



How farmers perceive and cope with *bowalization*: A case study from West Africa



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ABSTRACT

Bowal, a particular form of land degradation occurs only in tropical regions. This study aims at assessing the perceptions of farmers on the causes and consequences of *bowalization* and the developed strategies to cope with it in semiarid and sub-humid climate zones in Benin. Data were gathered using semi-structured interviews and questionnaires. Representatives from 279 households of nine ethnic groups in the semiarid zone of Benin (Peulh, Bariba, Dendi, Nagots and Mocolé) and in the sub-humid zone (Fon, Mahi, Holli and Adja) were interviewed. Pearson Chi-square Test was performed to analyze the perceptions on the causes, consequences and coping strategies with *bowé* in the two climate zones. Simple correspondence analysis was used to evaluate the coping strategies according to the ethnic groups. *Bowalization* was reported to be induced by non-adapted land use and soil erosion. An increase of farmed land and animal-drawn tillage was more perceived in the semiarid zone as cause of *bowalization*. *Bowalization* leads to loss of biodiversity in the two climates zones. Its consequences for the production of crops consist mainly in reducing water retention capacity of the soils, rooting difficulties for crops and increase of soil temperature. Farmers in the semiarid zone have adopted planting of cowpea and groundnut on *bowé*. Adapted cropping techniques in the semiarid zone consist in using a hoe for manual tillage and weed control. Ethnic groups of both climate zones that depend mainly on livestock herding have to practice transhumance and use food supply for the animals. The Bariba and Dendi in the semiarid zone modified their practices of tillage, weed control, sowing, fertilization, and livestock feeding most. The Mahi, Holli, Fon and Adja of the sub-humid zone mostly reduced their farmland, changed the crops and fields and adopted new off-farms activities. The Peulh mostly practiced transhumance independent from the zone. The type of coping strategies to *bowé* is dependent on the climate zone and ethnic group.

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Introduction

In tropical regions, distinctive landscapes exist where ferricrete occurs. Many terms have signified the process of ferricrete formation namely laterization, lateritization, latosolization and *bowalization*. In the Fulfulde language spoken in Guinea, *bowal* (plural *bowé*) means land cover associated with surficial ferricrete (Aubréville, 1947). From *bowal* is derived *bowalization*, a hypothesized process of land degradation that has concerned some scientists in Africa since the early 1900s. *Bowalization* implies some form of human impact (Aubréville, 1947), whereas the other forms of ferricrete formation in their current, technical sense do not (Bockheim and Gennadiyev, 2009; Yuangen et al., 2009).

Bowalization occurs mostly on plains with a sufficient amount of precipitation for leaching and strong winds for evaporation (Morgan and Pugh, 1969). During the *bowalization*, ferricrete horizons expand laterally. They form an effective barrier to water so that the vegetation on *bowé*, experiences flooding or high runoff rates in the peak rainy season, desiccates quickly and burns early in the dry season. Furthermore *bowé* impede root growth so that the vegetation is forced to adopt certain characteristics. As the soils rapidly absorb and reradiate solar energy *bowé* get extremely hot and barren in the dry season. In West Africa (Benin and Burkina-Faso) *bowé* are relatively poor in species diversity and differ in plant life forms compared to other vegetation types (Zwarg et al., 2012; Sieglstetter et al., 2012; Padonou et al., 2012). The abundant and dominant life forms on *bowé* are therophytes.

Up to the mid-20th century, *bowalization* was reported to be induced by anthropogenic deforestation and soil erosion (Morgan and Pugh, 1969; Richard-Molard, 1951; Aubréville, 1947; Chételat, 1938; Falconer, 1911; Lacroix, 1913). As Human-induced drought and desertification constitute some of the greatest environmental

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challenges of our time (Falkenmark and Rockström, 2008), farmers have to focus on the understanding of the actual underlying causes of *bowalization* in order to cope with it. As *bowé* are observed in semi-arid and sub-humid climate zones in Benin, farmers' perspectives on the underlying causes of *bowalization* may be independent toward the climate zones.

Since land degradation in the world affects biodiversity, production quantity and quality of crop, livestock and forest and agricultural populations in different ways (Masters and Sheley, 2001; Okin and Gillette, 2001; Jackson et al., 2002; Wainwright et al., 2002; Ito et al., 2004; MEA, 2005; Bird et al., 2007; Flamenco-Sandoval and Martínez Ramos, 2007; Aboh, 2008; Knapp et al., 2008), the rural population of tropical regions may be severely affected by *bowé*. The population's perception of the consequences of *bowalization* in the semi-arid and sub-humid climate zones in Benin is important so that they know how *bowalization* can affect their life. In order to cope with the negative effects of *bowalization* and to develop prevention strategies, profound knowledge about the causes and consequences of this phenomenon is necessary.

As different strategies are used by people to cope with land degradation in the world (Kangalawe et al., 2008; Stringer et al., 2009; Deressa et al., 2009; Newsham and Thomas, 2011), one could expect particular coping strategies to face *bowalization*. Knowledge about these strategies in the semi-arid and sub-humid climate zones in Benin is crucial to analyze and enhance them to improve the living conditions of the rural population.

Many authors argue that without an approach that combines the local perceptions and existing coping strategies, there is a risk that land degradation assessments represent only the opinions of the assessors and not empirical realities (Fairhead and Leach, 1995; Leach and Mearns, 1996; Bassett and Zuéli, 2000; Adger et al., 2001; Oudwater and Martin, 2003). Thus the aim of this study was to assess the perception of farmers on the causes and consequences of *bowalization* and to analyze their coping strategies against *bowalization* in the semi-arid and sub-humid climate zones in Benin.

Materials and methods

Study area

The study was conducted in the two climate zones in Benin where *bowal* occurs: the semi-arid zone (between 9°45' N–12°25' N and 0°45' E–3°55' E) and in the sub-humid zone (between 7°30' N–9°45' N and 0°45' E–3°55' E) (Fig. 1). Data were collected in the districts of Kandi and Banikoara in the semi-arid zone, and the districts of Zangnanado and Abomey in the sub-humid zone. In the semi-arid zone, mean annual rainfall is often less than 1000 mm and relative humidity varies between 18 and 99% (being highest in August and lowest in February). Mean annual temperature

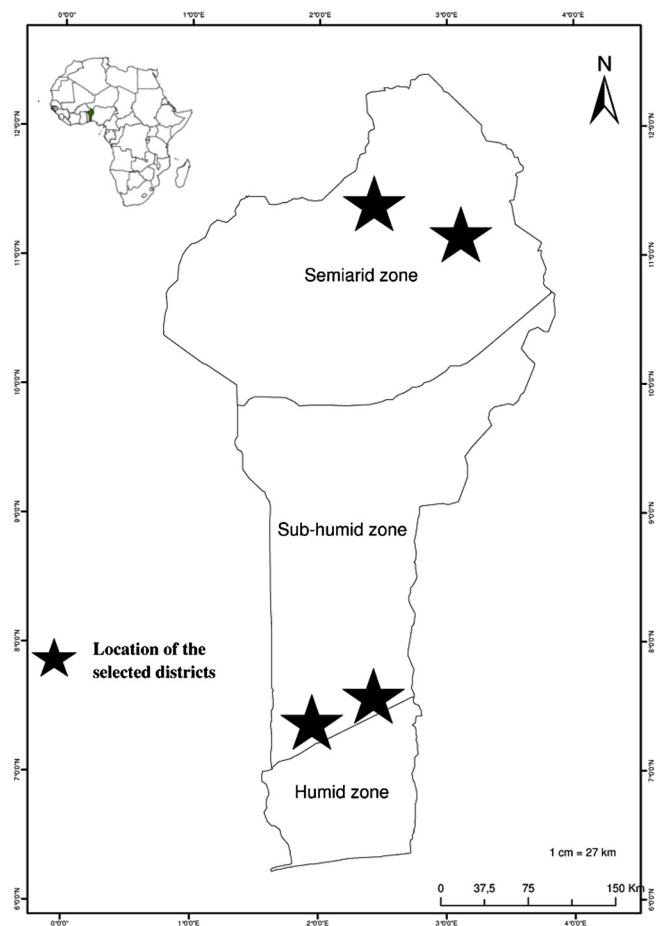


Fig. 1. Climate zones of Benin and location of the selected districts.

ranges from 24 to 31 °C. Hydromorphic soils, well drained soils, ferruginous soils and lithosols are the major soils types there. The Bariba (75.0% of the population) represent the main ethnic group in Kandi and Banikoara. Its main economic activities consist of agriculture and livestock herding (Table 1). The rainfall distribution in the sub-humid zone is unimodal. The rain season starts in May and ends in October. Between 900 and 1110 mm of precipitation are measured annually. The mean annual temperature ranges from 25 to 29 °C, and the relative humidity from 31% to 98%. Soils in this zone are ferruginous with variable fertility. The main ethnic group in the study districts of the sub-humid zone is the Fon. Its main activities are agriculture and charcoal production. The vegetation of the two zones is characterized by a mosaic of woodland, dry dense forests, tree and shrub savannas and gallery forests.

Table 1
Ethnics and economic activities in the two climate zones.

Variables	Sub-humid climate zone (%)		Semi-arid climate zone (%)	
Ethnics (%)	Fon	69.0	Bariba	75.0
	Mahi	11.0	Dendi	20.8
	Holli	16.1	Peulh	4.2
	Peulh	2.6	Nagots	0.8
	Adja	1.3	Mocolé	0.8
Activities (%)	Exploitation of wood	5.2	–	–
	Agriculture	85.2	Agriculture	100
	Livestock production	25.2	Livestock production	95.6
	Trading	7.7	Trading	14.2
	Charcoal production	54.8	–	–
	Crafts	12.6	Crafts	10.8

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