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Analysis of Land Use of Pastoral and Agropastoral Zone of South East Niger: Case of Goudoumaria

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ABSTRACT

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Like in the arid and semiarid ecosystems, the northern limit of rainy season crops ecosystems have a dynamic influenced by harsh climatic condition. In addition to this, there is a high demand in goods and services by the over increasing population. The objective of the present study was to analyze land use in pastoral and agropastoral areas in the department of Goudoumaria, located in the South East of Niger. It is an agropastoral areas, where the practice and success of rural activities is based on physical conditions, the repartition and regularity of rainfall. Hence, many sites have been selected in the study areas and data has been collected from each site and analyzed. Results of land use mapping revealed a change in vegetal cover appearance and this lead to increase in degradation of fertile lands by remobilization of dunes previously fixed.

Introduction

Niger Republic is located in the earth of Sahel, between 11°37' and 23°33' North latitude and 16° and 0°10' East longitude. It is

characterized by all types of arid and semi-arid ecosystems and covers an area of 1 267 000 km² among which 15 million hectares can be cultivated. However, only 6.5 million hectares are under cultivation (Projet-

MEPRED-Niger, 2007). More than 80% of these potentials are composed of sandy soils which are generally fragile, poor in nutrients elements and organic matter, hence sensitive to wind and water erosion (Projet-MEPRED-Niger, 2007).

The rainfall is characterized by high variability in time and space and the succession of drought since the beginning of nineteen seventies (Ozer *et al.*, 2010).

Agricultural yields are low as soils are poor in organic matter and are exposed to wind throughout the year and the practice of irrigation is very limited (less than 2 % of cultivated areas). Livestock rearing is prominent only in years of sufficient rainfall despite the fact that these are the two activities in the country.

The area of oasis “cuvettes” is also exposed to this phenomenon by the climatic variability and anthropogenic factors. The increasing livestock and population lives by exploiting natural resource of this area. However, in the second half of the 20th century, the disappearance of forest was noticed at an alarming rate of 2% yearly (Ariori *et al.*, 2005). Therefore, desert progression constitutes a major problem in the arid and semi-arid areas. Hence desert intensification is a great problem in arid and semi-arid regions.

It appears by the deterioration of land covers of soil and water resources. And with regards to the high demographic pressure, natural resources are endangered. However, authors stated that in Niger, compared to the 1970s, land degradation has been significantly reduced, erosion has been decreased, and soil fertility has been boosted and agricultural productivity enhanced through the practice of natural regeneration on 5 millions hectares since 2005 (Larwanou *et al.*, 2006 ; Baggian *et al.*, 2013; Francis and Weston, 2015).

Thus, the objective of this study is the analysis of land use in Goudoumaria.

Materials and Methods

Study site

The study was conducted in the department of Goudoumaria located between 13°38' and 14°09' north latitude and 10°65' and 11°26' east longitude.

Land use mapping

Previous works have helped identified the model type based on whether you are approaching a “cuvette” or a village. Thus land use mapping was based on the current state by visual supervised classification based on color, forms, degree of vegetation cover validated by field surveys and information derived from climatological data, interview, etc. The different operations consisted of image processing (Table 1); the mosaicing of two scenes for each year, the extraction of the study area; the supervised classification and layout.

Results and Discussion

Land use in 1986

Analysis of the situation reveals that in 1986, trees and shrubs occupies more than half of the total area mapped in some locations, then the mosaic crop-shrubbs of interdunal corridors. This area was less populated as houses represent only 0.16% of the total area. Finally, the remaining areas were occupied by palm groves, cropping lands and dunes (Table 2, Figures 1 and 2).

Land use in 1999

For the situation of 1999 (Figure 3), there is a regression of trees and shrubs in favor of all

other units particularly bright dunes and very little covered dunes. There is also a slight increase in human occupation and cultivated area (Table 3).

Land use in 2010

The 2010 situation is represented spatially by Figure 4. This period is marked by a resumption of steppe formation that increases in area. While those of all other units had regressed, except for housing zones which are widening by 0.21% (Table 4).

Land use in 2014

Finally, the analysis of 2014 situation (Figure 5), which is considered as the current state of ecosystems gives a breakdown of units with a

small changes in the area of all units compared to the situation in 2010 (Table 5). In addition, this situation reveals a steppe regression of 12.78% in favor of dunes very little covered which will have more than double their surface area (with an increase of 112.48%); the bright dunes will increase to 33.29% and the residential areas to 38.69%. The areas occupied by palm groves or “cuvettes” will decrease by 2.92% (Figure 5).

Land use and soil utilization reflect human pressure on the ecosystems and their responses to the quality and quantity of services offered. In 1986, tree-shrub steppe and palm groves which constitute stable and covered units still occupied considerable areas. This period marks the end of the great drought of the 70s and 80s.

Table.1 Characteristics of images used

Images	date	Spatial resolution	Temporal resolution	Swath	Spatialised Parameters
Lansat 5	07/10/1986	30m	16 days	180*180	Land use
Landsat 5	19/10/1999	30m	16 days	180*180	Land use
Landsat 7	13/04/2010	30m	16 days	180*180	Land use
Landsat 8	17/10/2014	30m	16 days	180*180	Land use

Table.2 Distribution of land use units in 1986

Land use units	Area in hectare (ha)	Percentage (%)
Trees and/or shrubs by location	177858.92	67.14
Very little bright dunes covered by location	15031.76	5.67
Bright dunes	15530	5.86
Mosaic crops – trees-shrubs of interdunal corridors	34872.05	13.6
Cropping areas	15045.05	5.68
Palm groves	6182.83	2.33
Housing area	415.69	0.16
Total	264936.35 ha	100

Table.3 Distribution of land use units in 1999

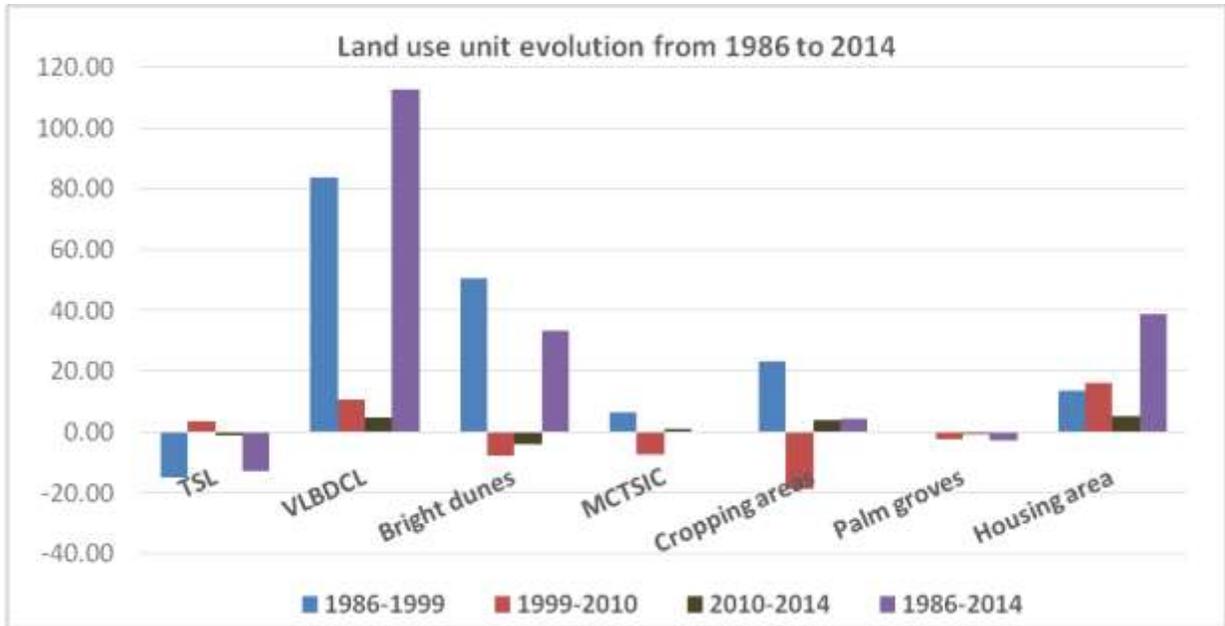
Land use units	Area in hectare (ha)	Percentage (%)
Trees and/or shrubs by location	151608.98	57.22
Very little bright dunes covered by location	27566.94	10.41
Bright dunes	23344.91	8.81
Mosaic crops – trees-shrubs of interdunal corridors	37204.57	14.04
Cropping areas	18549.39	7
palm groves	6189.72	2.34
Housing area	471.84	0.18
Total	264936.35	100

Table.4 Distribution of land use units in 2010

Land use units	Area in hectare (ha)	Percentage (%)
Trees and/or shrubs by location	156738.86	59.16
Very little bright dunes covered by location	30477.88	11,50
Bright dunes	21570.66	8,14
Mosaic crops – trees-shrubs of interdunal corridors	34478.08	13.01
Cropping areas	15072.16	5.69
palm groves	6050.97	2.28
Housing area	547.74	0.21
Total	264936.35	100

Table.5 Distribution of land use units in 2014

Land use units	Area in hectare (ha)	Percentage (%)
Trees and/or shrubs by location	155119.37	58.55
Very little bright dunes covered by location	31939.78	12.06
Bright dunes	20701.10	7.81
Mosaic crops – trees-shrubs of interdunal corridors	34904.36	13.17
Cropping areas	15692.61	5.92
palm groves	6002.60	2.27
Housing area	576.53	0.22
Total	264936.35	100



TSL: Trees and/or shrubs by location; VLBDCL: Very little bright dunes covered by location; MCTSIC: Mosaic crops – trees-shrubs of interdunal corridors

Fig.1 Evolution of land use in the study area

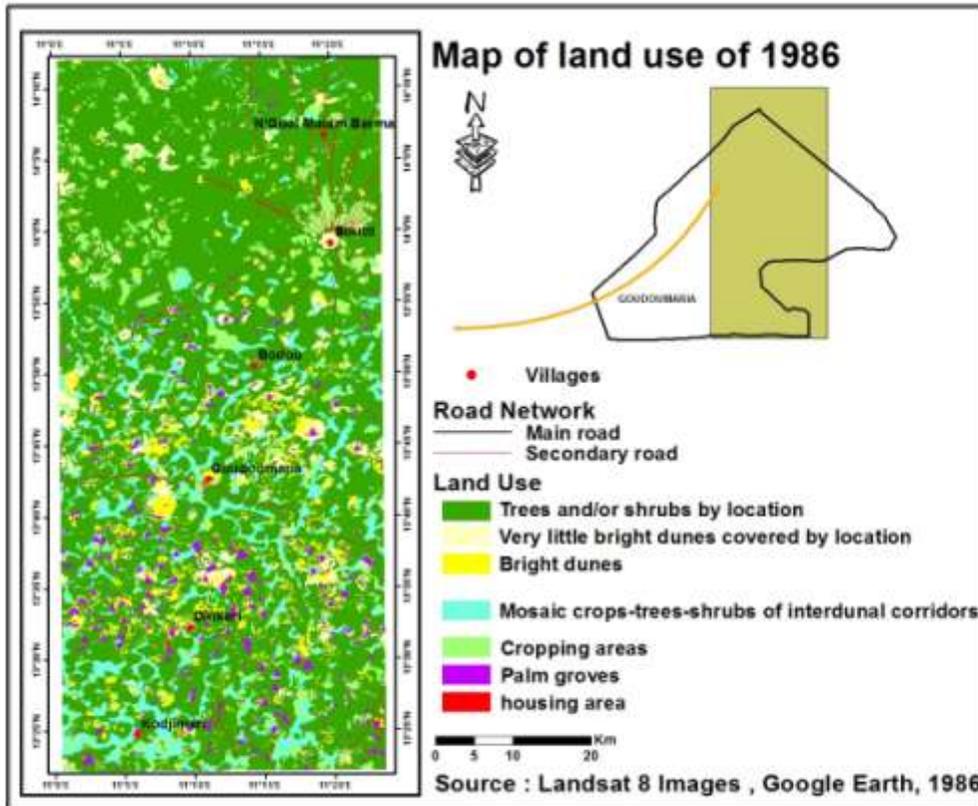


Fig.2 Map of land use of the study area in 1986

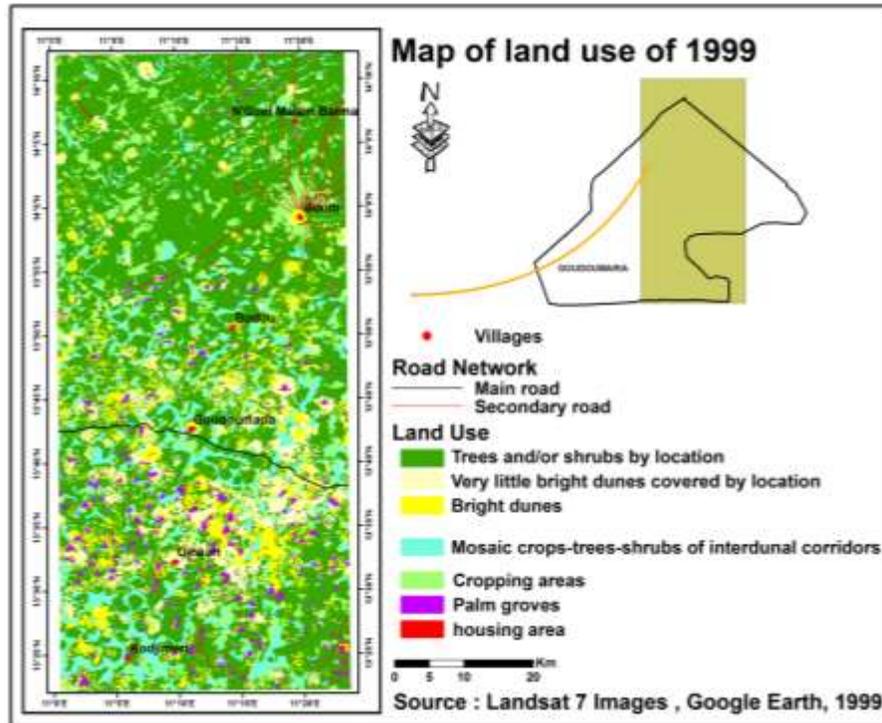


Fig.3 Map of land use of the study area in 1999

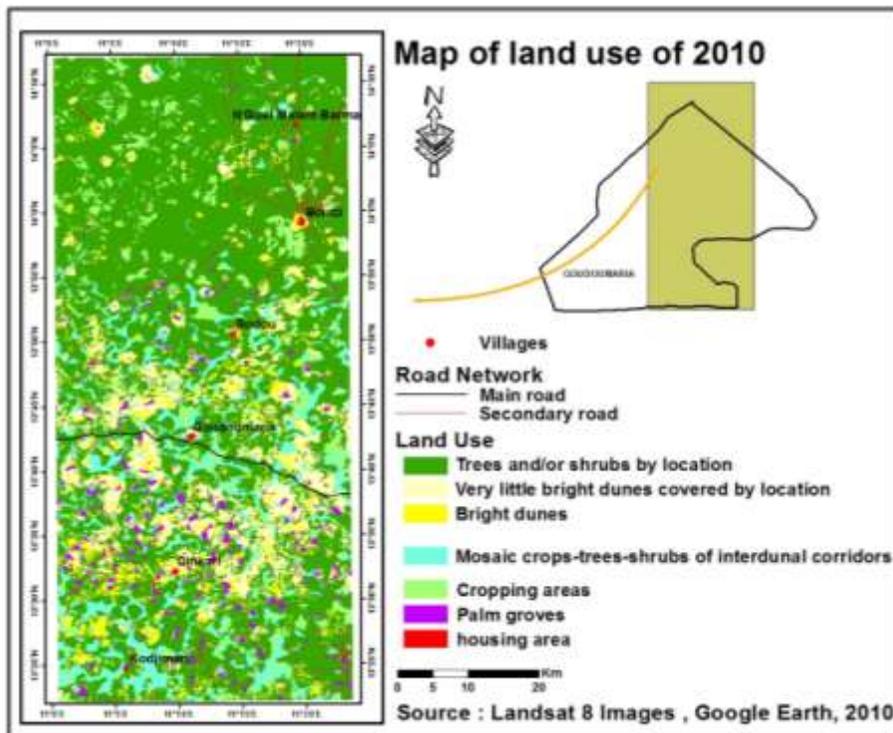


Fig.4 Map of land use of the study area in 2010

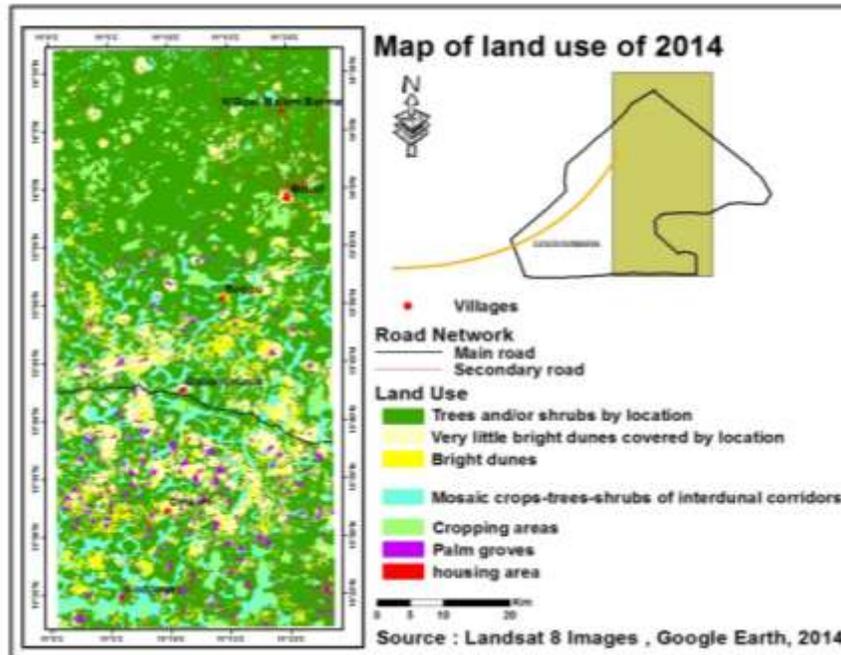


Fig.5 Map of land use of the study area in 2014

Before these events, the areas were more immense because the state of degradation was not yet advanced. Note that other units were almost nonexistent. Thus mobile dunes begin to appear in 1975 in the south, where cultivation areas have been developed (Ado, 2011). But the phenomenon was still insignificant. In 1999, the situation has changed dramatically. Then from 1986 to this period, the area of extension of the steppe has considerably receded.

This can be explained by the progression of degraded units that are the dunes very little covered and the dune alive related to the irregularity of rainfall during these years (the only rainy year 1994 with a total of 554.9 mm) and the increase of cultivated area and residential area.

A slight improvement in the condition of stable units will be observed in the 2010 situation. In 2014, a regression of all covered units was observed. Thus, the area occupied by the palm groves or "cuvettes" decreases because of silting in pastoral areas where

many of these units are deprived of their vegetation covers and their areas and that of the steppe in the south because of the return to culture after fallow and decrease of trees.

It emerges from this study on the evolution of land use, that these units have regressed through the study of vegetation, soil and water, the perception of the population. There is an adverse change.

Competing interests

The authors declare that they have no competing interests.

Aknowledgements

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