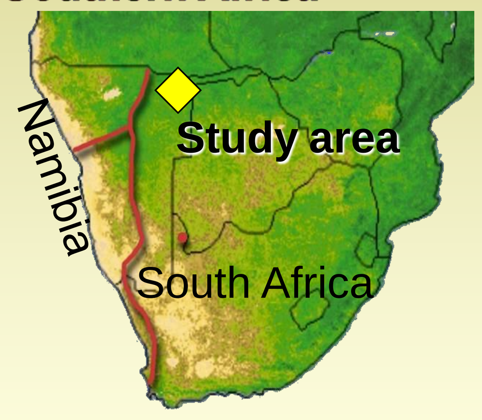

The BIOTA Southern Africa Transect

Dryland Farming in the Kavango Region: Effects of Land Use on Soil Properties

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1. Introduction and Aims

In northern Namibia's Kavango region, the vast majority of households live on subsistence farming without financial conditions allowing the use of chemical fertilisers or agricultural mechanisation. Hence, it is important to find low-cost management practices for a most effective use of natural resources that can be implemented by the people in the Kavango.

Embedded in the BIOTA Southern Africa project, this study's aim is to assess the degree of soil degradation effected by land use to provide a basis for sustainable management.

2. Study Area

Average precipitation in the Kavango is 500 mm/a with a wet season in summer (November to April) (Mendelsohn & El Obeid 2003). The area is characterised by degraded linear dunes of the Kalahari basin running in east-west direction. These are disrupted by omurimba (wide flat dry water courses), running from south-east to north-north-west.

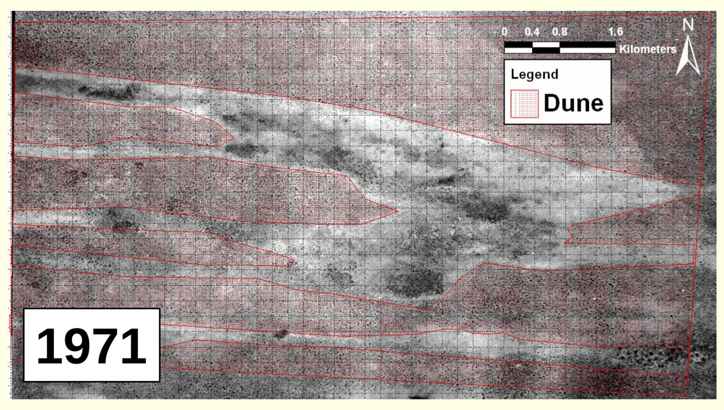
Cropping takes place nearly exclusively on the interdunes (see Fig. 2). Main crop is pearl millet (*Pennisetum glaucum*) together with maize *(Zea mays)*.

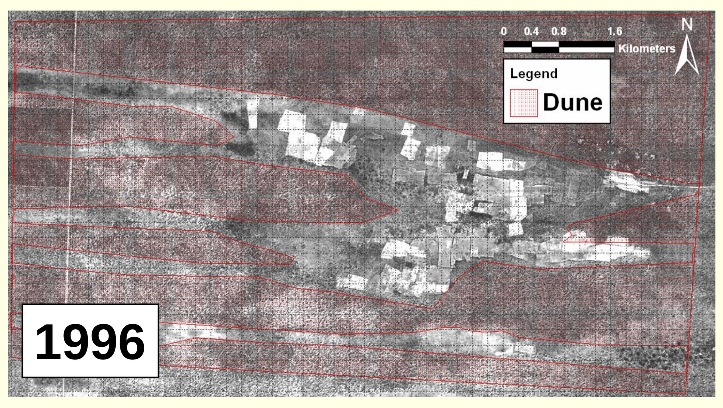
3. Sampling and Classification Methods

The time of cultivation of the acres was determined on the basis of local informants as well as satellite data and aerial photographs respectively (see Fig. 2). To investigate the influence of land use on the soil over the time, areas were categorised as young (1-3 years), middle aged (3-11 years) and old (>11 years) acres, young (1-3 years) and old (>3 years) fallows as well as comparable pristine sites.

Mixed topsoil samples were obtained from 9 plots per 100 m², while profiles were sampled per horizon, which in turn were defined by means of the KA 5 (AG Boden 2005). The profiles were classified by the WRB (FAO 2006) due to the international nature of the project.

The topsoil was classified according to its colour in the colour classes (CC) CC1 (dark) with a Munsell value (moist) of 2 to 2.5, CC2 (medium) with a value of 3, and CC3 (pale) with a value of 4.





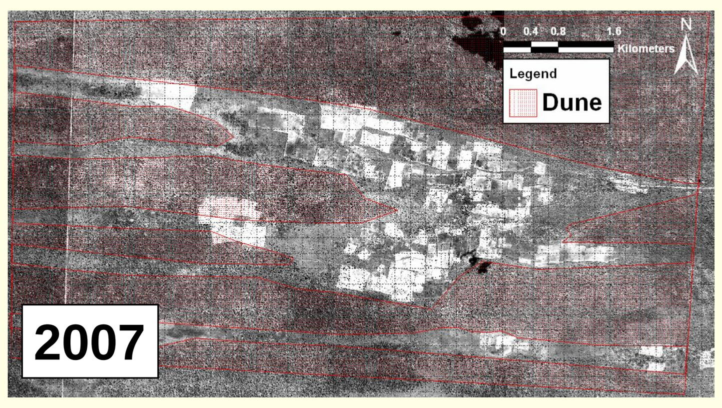
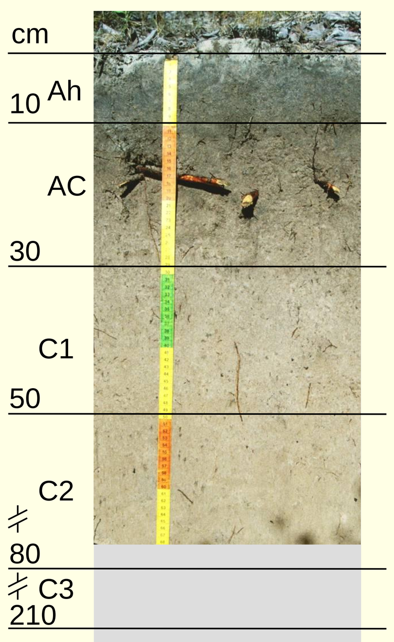


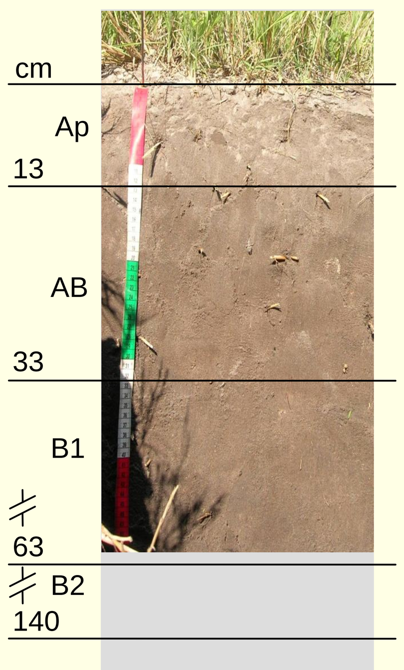
Fig. 2: Aerial photographs of the study site from 1971 and 1996 and a satellite image from 2007, showing the dune-interdune alternation with acres (pale angular areas) on the interdunes

4. Typical Soils in the Region



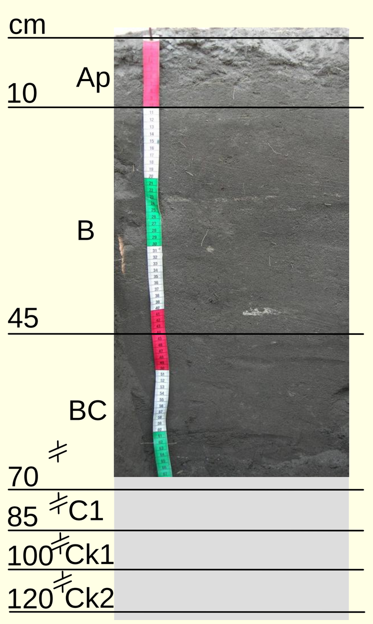
Ferralic Arenosol (Dystric, Greyic)

- Typical dunal soil
- Medium sand dominated
- 1-2 mm layer of bleached sand
- Single grain structure and low excavation difficulty
- Fragments of coal even in deeper layers



Haplic Arenosol (Eutric, Greyic)

- Typical interdunal soil
- Vegetation: (thorn-) bush-thickets
- Medium sand dominated
- 1-2 mm layer of bleached sand
- Subangular blocky structure, low excavation difficulty
- Deep, intense rooting



Haplic Arenosol (Hypereutric, Greyic)

- Typical omuramba-influenced soil
- Medium sand dominated
- 1-2 mm layer of bleached sand
- Subangular blocky structure, moderate excavation difficulty
- Calcareous throughout the profile, increasing with depth, below 120 cm slightly cemented

5. Land Use and Soil Fertility

One central aim of this study was to assess the influence of cropping and fallow periods on soil fertility. To minimise the influence of substrate-driven differences within each land use class, an easily on-site implementable classification by soil colour was developed (see also Wisch et al. 2009).

Dunal and interdunal soils strongly differ in their colour and soil properties (Petersen 2008) (see Ch. 4). The box-plots in Fig 3. show the results of the classification for soil organic carbon (SOC). The decrease from CC1 to CC3 was also significant for total nitrogen, pH, exchangeable calcium, potassium, and magnesium.

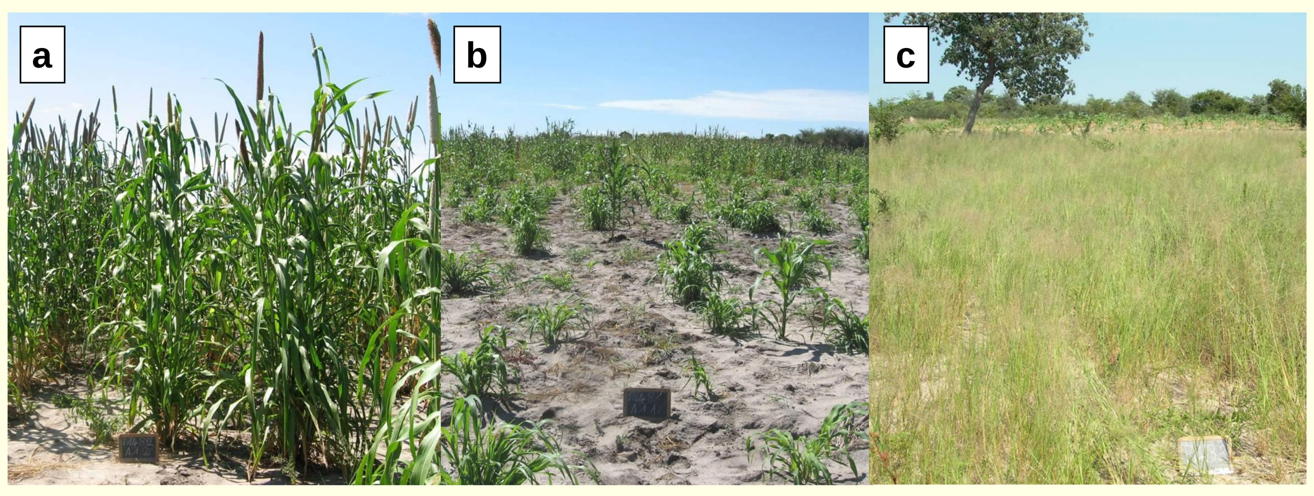


Fig. 6: Pictures of acres in good (a) and bad (b) condition as well as a fallow (c)

Comparing the land use classes, a significant decrease in SOC from pristine soils to acres and fallows is found within the colour classes (Fig. 4). Nevertheless, no recovery can be seen in fallows, there is even a slight decrease. One reason for this may be the management practices: Acres or part of acres are left fallow only when the expenditure of work by far exceeds the outcome and yield tends to zero. This is a result of the high land use pressure caused by the low economic buffer. Thus, only extremely leached acres fall in the class of fallows. The fallow periods of the investigated acres do not seem to suffice for a full recovery. No differences can be found between young (1-3 years) and older (> 3 years) fallows (Fig. 5), so the current practice is highly unsustainable. Between acres of different ages, only slight differences were found, no clear decrease in the course of cropping can be seen in this investigation. This may be due to the highly variable n of the age classes.

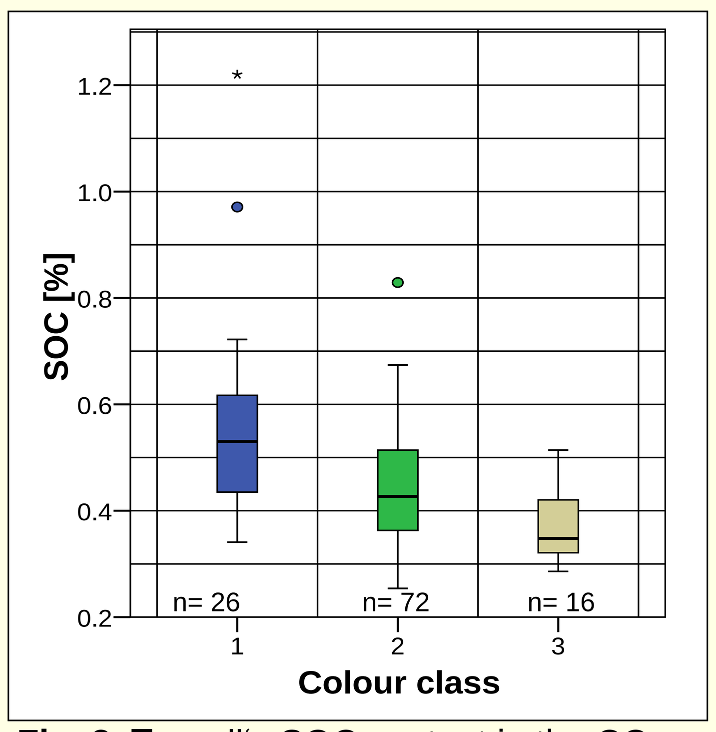


Fig. 3: Topsoil's SOC content in the CC

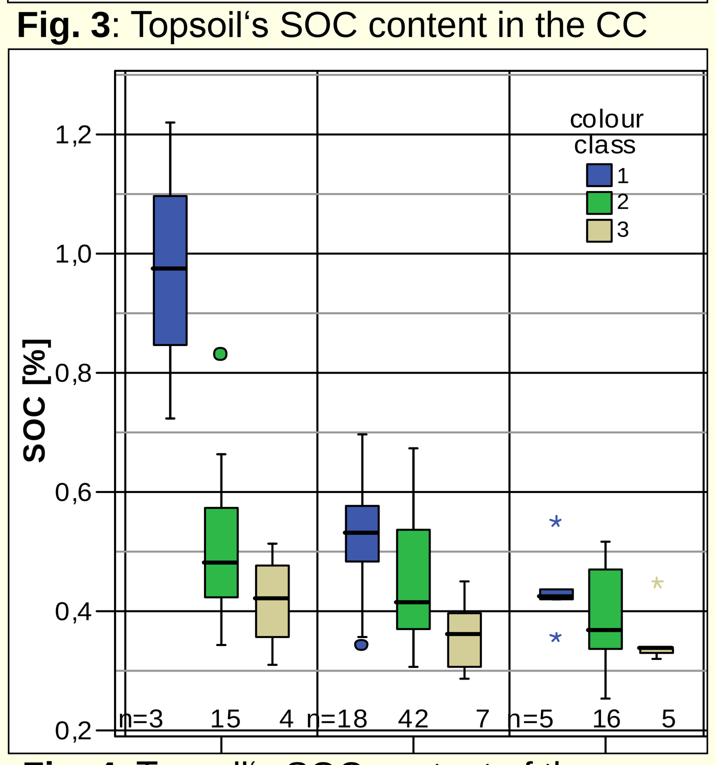
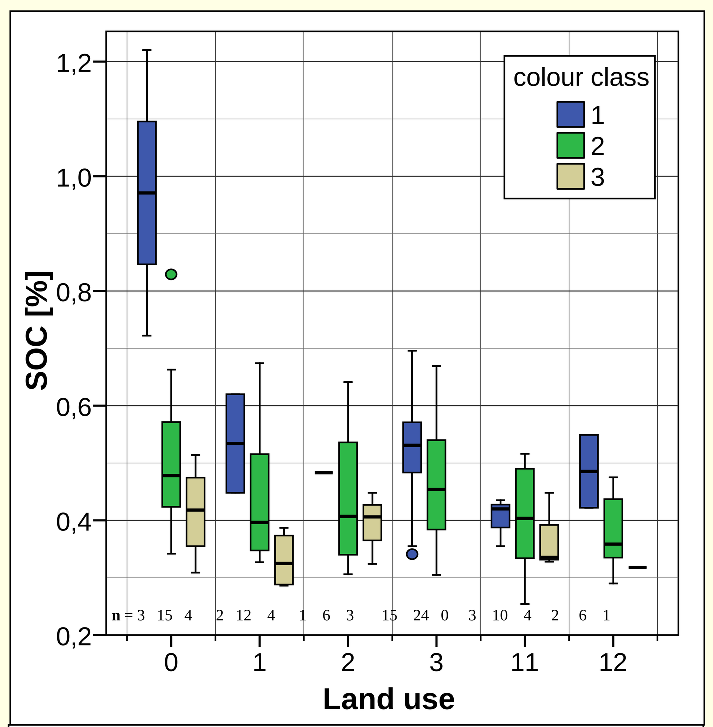


Fig. 4: Topsoil's SOC content of the combined colour and land use classes



Land use classes: 0 = Pristines; 1 = Young acres (1-3 years); 2 = Middle aged Acres (3-11a); 3 = Old acres (>11a); 11 = young fallows (1-3a); 12 = old fallows (>3a)

Fig. 5: Topsoil's SOC content of the colour and usage classes differentiated by age

6. Conclusions

The SOC contents strongly decrease in the course of cultivation, strongly correlated to the soils nutrient content. The current, short-period fallowing practices in the region do not fulfill criteria of a sustainable land management.

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