IMPETUS BENIN

Assessment of land-cover and land-use changes in the Upper Oueme catchment and their driving forces

Evaluation de la dynamique du couvert végétal et de l´utilisation des terres dans la Haute Vallée de l'Ouémé et analyse des forces d'entraînement

Michael Judex & Hans-Peter Thamm
Remote Sensing Research Group, University of Bonn, Germany

Introduction

Land-use and land-cover changes are the consequences of change in society and agricultural systems or industry. They alter natural material and energy cycles and are therefore important issues e.g in regard of water and food production. The study area in central Benin is facing rapid population growth during the last decades, caused by natural growth and high regional migration rates with unchanged traditional agricultural production systems. Therefore enlargement of agriculturally used areas is expected.

Used data

To analyse land-cover changes, data from the LANDSAT satellite series are used. This satellite delivers data since 1972, the newest one with a resolution of 30mx30m in eight spectral channels. To compare the land-cover changes, two images from the year 1991 (december) and 2000 (october) are classified with the

Foto 1: Intensive agricultural use with little fallow periods

Photo 1: Utilisation de l'agriculture intensive à faible durée de jachère

Foto 2: New established yams field

Photo 2: Défriche d'igname

maximum likelihood method. The classification scheme includes classes for vegetation cover plus different land-use categories like settlement and agriculturally used areas.

Problems during the classification process evolve because of two facts: 1. high interannual variability of vegetation cover and the main problem is that up to 80% of the savannah areas are burned during the dry season and therefore recognition of different savannah types is not possible, and 2. difficulties in separating spectraly similar classes, like field areas and inselbergs. This could be solved with the help of a newly availiabile digital elevation model in a 90m resolution (NASA, data from SRTM mission). The quality of the class "agriculturally used" could be substantially improved. The accuracy of the classification was proved for the researched agricultural areas and was nearly up to 80%. The accuracy assessment of the savannah areas is still in process with additional aerial photos.
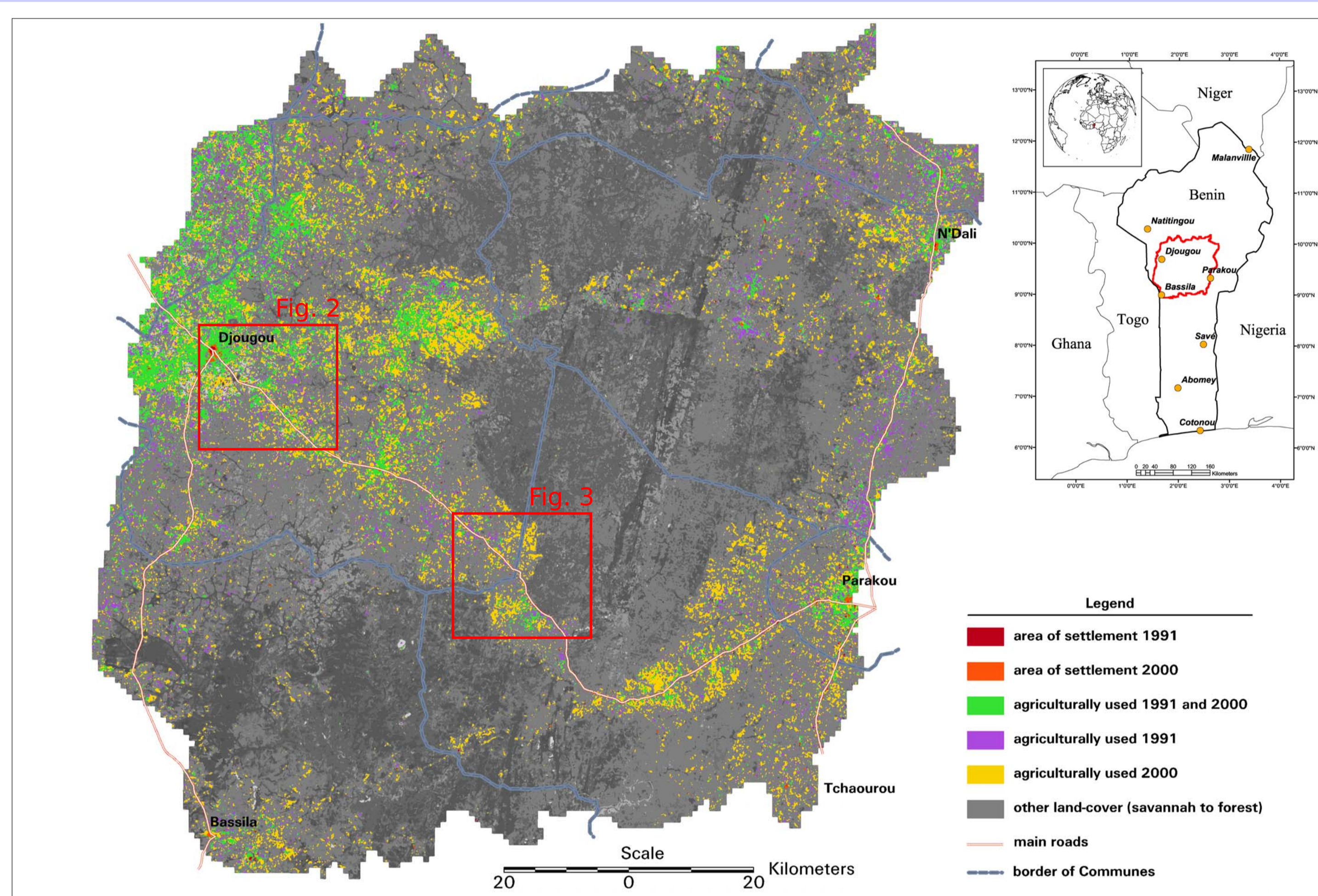

Fig. 1: Changes in land-use in the Upper Oueme catchment from 1991 to 2000. Based on LANDSAT data

Fig. 1: Dynamique de l'utilisation des terres dans le Bassin de l'Ouémé Supérieur à base des images LANDSAT

Legend
- area of settlement 1991
- area of settlement 2000
- agriculturally used 1991 and 2000
- agriculturally used 1991
- agriculturally used 2000
- other land-cover (savannah to forest)
- main roads
- border of Communes

Land-use and land-cover change

Comparing the land-cover classifications from 1991 and 2000, the class "agricultural used areas" shows a very high spatial dynamic. The traditional shifting cultivation with fallow periods of different duration is clearly visible (fig. 1 to 3). Only a minority of areas were in use 1991 and 2000. This could be due to continuous use, but also new re-use after a short fallow period. A lot of additional areas are under cultivation in 2000 comparing to 1991, which is noticeable in fig. 3. In total, the study area
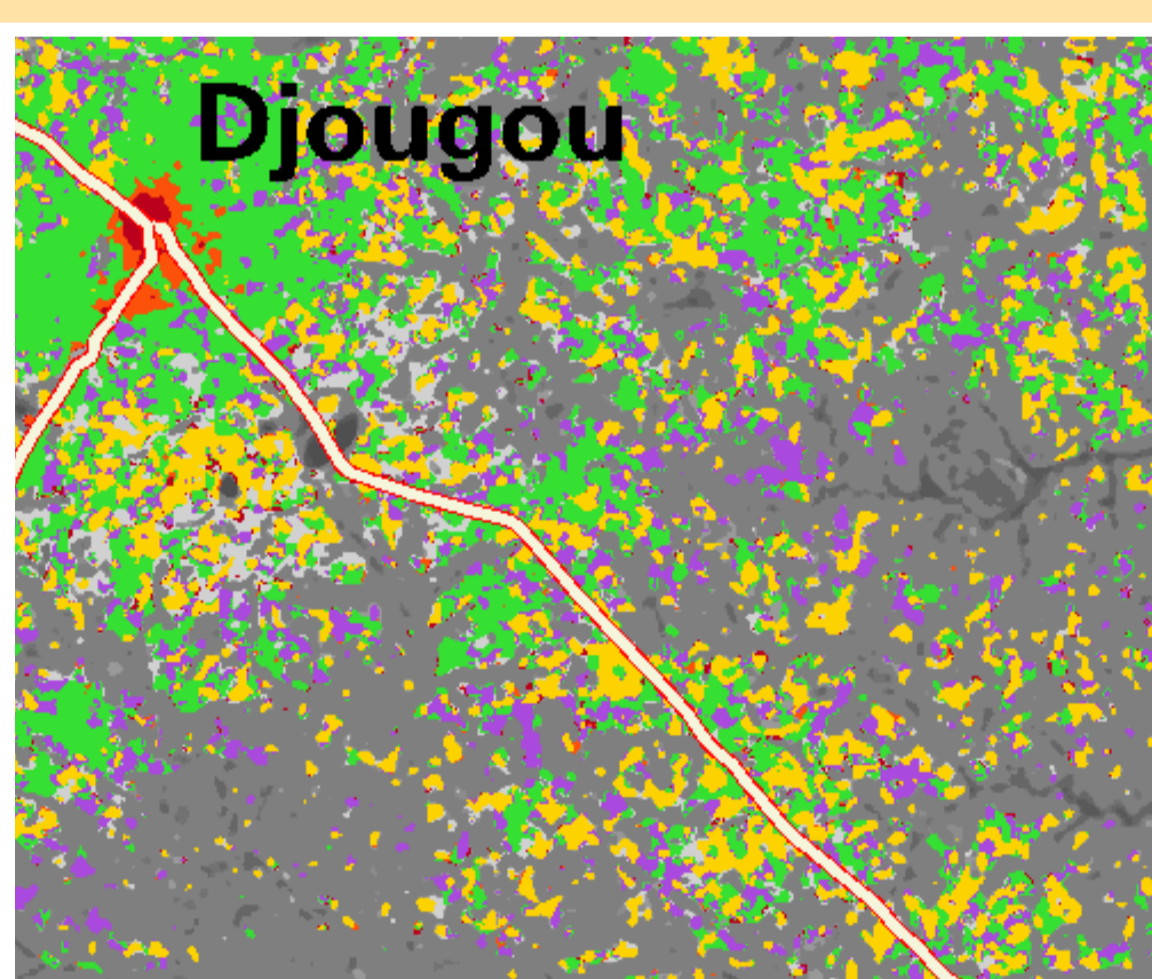

Fig 2: Detail of fig. 1. In dense settled areas new fields are established on young fallows

Fig. 2: Détail de fig. 1. Dans les régions densément peuplées, les nouveaux champs sont installés sur de jeunes jachères.
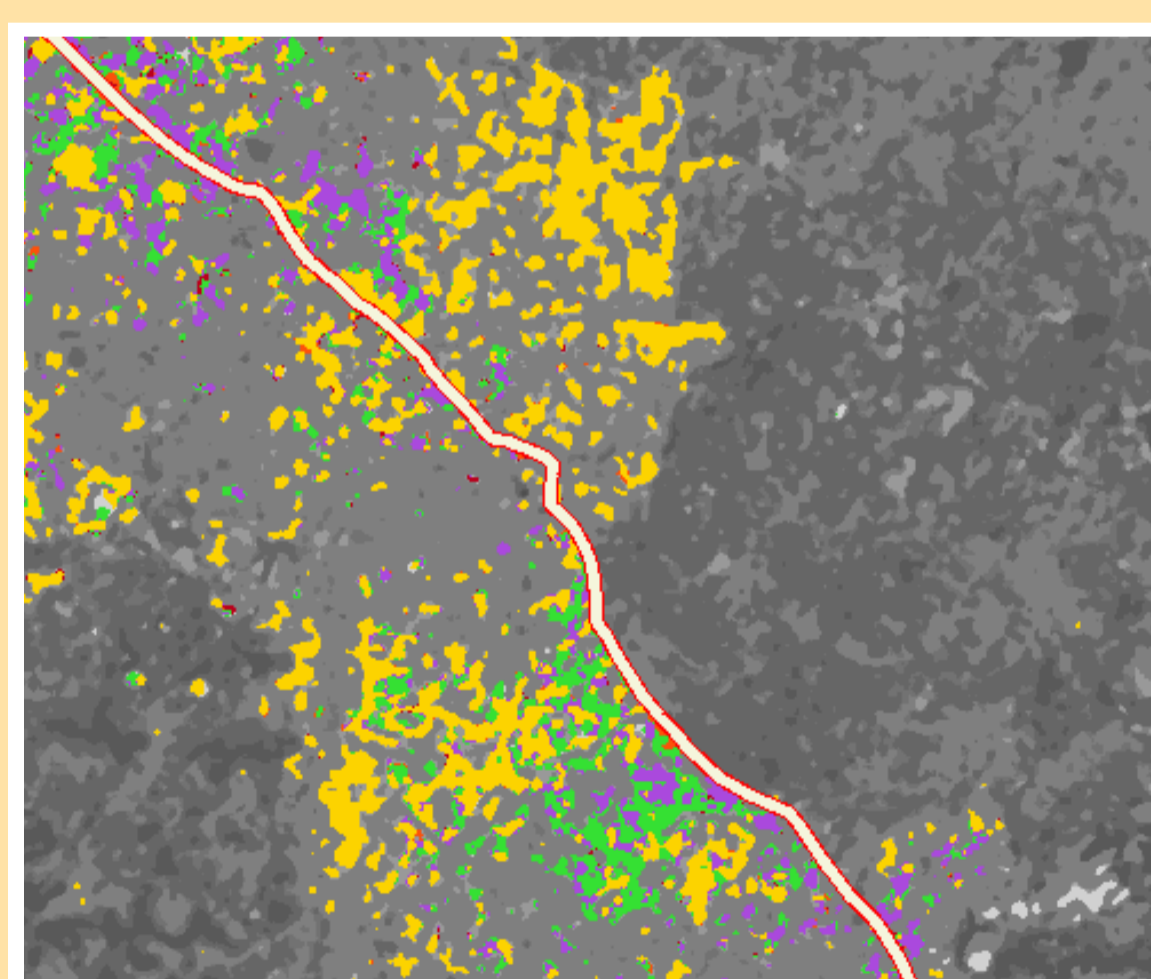

Fig. 3: Detail of fig. 1. New fields evolve in some distance to villages

Fig. 3: Detail of fig. 1. De nouveaux champs se développent à quelque distance du village

reveals a growth of agriculturally used areas (field areas only) of 71,3% and nearly 90% of settled areas (fig. 4 shows data calculated for administrative unit "commune").

The changes in the Upper Oueme catchment have one general force: population growth. The study area has an annual growth rate of 4 %, but some villages have nearly twice as mutch due to migration. Those villages with high fraction of migrants show high activity in aquisition of new field areas (fig.3). The local land-cover changes however are influenced by many other factors: history, social networks, local natural conditions and many others. Statistical analyses have shown, that the occurance of agriculturally used areas depends on population density and distance to roads. Other factors like suitability of soils for agriculture (data are available only from soil maps of Benin, different authors, 1978-79) seem to have only very little influence on the place of agricultural expansion. This is due to the resolution of the soil map (1:200.000) and the mapping method.
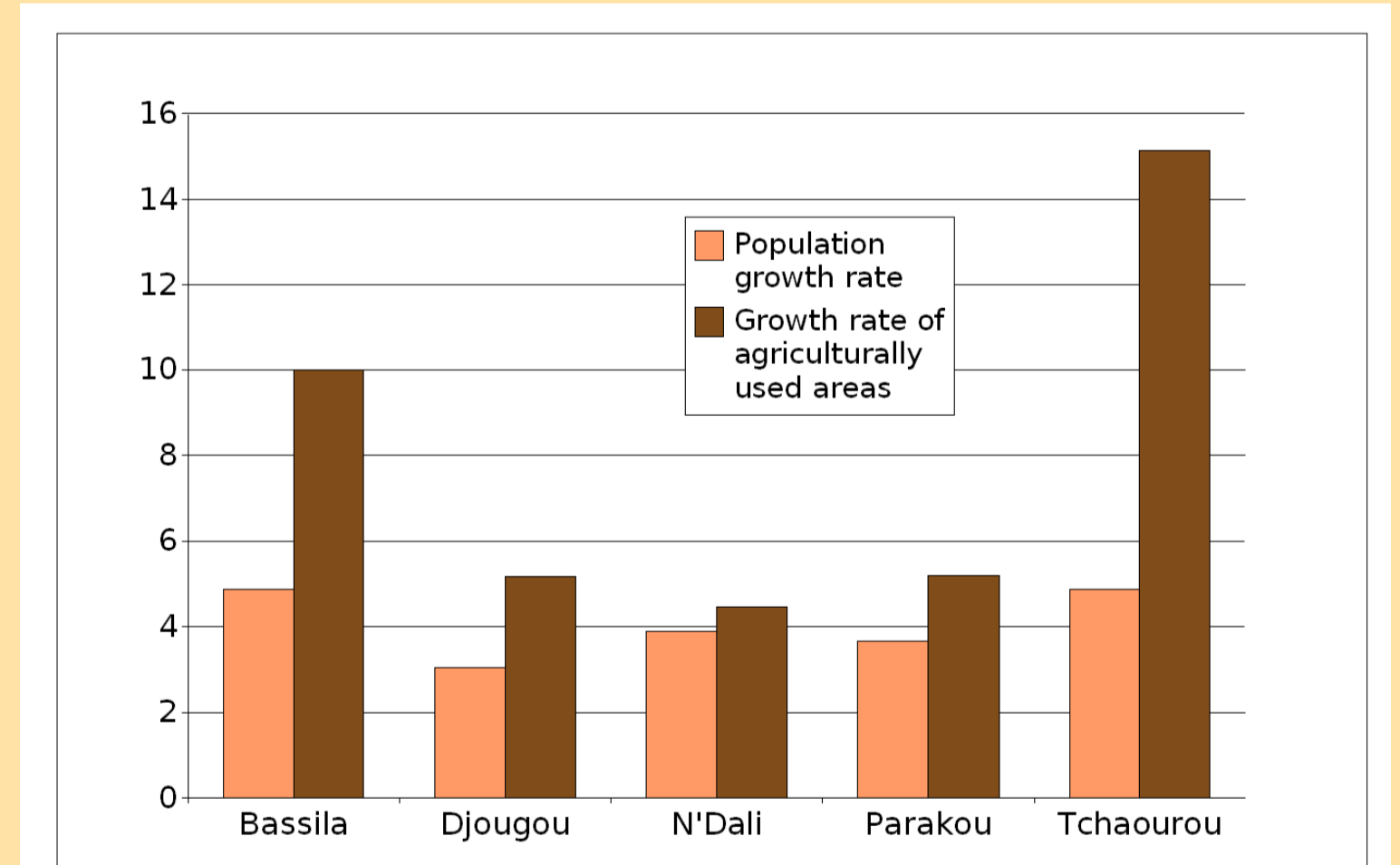

Fig. 4: Comparison of the growth rates (% per year) of population and agriculturally used areas for selected communes in central Benin

Fig. 4: Comparaison des taux annuels de croissance (%) de la population et des superficies agricoles pour certaines communes du Centre- Benin

Results

The study area shows high land-use conversion ratios, which is founded in natural production systems and population growth. Those changes in land-cover have clear driving forces and have the potential to alter the environment substantially, e.g through the hydrological cycle. With up to 15% annual growth rate of field areas the Upper Oueme region is one of the fastest changing region in Benin.

Contact:
M. Judex, University of Bonn, Remote Sensing Research Group, Meckenheimer Allee 166, 53115 Bonn, Germany. E-mail: judex@rsrg.uni-bonn.de

University of Bonn   bmb+f   NRW Ministerium für Wissenchaft und Forschung des Landes Nordrhein-Westfalen   University of Cologne