Land Cover as a Base for Food Security in Sudan

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Abstract

The current paper gives a brief account on Sudan environmental setting and its main types of food production systems.

It also highlights the main land cover types, areas and percentages in Sudan and the present utilization of the land cover database of 2003 and 2011 in land use planning, mapping, agricultural crop area measurement and crop yield estimation.

The paper shows case study of incorporating low resolution satellite data such as MODIS data for crop monitoring.

Application of the land cover for land degradation assessment, as one of the environmental factors that negatively affect food production, is also highlighted.

Introduction

- Sudan area is 1.949 million square kilometers.
- Sudan population is about 32 millions.
- Annual rainfall amount exceeds 800 mm in the South and below 100 mm in the extreme north.
- Three major types of agricultural systems are practised in Sudan:

  (1) Irrigated agriculture,

  (2) Mechanized rain-fed agriculture, and

  (3) Traditional rain-fed agriculture.

  (Both 2 & 3 are frequently affected by drought).

  The rain-fed agriculture is the dominant system.
- Sudan has one of the largest livestock population in Africa, including camels, cattle, sheep, and goats, which depends mostly on the natural rangelands.
- The rain-fed agriculture and animal breeding are the dominant systems of food production.

Fig. (1): Sudan Location Map

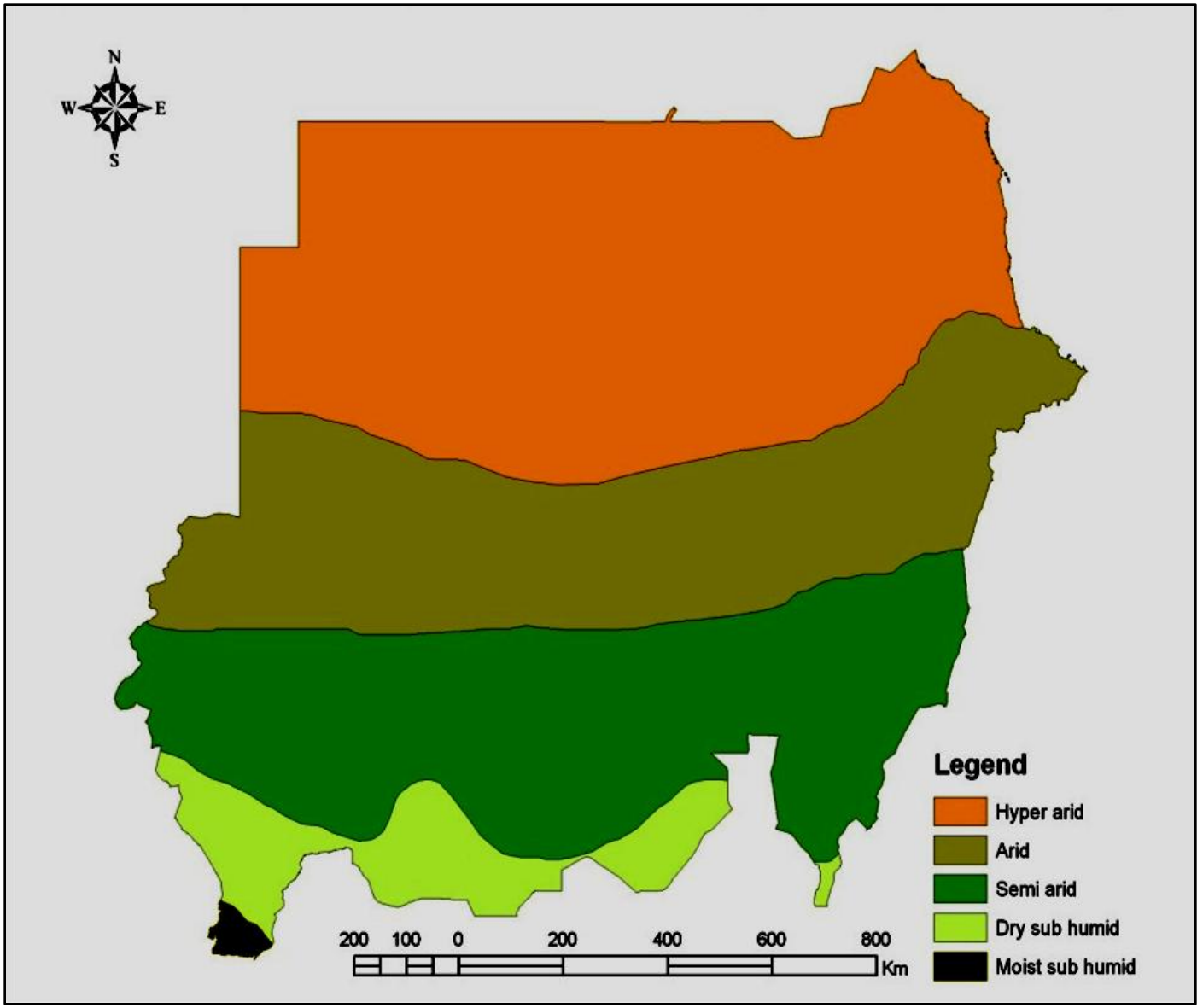

Fig. (2): Sudan Climatic Zones

Sudan environment & food security

- ✓ The status of food security in Sudan is highly affected by its environment and the related environmental problems which, in some cases, reach the stage of disaster.
- ✓ Most of the disasters experienced by the Sudan are of ecological nature such as droughts, floods, desertification, pest and locust attacks,…etc.
- ✓ Drought is one of the major environmental problems that negatively impact food security.
- ✓ Over 80% of the 32 million Sudan's population lives in rural areas, depends on agriculture and livestock.
- ✓ The total area considered as drought prone is about 69,000 sq Km and this area produces 90% of the cultivated food crops and 85% of fire wood.

Table (1): Drought Impact Situation in Sudan

Year	Drought Coverage	Consequences
1886		
1906	Affecting all Sudan	Severe famine
1913	Localized (part of Sudan)	
1940	Localized (part of Sudan)	
1967	Localized (part of Sudan)	
1973	Localized (part of Sudan)	
1984/85	Localized (part of Sudan)	Severe famine
1989/90	Localized (part of Sudan)	
1997	Localized (part of Sudan)	
2000	Localized (part of Sudan)	
2003	Localized (part of Sudan)	food shortage in some areas
	Localized (part of Sudan)	
	Localized (part of Sudan)	
2008	Localized (part of Sudan)	
2009	Affecting part of South Sudan	Localized famine
2011	Affecting most of South Sudan	food shortage in some areas

Fig. (3): drought impacts

Sudan land Cover (LC)

land cover is the easiest detectable indicator of human interventions on the land, and hence it is a critical element in natural resources management.

Remote Sensing Authority (RSA) of Sudan in collaboration with FAO SIFSIA project, and the ministry of Agriculture, produced a multipurpose Sudan land cover database 2003 and 2011.

Sudan LC production was based on medium resolution remote sensing data from Landsat, SPOT, IRS and ASTER data and field information.

The land cover information was used intensively as a base for food security status assessment in Sudan.

It is well known that the availability and accessibility of the resources could easily be assessed through land cover and land use analysis

Sudan land Cover, cont'd.

Sudan land cover database 2011, comprises 500,000 polygons, classified according to LCCS to 83 land cover single classes. The 83 original land cover classes were aggregated into 7 generalized and simple classes covering both terrestrial and aquatic/regularly flooded land. The distribution and area coverage of Sudan main land cover classes is described below and depicted by fig. (4).

The whole agricultural land in Sudan, including rainfed and irrigated crops, is 23,710,025 hectares which cover 12.5% of the total area of the country.

Bare rocks and soils and other unconsolidated materials cover half of the total area of Sudan i.e. 95,277,727 ha. (50.7%).

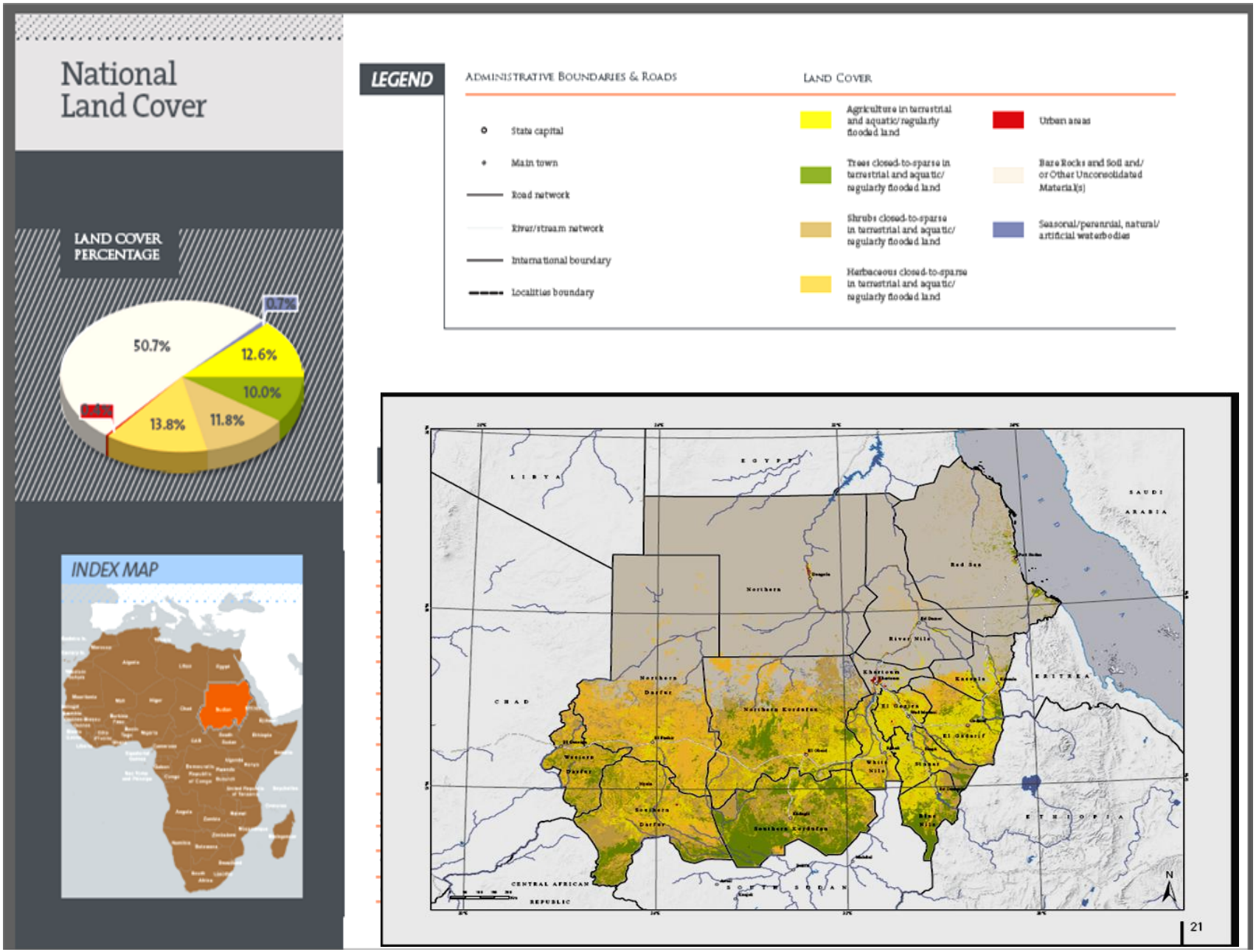

Fig. (4): National Land Cover

Land Cover Utilization in Food Security

The basic information that is related to food production, such as crop spatial area coverage and distribution is provided and made available through the land cover database.

Examples show cases of the land cover information used to assess natural resources status and to develop sound actions to achieve food security in Sudan:

1- Traditional rainfed agriculture.

2- Mechanized rainfed agric.

3-Rangeland development

4- Irrigated agric.

Kordofan State where traditional agriculture is practised in small areas in form of isolated or cultured fields (field size equals to 5 hectares). Demarcation of crop area, location and distribution of the small fields, was achieved through the land cover mapping,

Agricultural land is 4.500000 Ha (19.0%)And rangeland is 45.3% of the State area

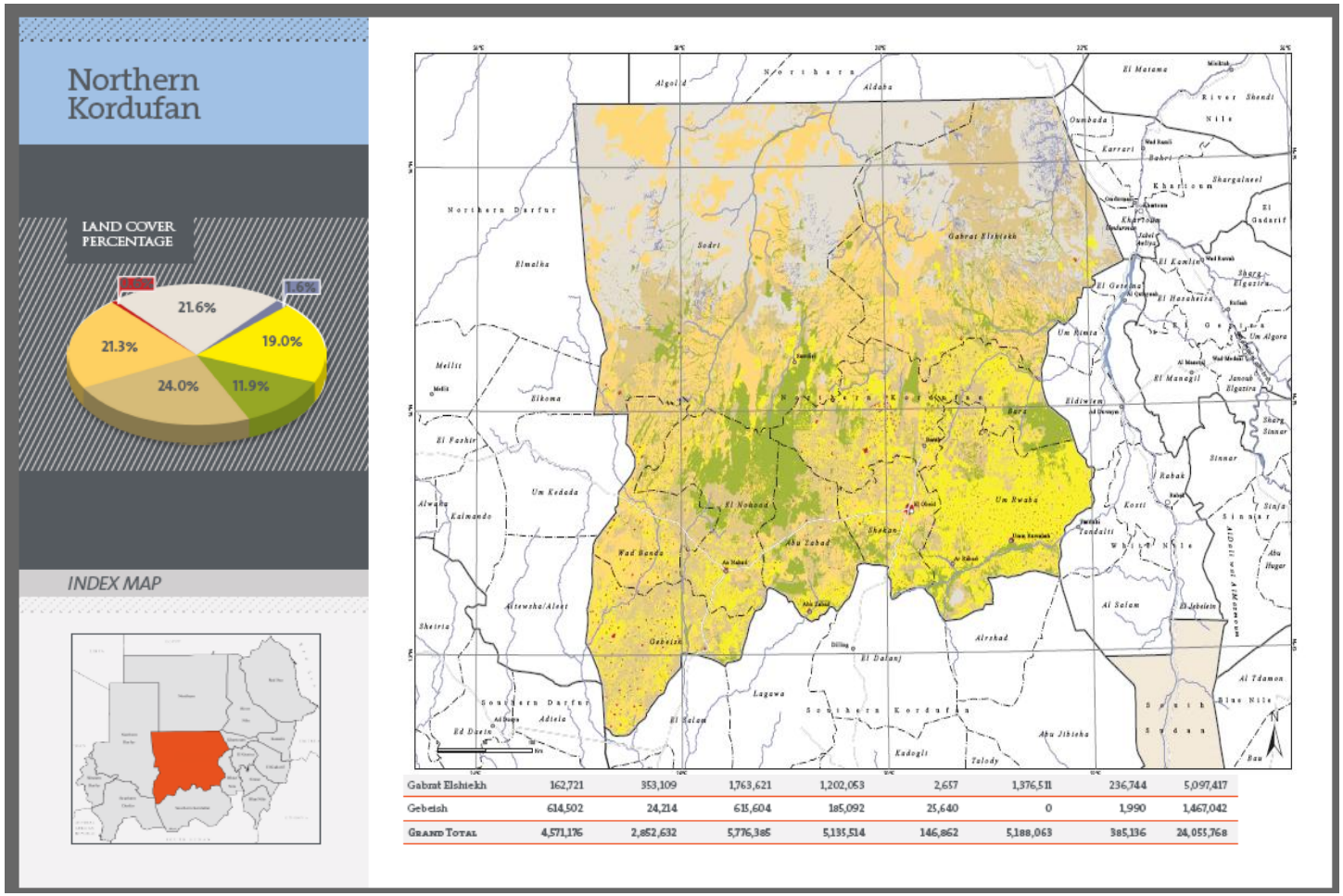

Fig. (5): North Kordufan Land Cover

Gadarif State is one of the key state in crop production under the mechanized rain fed system. Through land cover mapping a reasonable level of crop area measurement and stratification for statistical crop production estimation was easily achieved.

The total area under agriculture is 3,450,932 hectares

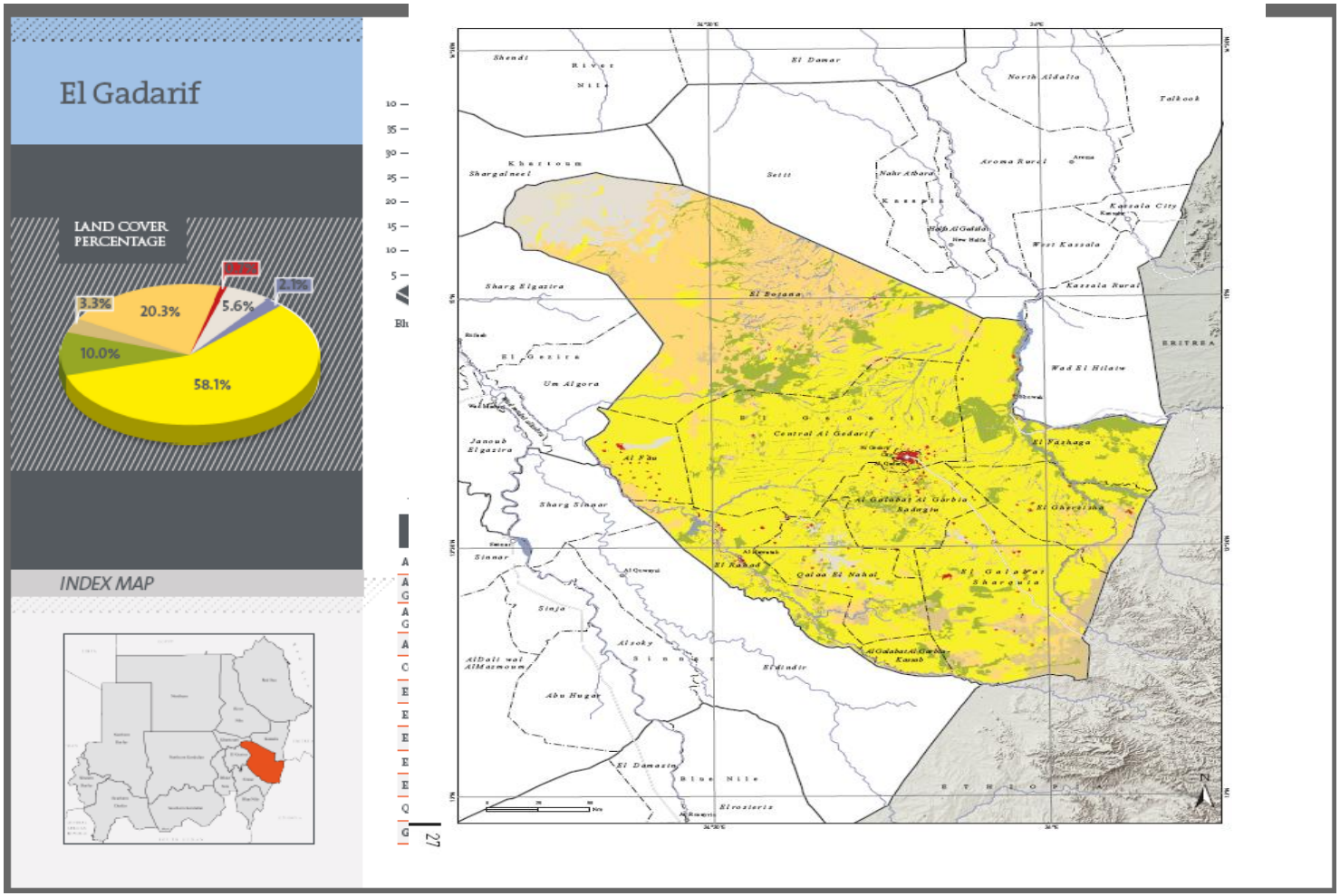

Fig. (6): El Gadarif Land Cover

The rainfall of September 2012 and its impact on crops were depicted by MODIS data. When overlaying the layer of rainfall extent on the land cover map of the same area , the affected crops (which were classified as a loss) were identified and their adverse effect on the harvest could be estimated. Sound measures and actions can be easily taken based on such information.

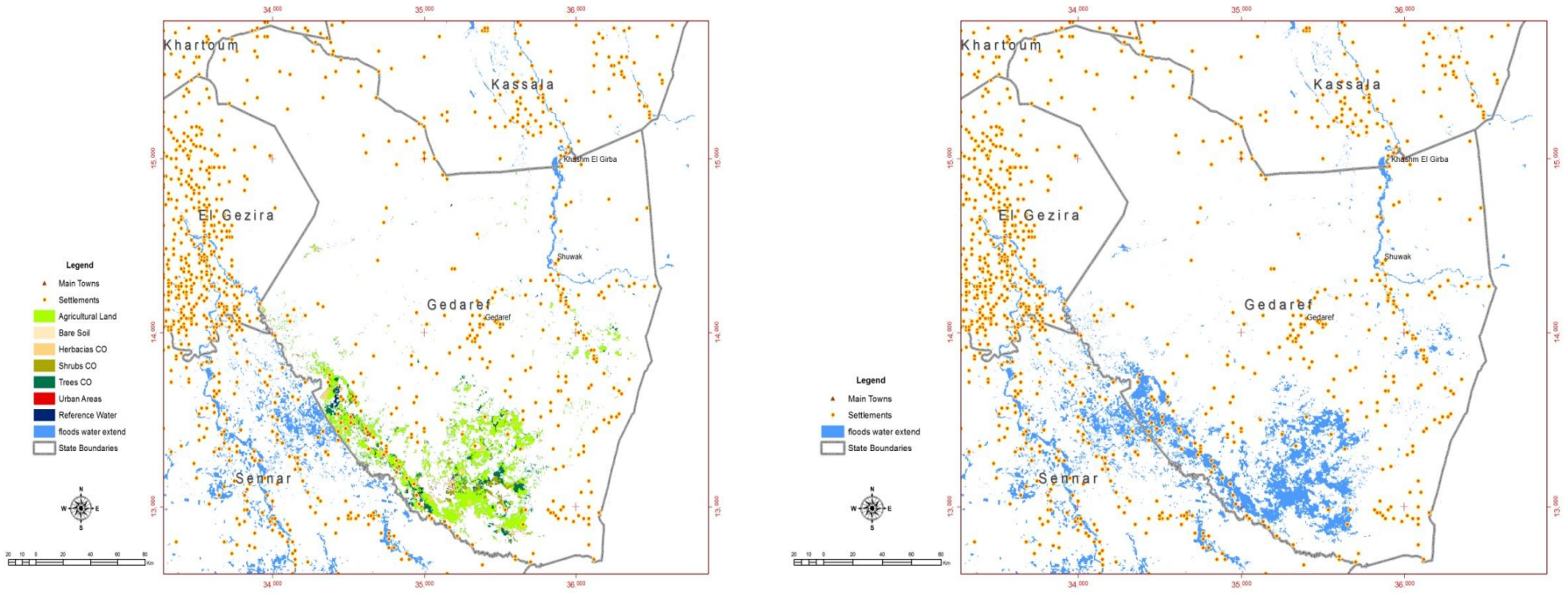

Fig. (7): El Gadarif Rainfall and Land Cover

A strategy for rangeland development 2011 was achieved based on the LC database incorporated with socio economic data. The LC database furnished the base for rangeland monitoring using various vegetation indices from low resolution data.

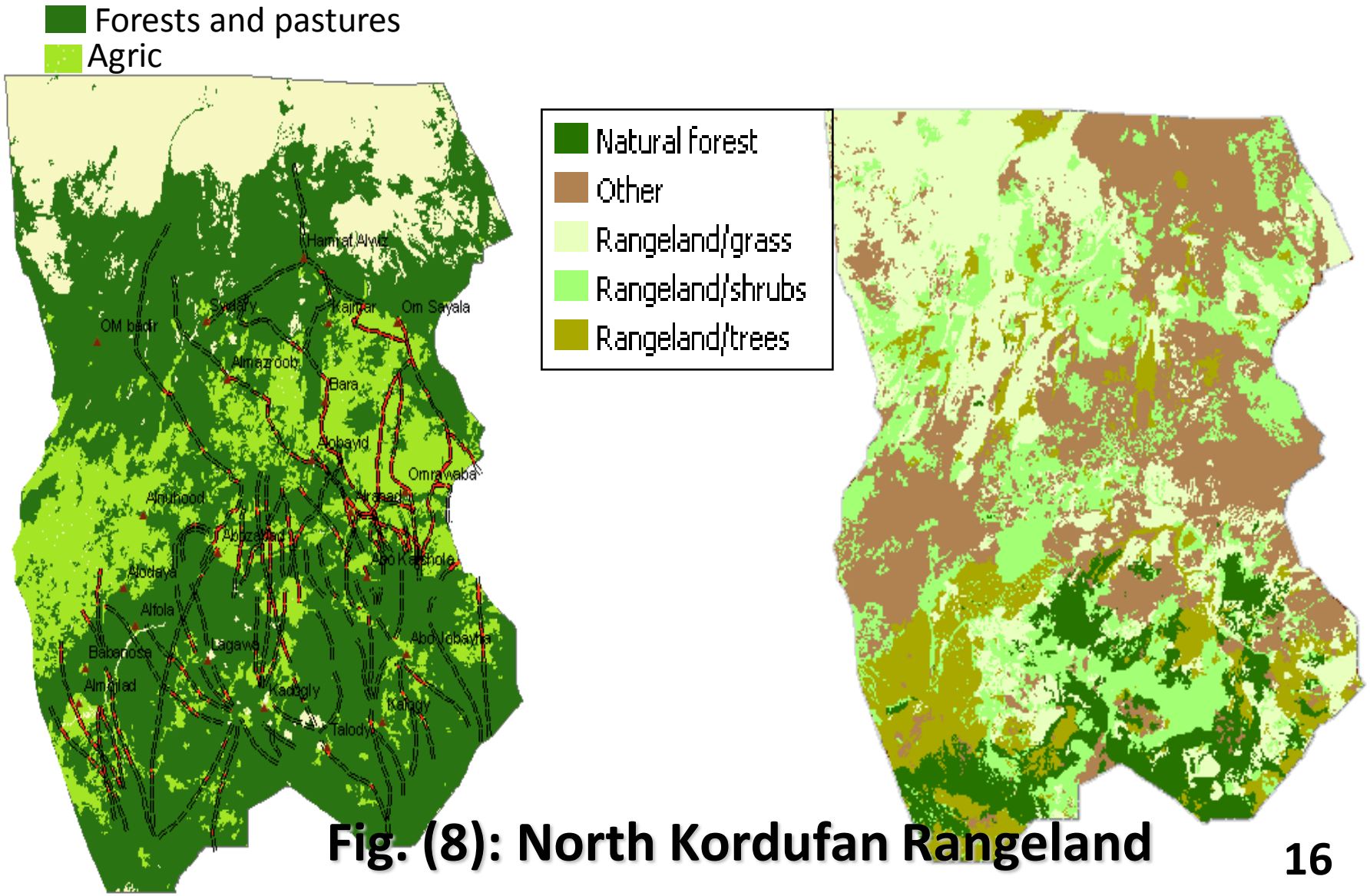

Fig. (8): North Kordufan Rangeland

For the irrigated sector; The Northern State, according to its geographic location in the northern part of Sudan, is threatened by desertification, mainly sand encroachment whereby sand covers some of the potential land and agricultural schemes. 92% of the area of the state is under the LC class "Bare rocks and soils and other unconsolidated materials“

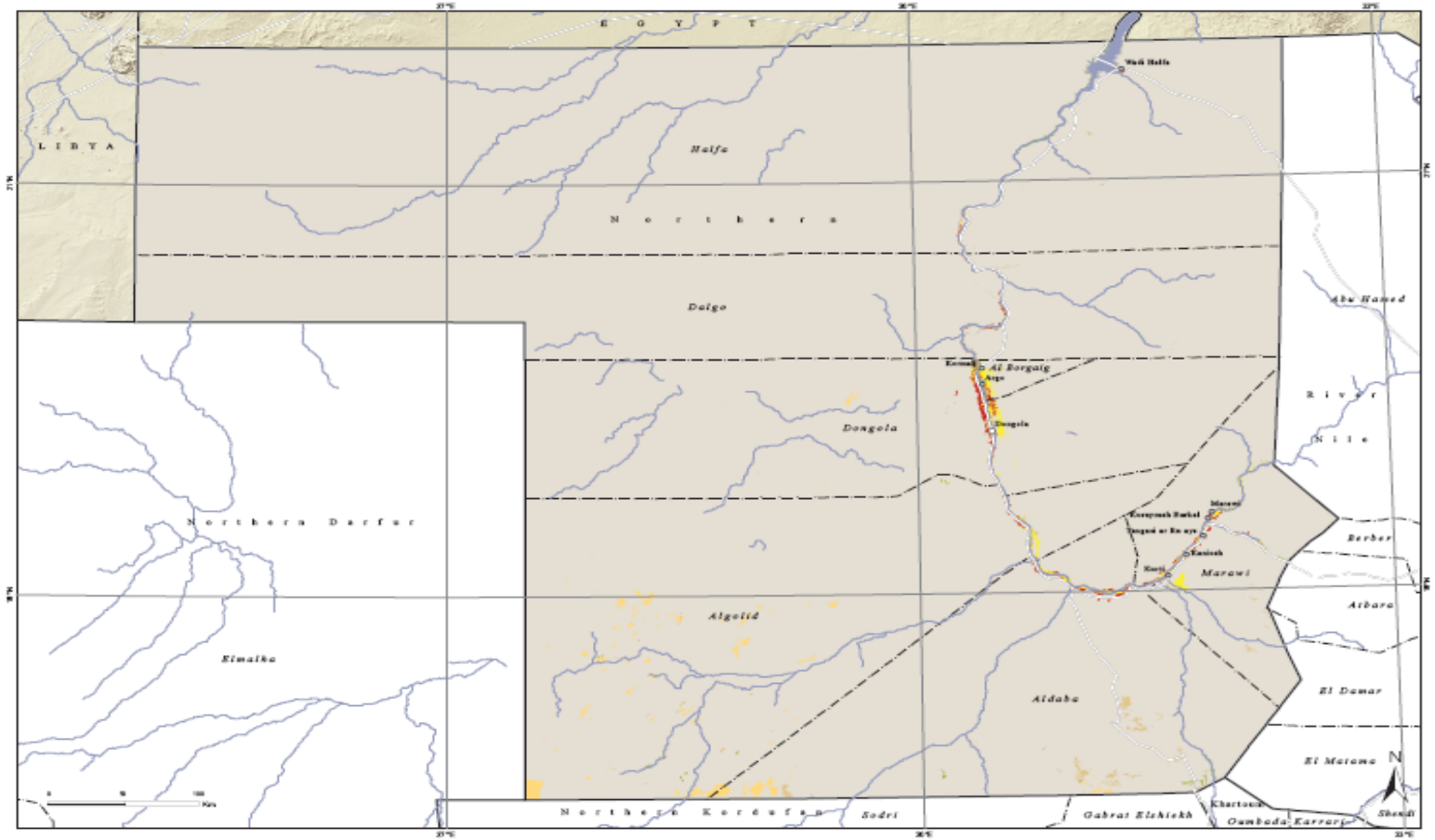

Fig. (9):Northern State land cover

A study, carried out in 2009, indicated that the range of the rate of sand dune advance was 6-23 m/year in Dongola area, Northern State.

The LC change analysis mainly in wadi Elseliem revealed that a large area (estimated at 86% of the total project's area), which was once under cultivation due to sand encroachment, is now abandoned, hence food shortage is likely to appear.

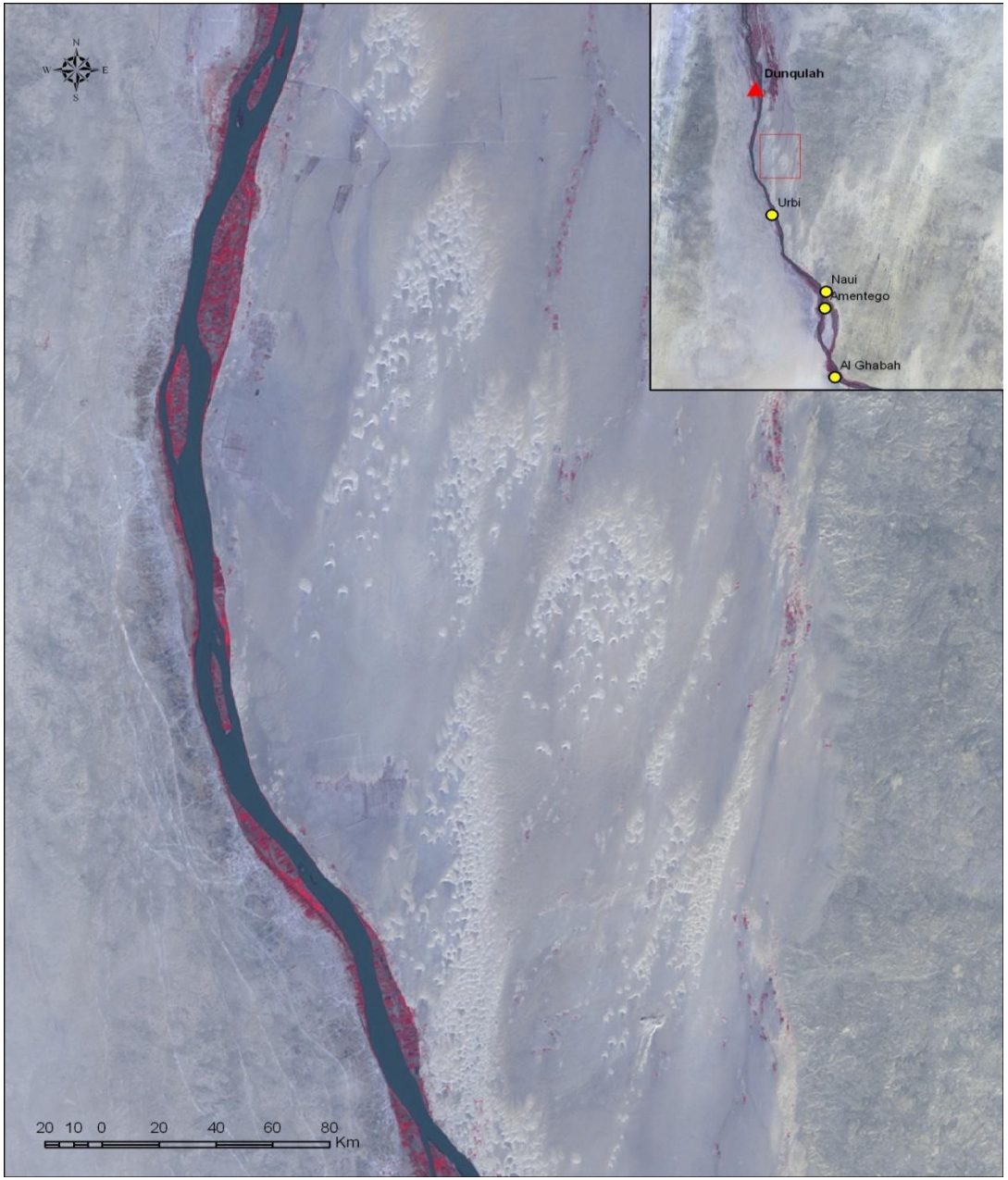

Fig. (10): Sand dunes advance in Northern State

North west part of El Gazira Scheme

2001

2005

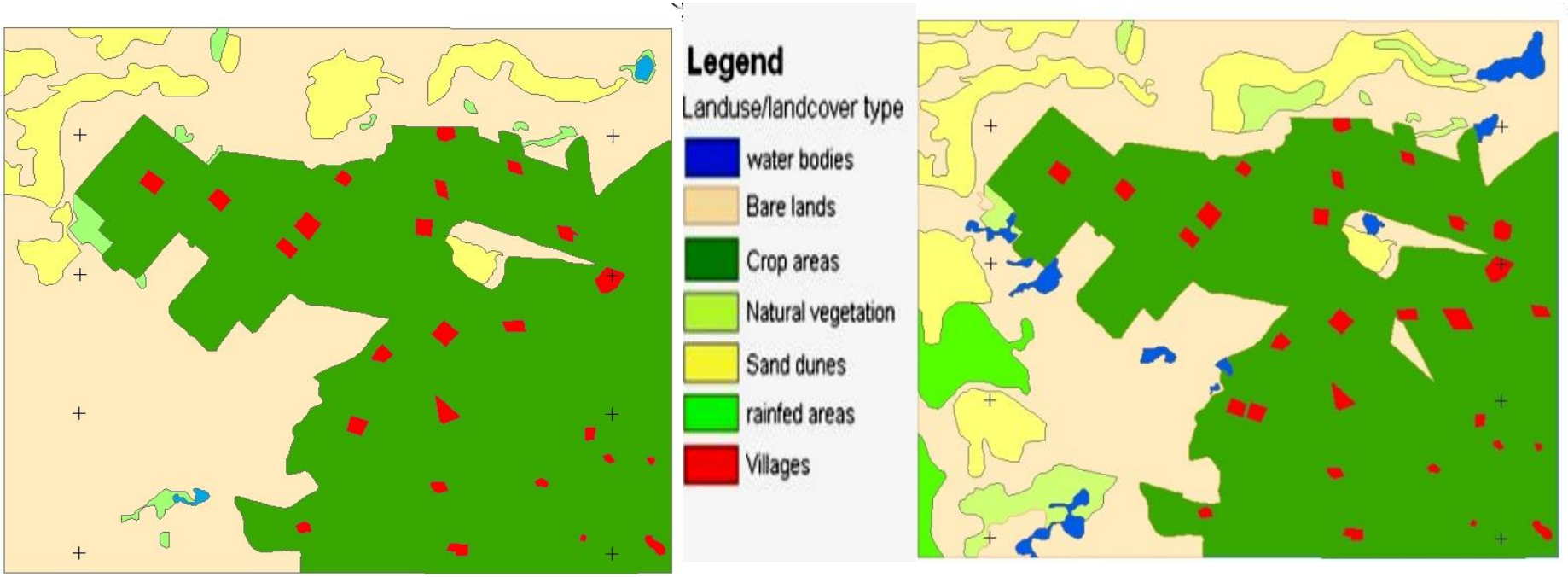

Fig. (11): Sand dunes advance in ELGazira scheme

Since 2001 sand encroachment has extremely affected this area part of El Gazira scheme. This migrating dunes has its negative impact on food security. Land cover data can be utilized for management.

Land Cover Applications

- Land use planning and development activities.
- Natural resource management,
- Damage assessment and delineation (flooding, volcanic, seismic, fire),
- Soil and land conservation, pest control, crop monitoring,
- Environmental studies (forestry, biodiversity, wildlife habitat protection).

Conclusion

1. **Rain fall variability has a negative impact on the rainfed sector and specifically in the traditional sector where the limited resources of the farmers in the traditional sector forced them to migrate when it is too dry.**
2. **Sand encroachment is an environmental factor that impacted negatively the irrigated sector which was considered to be of a stable production. Some of the productive schemes such as Elseliem faced a very serious status of desertification and a complete loss of more than 4/5 of the project area is reported. The project is affected by dunes and sand encroachment. At present the fertile soil is buried under large sand dunes. Some of the irrigated projects in central Sudan such as El Thamied faced the same problem.**

Conclusion, cont'd

3. **The availability and accessibility of the resources could easily be assessed through land cover and land use analysis. Land cover change detection provides critical information for planning and management of the resources and hence it should be part of the food security monitoring system in Sudan.**