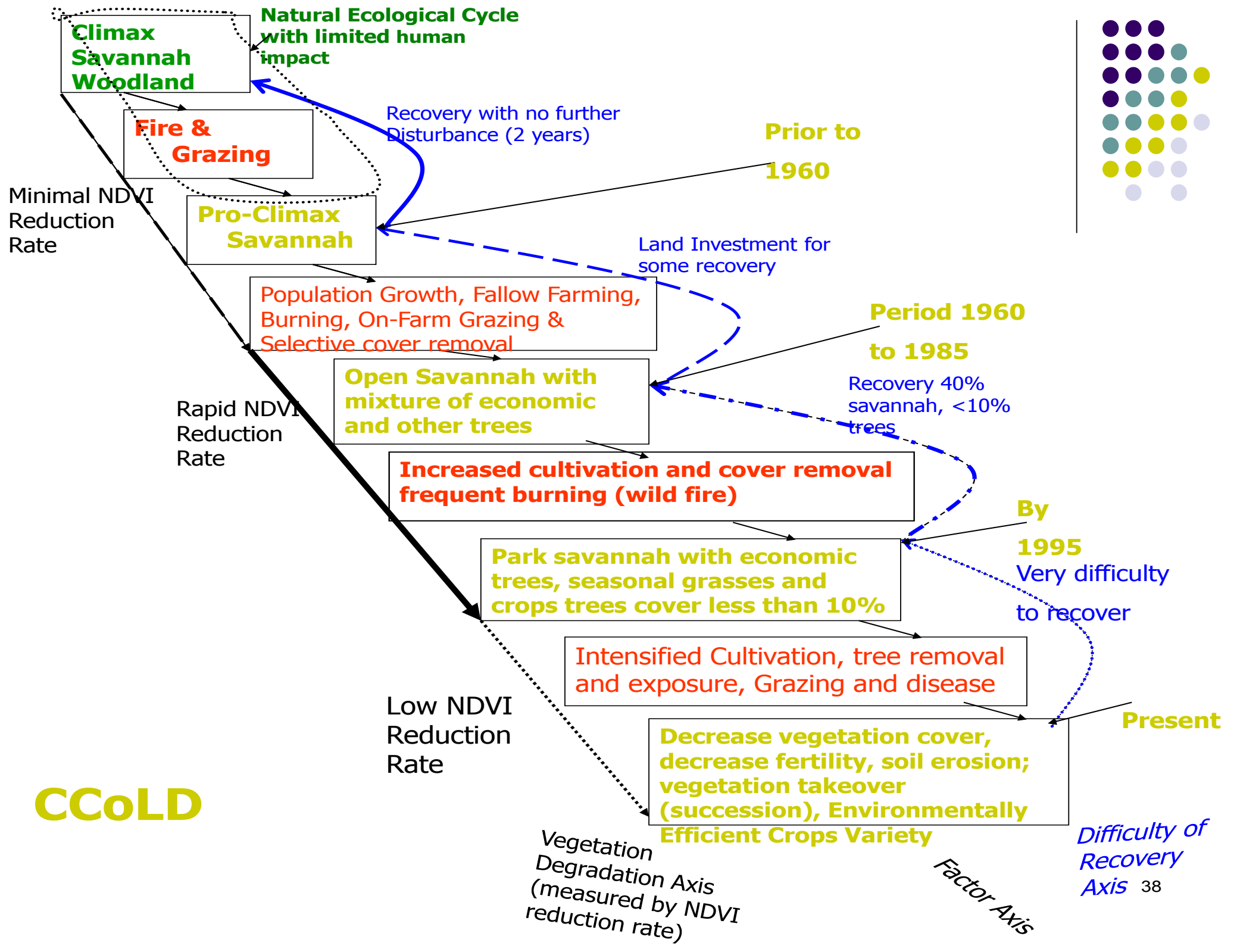
Several attempts have also been made, but with limited success and sometimes with worse results to control and combat the threat of desertification in this region. For example, Nsiah-Gyabaah (1994), has argued that the implementation of International Monetary Fund/World Bank Structural Adjustment Program (SAP) and the Economic Recovery Program (ERP), with its associated export promotion, currency devaluation and withdrawal of agricultural subsidies as one of the worst development policies that have exacerbated land degradation in Ghana. The Food and Agricultural Organization (FAO) attributes the limited success in efforts at combating desertification to the general uncertainty in the origins, extent and gravity of the desertification process. However, FAO also concluded that technologies such as remote sensing and Geographic Information Systems (GIS) hold the key to combating desertification in the future.

The questions addressed in details in this study are:

- How much land degradation has actually taken place in the UER, Ghana?
- What were the main anthropogenic drivers of land degradation in the area?
- Are there any additional evidences supporting or not supporting significant desertification in the UER?

Using a combination of remote sensing and ground data, paired with several socio-economical markers, this study responded to the urgent need for answers to these questions to provide accurate and up-to-date information about desertification, as a precursor to any attempt to plan and combat desertification in the UER and Ghana.

Continuous Cycle of Land Degradation (CCoLD)
Shows desertification in the UER is in the 4th stage of degradation showing visible signs of decreased land cover, low fertility, vegetation takeover by environmentally efficient grasses and crops (as below)



FGD with Questionnaires

Respondents	Information
Total No. Respondents (farmers)	60
Maximum Age	83
Minimum Age	25
Average Age	50.7
Ave Household Size	14.3
Average number migrated	4
Sex ratio (F:M)	1:4
Average number of farm plots	4
Average farm size	3 hectares
Livestock per household	34
Selection / qualification	Snowballing; Farmer, 25yrs or Older; 20yrs residency

Major FINDINGS

- AVHRR NDVI shows general increase in vegetation cover and health from 1982-2007
- Landsat NDVI also shows increase in general vegetation
- However Landsat NDVI indicates that there are pockets of heavily degraded lands degradation. This suggest that land degradation is a function use
- Local observers supported the observation from landsat NDVI that land degradation is a function of use, and number one culprit is the use of fire:

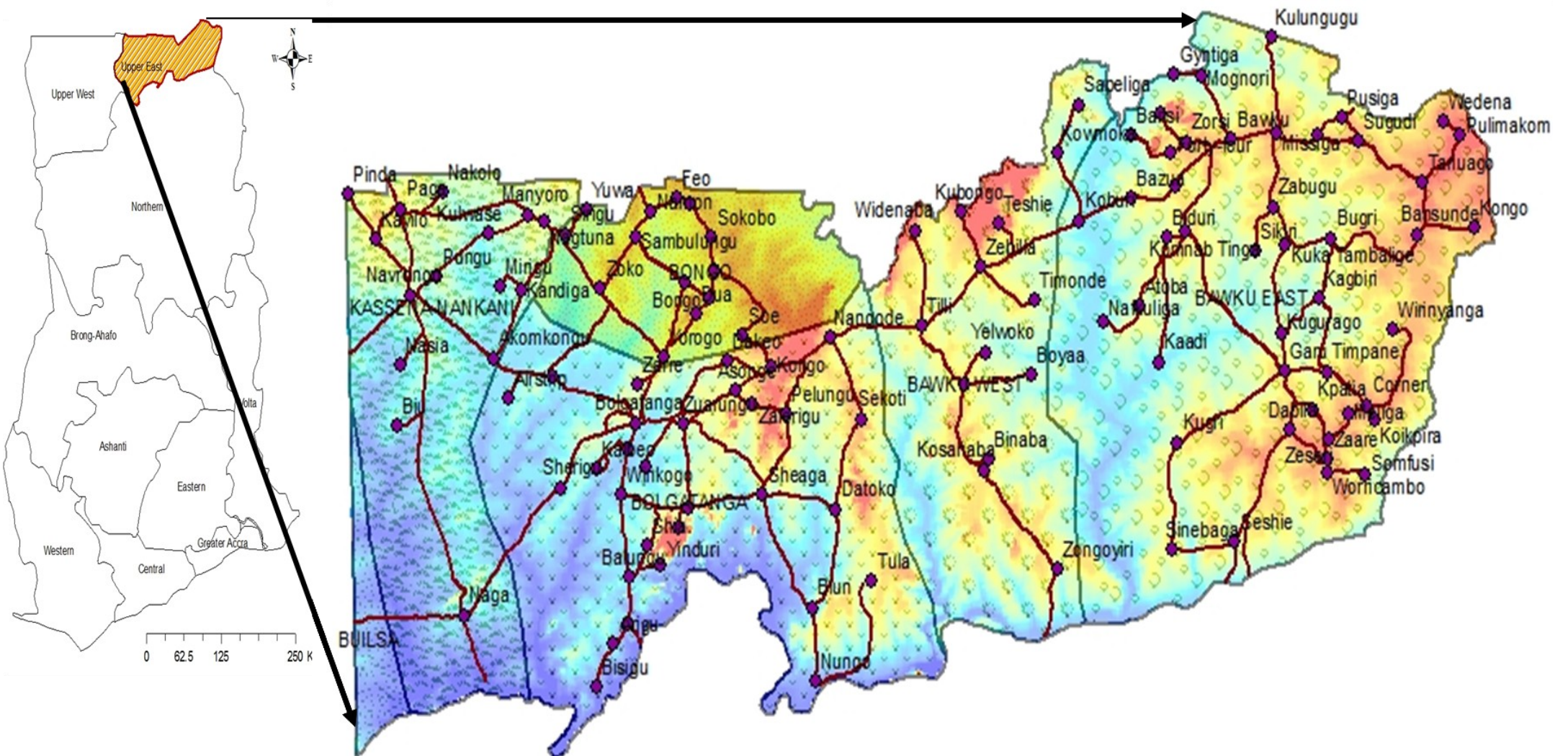
- fire for land clearing for farming
- fire for Hunting
- accidental fire from unfinished Cigarette
- fire for religious-Cultural purposes

Cutting of vegetation for thatching and firewood
Low to no investment in land improve-

Recommendations

- The compatibility of sustainable resource management with rapid population growth
- The possibility of turning around a degradational cycle towards conservation.
- Coordination and harmonization of all programmes
- Community participation (Including local Institutions like TINDANAs)

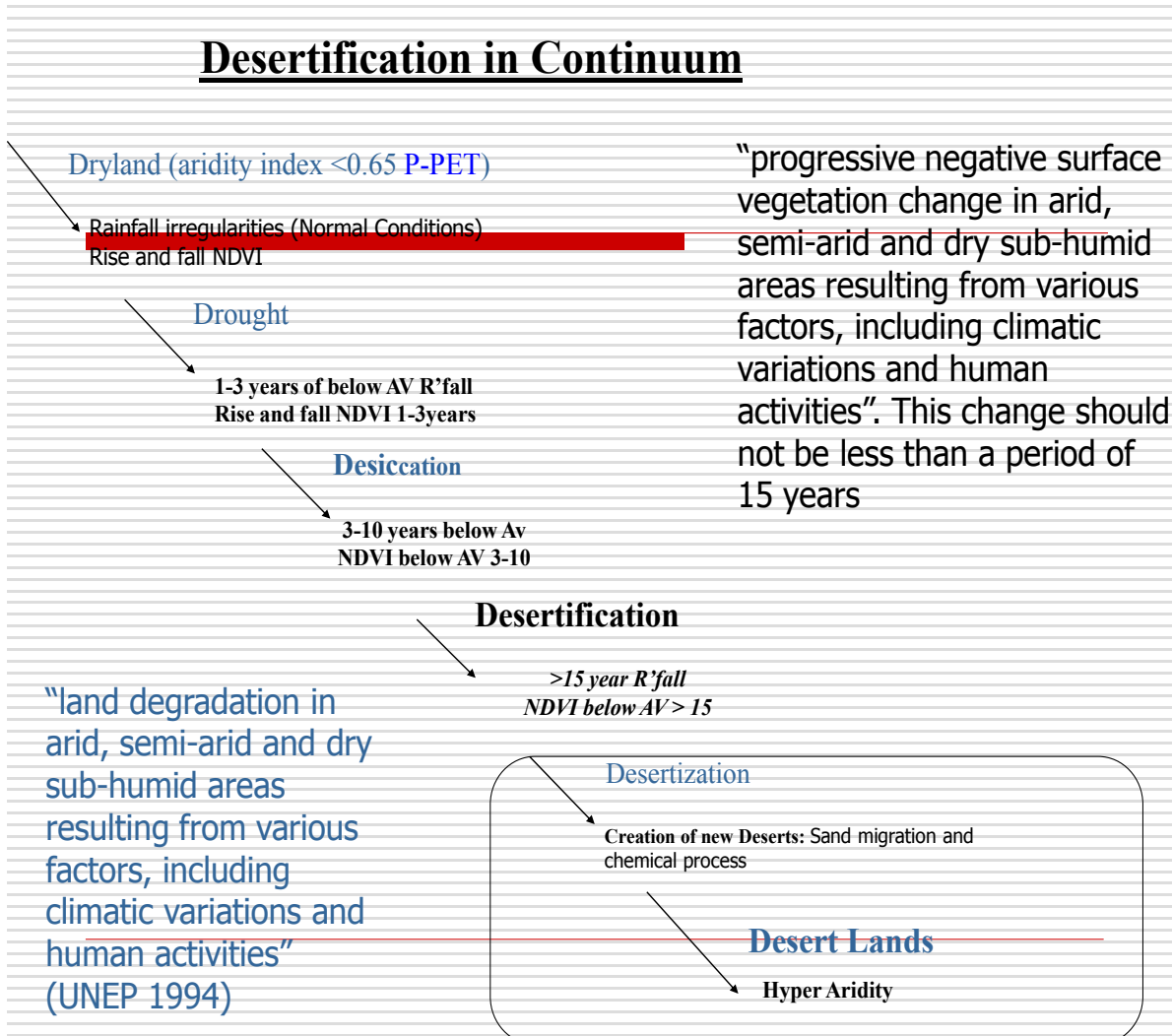
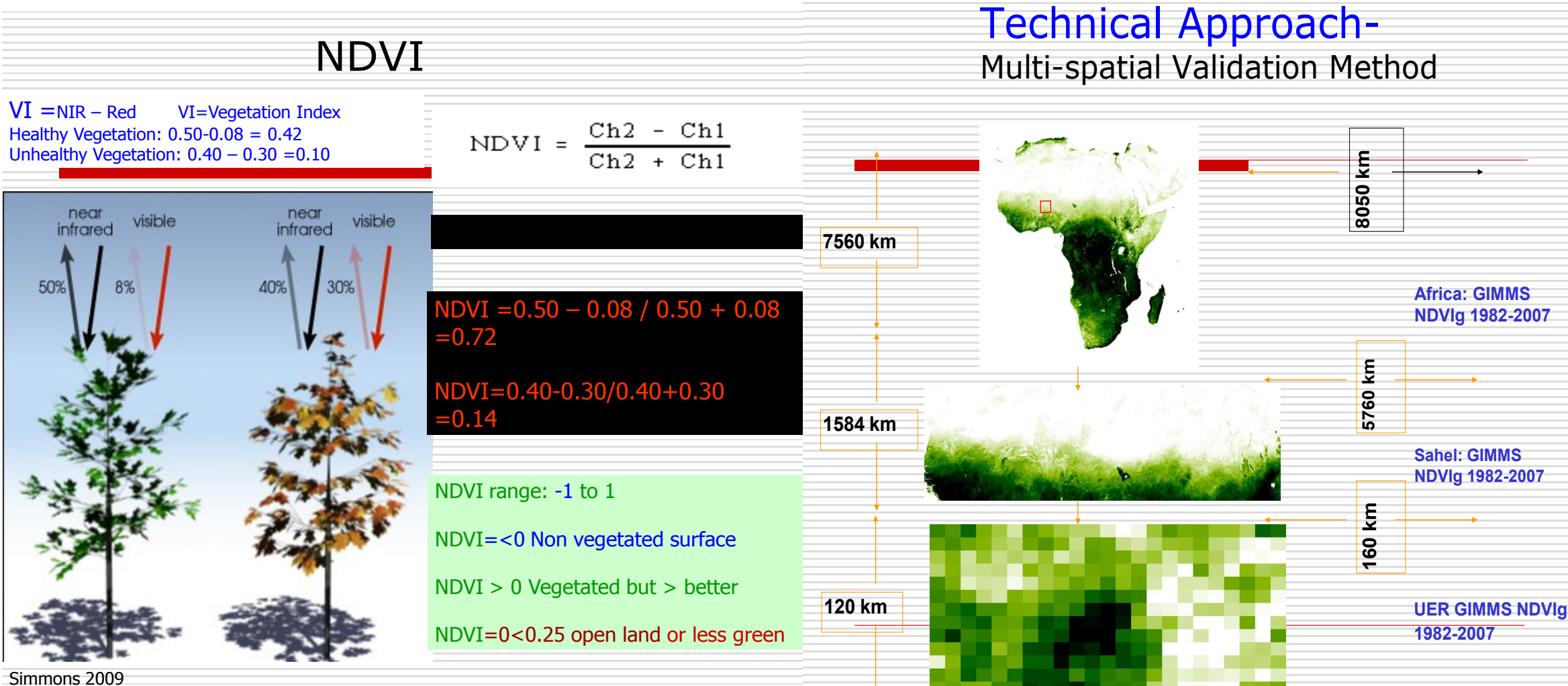
STUDY AREA (THE UER)



METHODOLOGY

Satellite Data

- Landsat TM%:
21-11-1984; 18-11-1986; 30-11-1990; 07-11-1999; 09-11-2000; 30-10-2002
- Advanced Very High Resolution Radiometer (AVHRR)
03-4-1982 - 31-12-2007
- Focused Group Discussions with Questionnaires :80 Respondent
- Crop Production Data
- Field Evidence



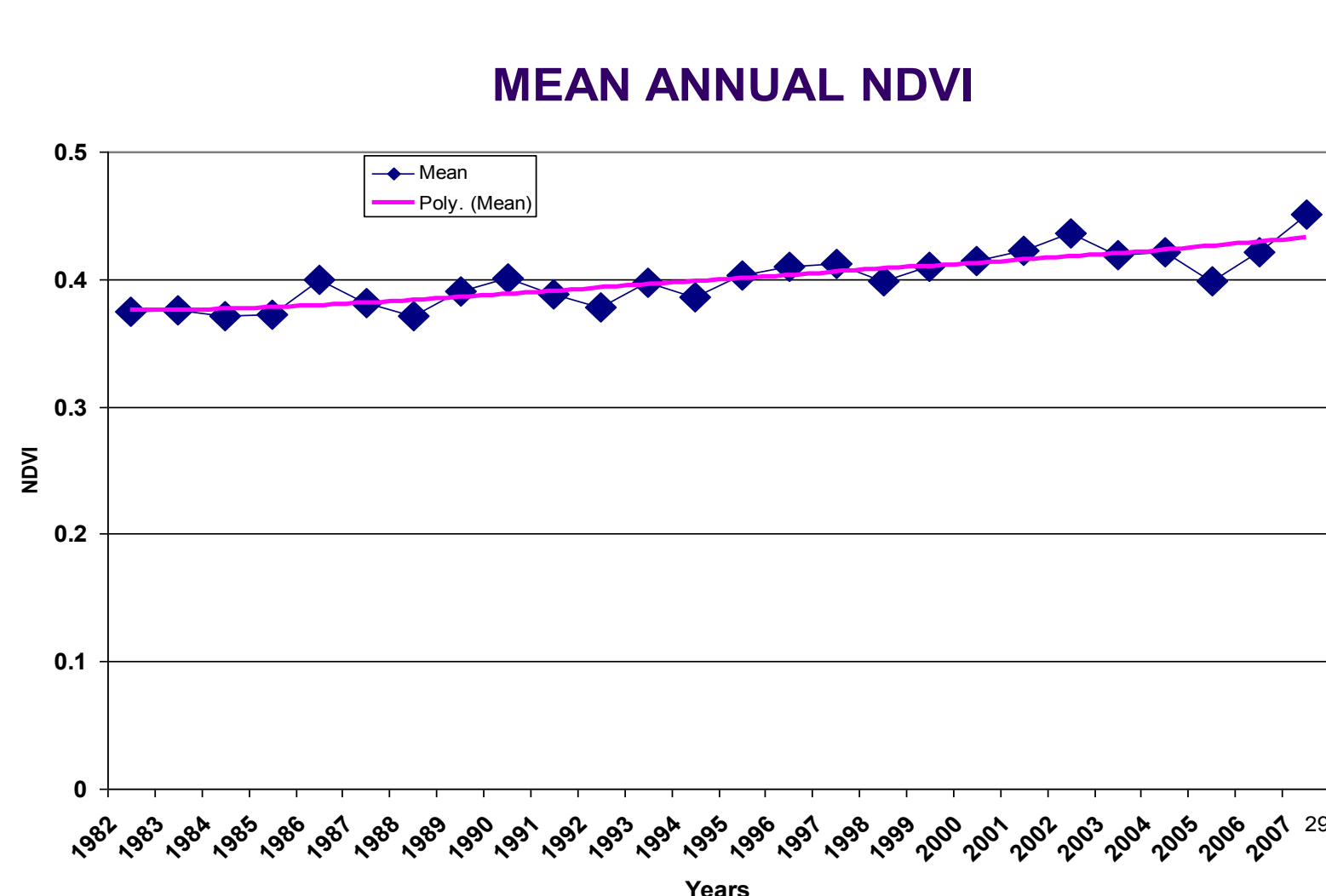
Temporal Trend

Mean Mean NDVI

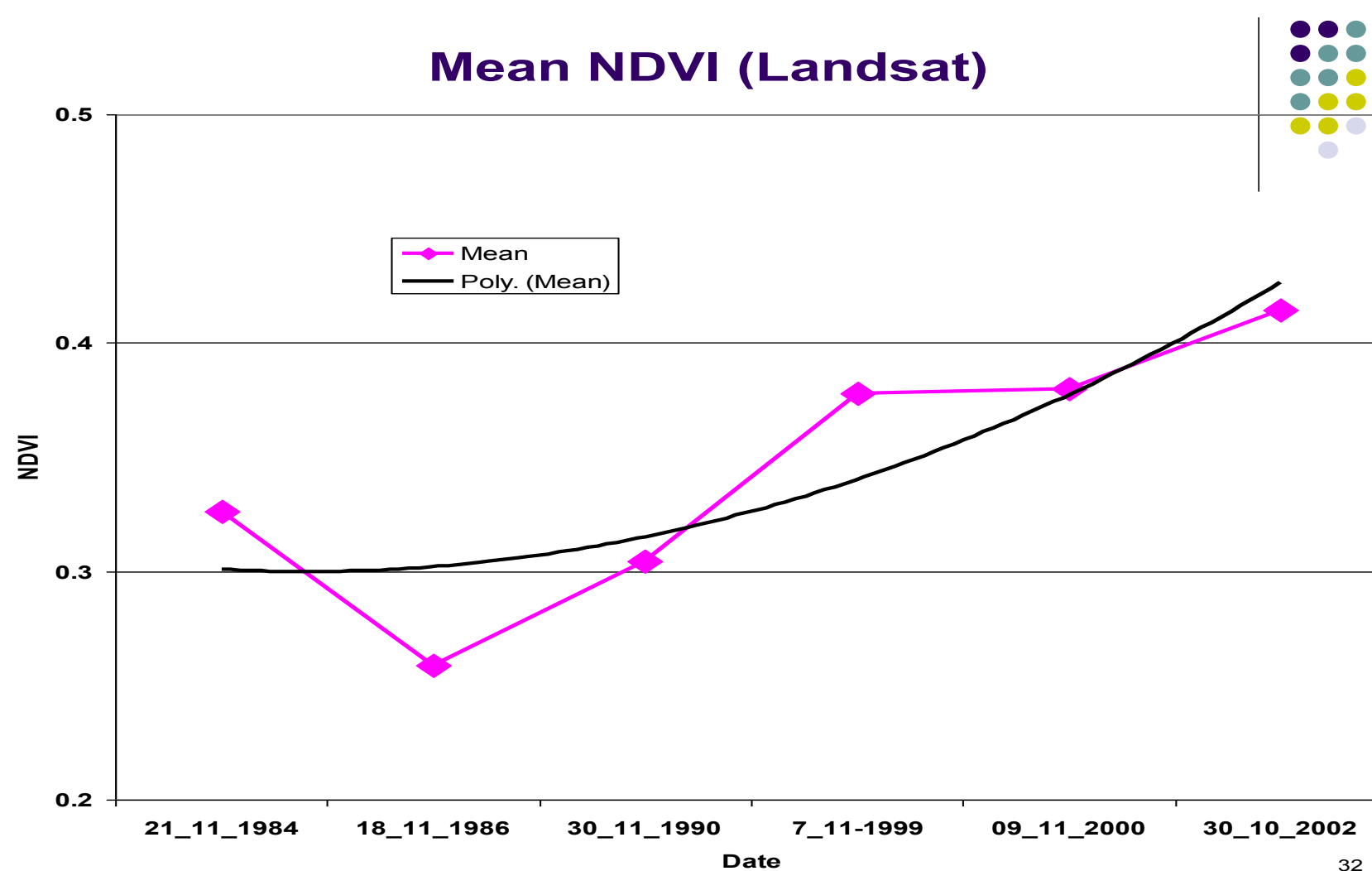
- Spatial Trend:
- NDVI Differencing
- 1982-1990
- 1990-1999
- 1999-2007

- Mask =
- NDVI= Negative
- NDVI= Positive

NDVI Analysis (AVHRR) (1982—2007)

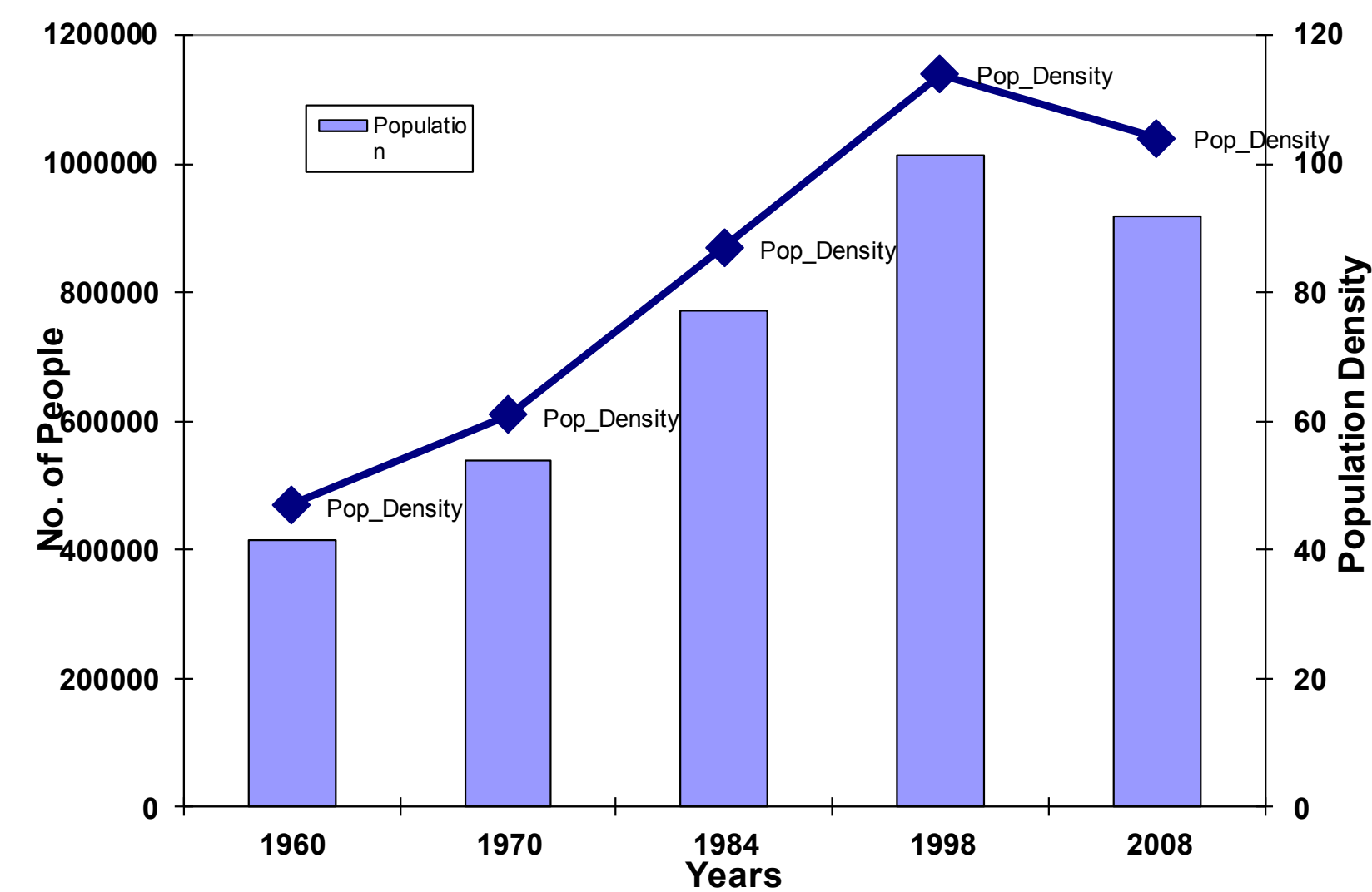


NDVI Analysis (Landsat TM5)

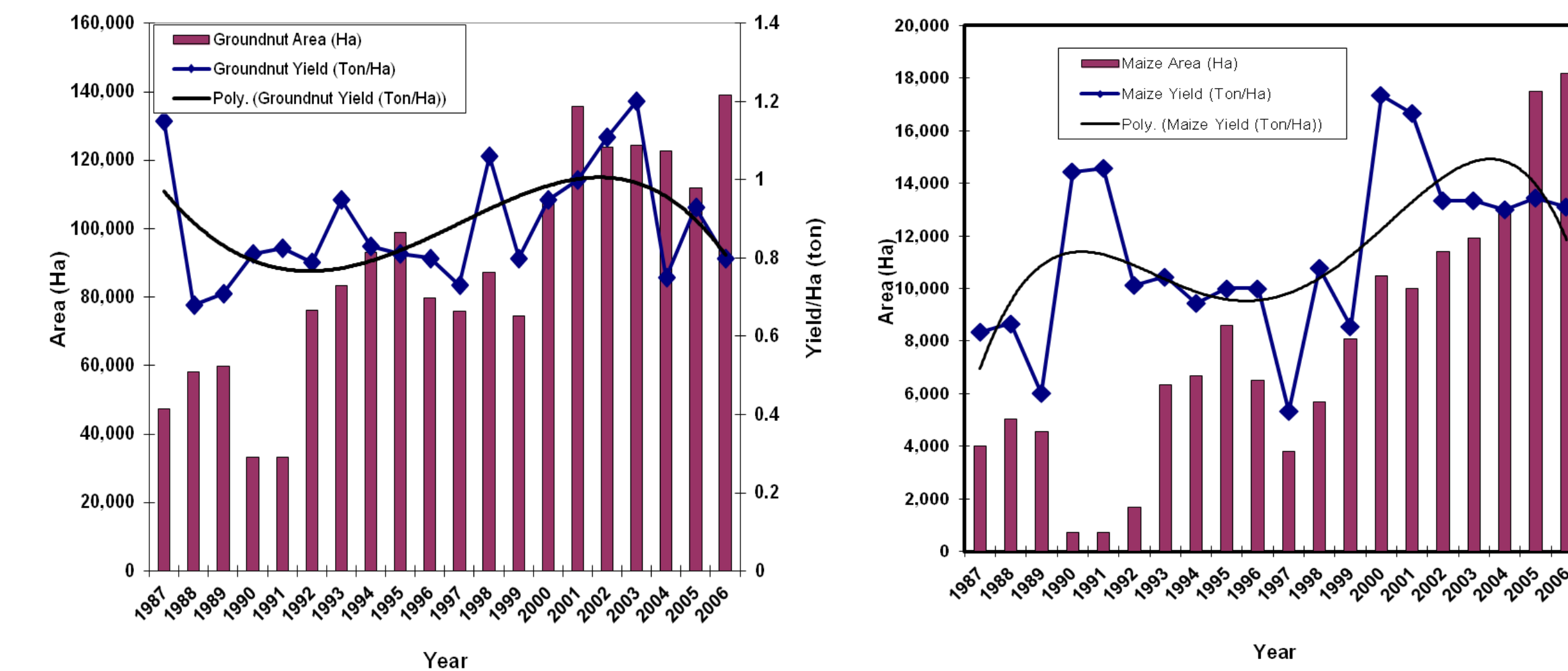


Other Evidence of Land Degradation

Evidence of Population Migration



Evidence of Reducing Yield and Land Extensification



Evidence of Ecological Succession in the UER



Conclusion

- Satellite Data –NDVI, may be a good process indicator of desertification, it does not tell the entire story.
- Combining NDVI with physio-ecological and socio-economic data is much telling

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