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Applying Remote Sensing Tools for Assessing Desertification Process within the Agrosilvopastoral System, North Kordofan- Sudan

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Introduction

Agrosilvopastoral sector contributes to one third of export earnings pertaining to cash crops in Sudan, viz. watermelon seeds (70%), roselle (65%), camels (30%), sheep (17%) and gum arabic (50%). Despite huge potential, the sector is suffering due to fragile ecosystem that makes the regions more vulnerable to land degradation and desertification risks.

Recently, climate changes, successive droughts, population pressure and chronic food shortage in the study area forced farmers to change the bush fallow rotation system, by expanding years of cropping patterns at the expense of fallow rotation. This resulted in wind erosion and loss of soil fertility, along with reduction of crop yields.

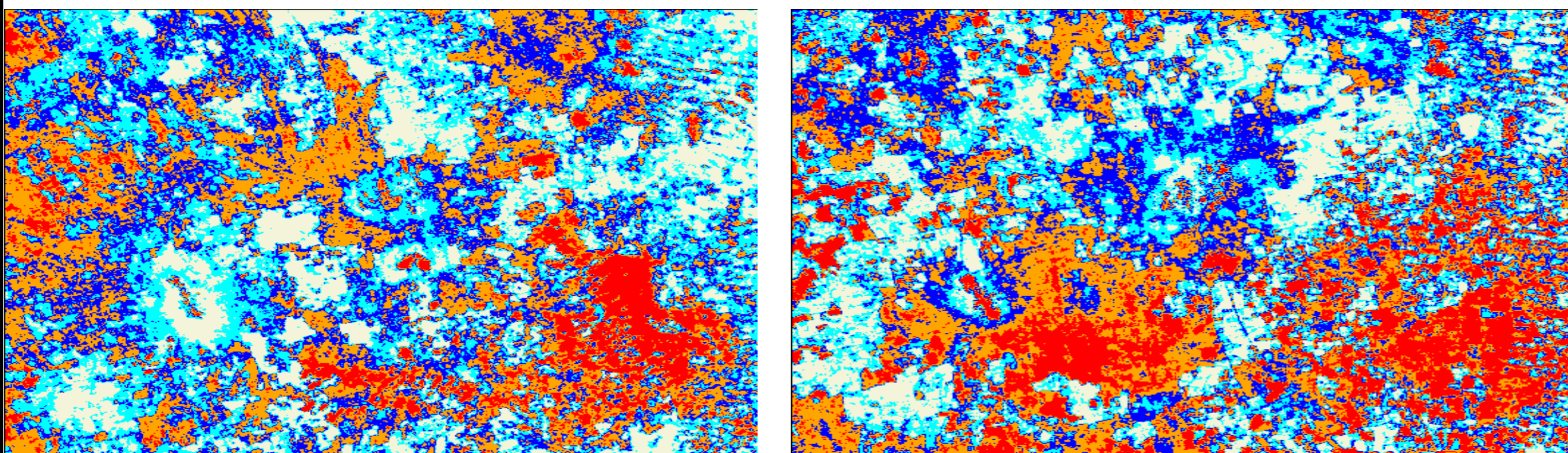
Objective

- Generally to highlight land cover/land use change within the agrosilvopastoral system in North Kordofan.
- Specifically, to screen and assess the impacts of desertification process within the system by applying remote sensing and GIS tools in relation to socioeconomic and human factors.



Acacia senegal, millet and sorghum crops in the western part of Bara locality (2005)

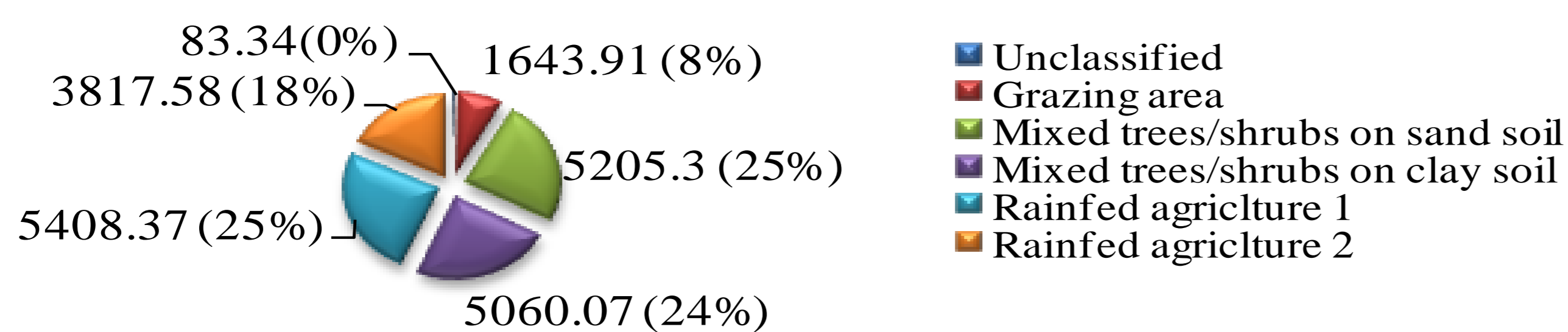
Results & Discussion



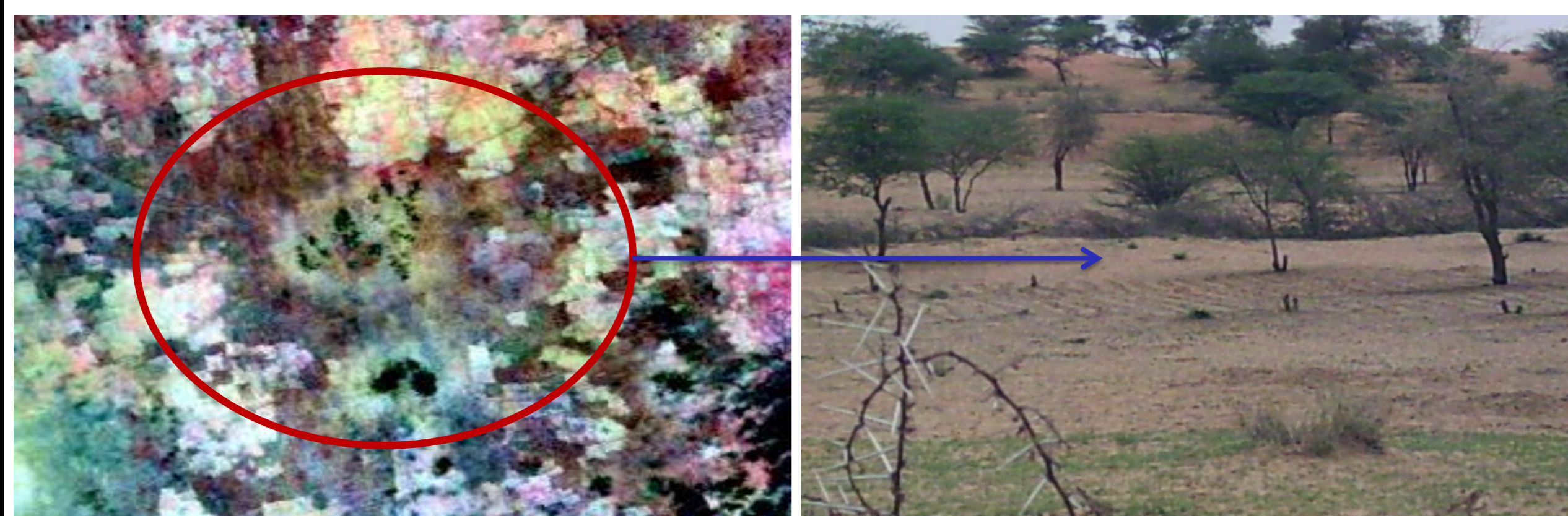
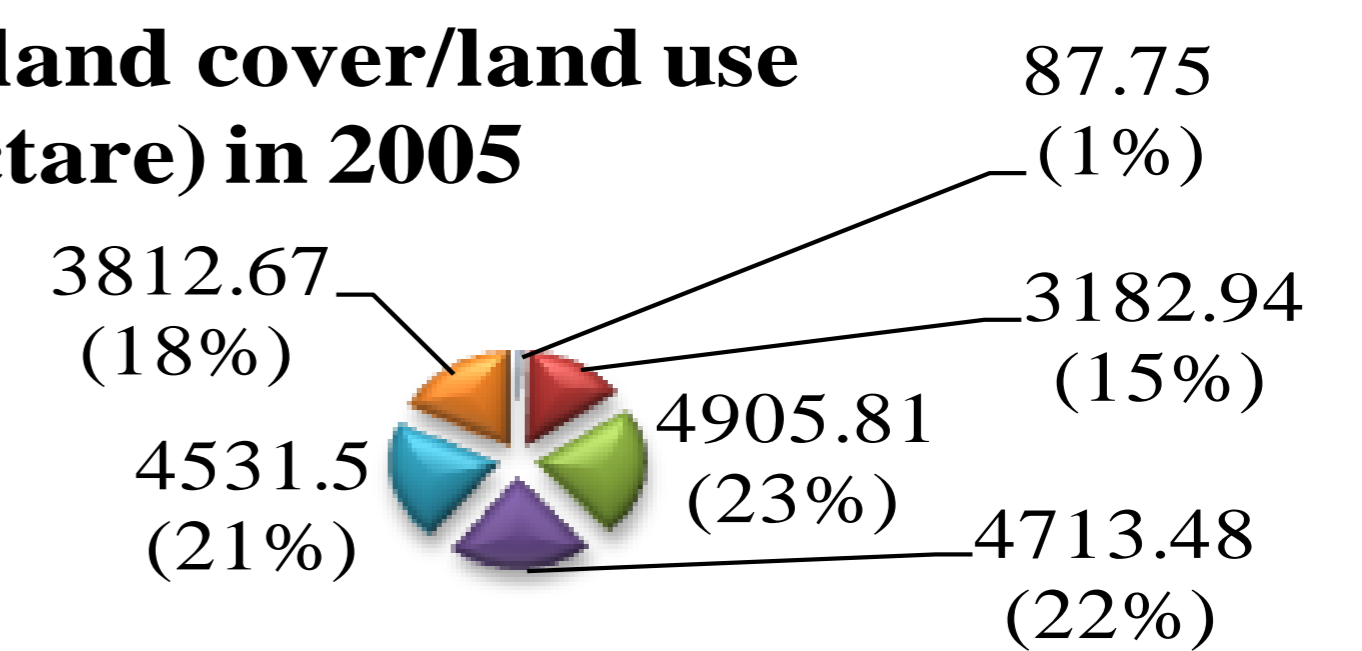
(a) Classified map1987

(a) Classified map2005

Classes of land cover/land use (hectare) in 1987



Classes of land cover/land use (hectare) in 2005



Rain-fed agricultural areas around western Bara

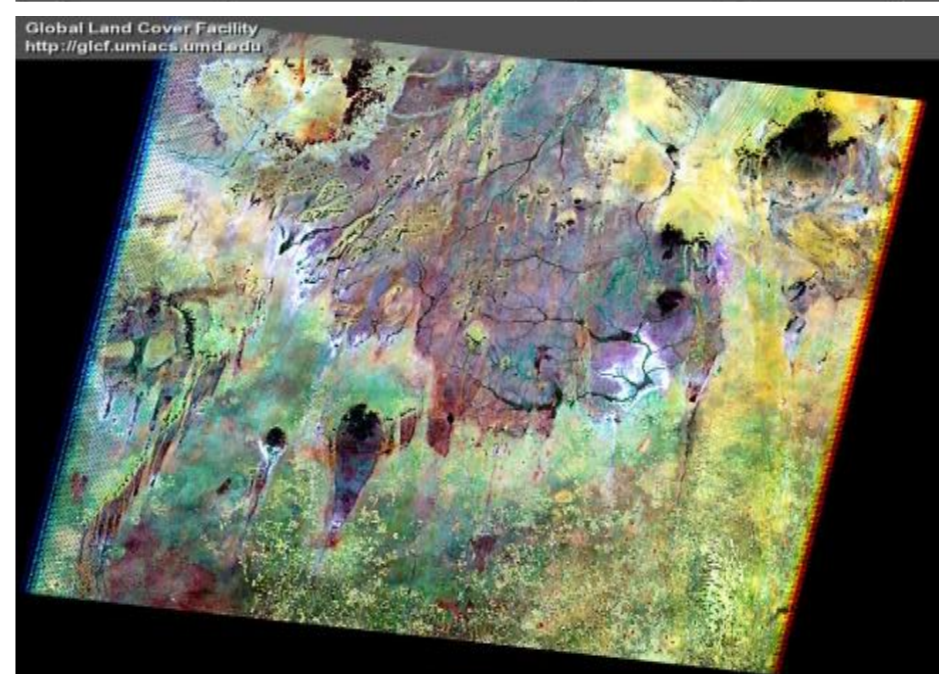


Desertification due to intensive grazing in study area

Conclusions & Outlooks

The paper gave strong arguments that link the process of desertification in North Kordofan to the land cover /land use change within the agrosilvopastoral system. Application of remote sensing and GIS for screening and assessing desertification needs powerful networking with different institutions and organizations and capacity building and sharing of information.

Study area



Landsat ETM 2005

Methodology

Remote Sensing Data:

- Selection of the satellite imagery:**
- Two cloud free Landsat TM and ETM scenes
 - Acquired in Oct. 1987 & Nov. 2005
 - Both 7 and 9 spectral bands (μm)
 - Ground resolution (30 x 30 m)
 - 7 TM spectral bands: Blue (0.45-0.52), Green (0.52-0.60), Red (0.63-0.69), near IR (0.76-0.90), mid IR (1.55-1.75), mid IR2 (2.08-2.35) and Thermal (10.4-12.5).

Socioeconomic and human factors

Environmental data

Analyzing remote sensing images:

- Digital image processing (sampling/quantizing numeric representation of scenes)
- NDVI (Normalized Difference Vegetation Index)
- Image classification: to categorize all pixels in an image into land cover/land use classes or themes.
- Unsupervised classification with combination of three bands (5, 4 and 3) was used.

Evaluation of image classes

Land cover/land use change

Unclassified	Grazing lands	Trees/shrubs on sand soil
Rain fed agriculture	Rain fed agriculture2 (scattered)	Trees/shrubs on clay soil

- ✓ Significant increase (88%) in areas of grazing lands at expense of crop lands and forests due to:
 - Increase of annual growth rates of sheep (7.6%), goats (10.1%) and camels (1.8%). Average growth rate of livestock population over the whole period (1987-2005) = 108% bigger than increase in areas of pastures (88%).
 - Overgrazing affects soil fertility/ leads to poor productivity of crops. average productivity of millet, sorghum and watermelon seeds for 2006/07 = 0.087 ton/hectare (60% less than 1980).
- ✓ Declining areas of Mixed trees and shrubs on sand (-8.3%) and clay soil (-8%) because of:
 - Removal of shrubs and trees from the agricultural lands.
 - Burning of shrubs and Acacia trees for wood and shifting cultivation.
 - destroying of soil cover, and leaving it bare (vulnerable to soil erosion and desertification)
- ✓ Decreasing (-12.5) of total cultivated rain-fed area (millet, sorghum, sesame and watermelon)
- ✓ Elimination/ declining of fallow rotation period.
- ❖ **Change in agrosilvopastoral system:**
(Change of cropping patterns, short fallow period, grazing lands increase over forest and crop lands, poor soils, wet season has contracted, rainfall zones migrated slightly southwards)