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Research paper

Shifting environments in Eastern Guinea-Bissau, West Africa: The length of fallows in question

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ABSTRACT

In the understanding of the relationship between forests, agriculture and landscape change, the impact of shifting cultivation has been a major topic, but also a major point of debate. The very definition of the concept is under discussion, starting with the importance given to the length of the fallow period and ending with the question of defining it as a system, many systems or a "tool kit". Can we consider the length of the fallow period or the crop-fallow time ratios as good indicators for the sustainability of shifting cultivation, and is permanent agriculture only adopted beyond certain thresholds? These are some of the topics this article aims to address through a case study conducted in Eastern Guinea-Bissau. In this social and agro-ecological relatively homogeneous region, while shifting cultivation of peanuts for export and cereals for home consumption caused major deforestation and soil degradation during colonial times, today these agricultural practices are being substituted by an expanding cashew nuts agricultural frontier.

1. Introduction

The demise of shifting cultivation has been generally presented as inevitable under conditions of population increase causing the shortening of fallow lengths [e.g.,1]. Following Ruthenberg's [2] work "Farming systems in the tropics", the concept of shifting cultivation has been frequently associated to short cropping periods and long fallows under slash-and-burn agricultural practices [e.g.,3,4]. Other scholars, however, include all (short or long) fallow systems that use the felling of trees, the burning of the slashed vegetation to increase soil fertility, and the shifting of fields [e.g.,3,5,6,7,8]. For these scholars, shifting cultivation, swidden agriculture and slash-and-burn cultivation are synonyms (idem).

More recently, Fujisaka et al. [9] elaborated a "practical classification" of shifting cultivation and identified several main parameters: former vegetation type and final cover; climate and soil conditions; techniques of clearing and burning; crop-fallow time ratios; first crop, crop associations and sequences; use of livestock, tools and techniques; type of user. Indeed, many authors argue that shifting cultivation is not a system, but many systems [e.g.,2,6,10] or even a tool kit with which farmers can improvise [11].

Moreover, even if we only adopt the concept of shifting cultivation when long fallows are being used, it is debatable the centrality given by many authors – also criticized by Ickowitz [12]–to the length of the fallow and/or to the relationship between the length of the fallow and the cultivation periods. Ruthenberg [2] uses the R value (number of years of cultivation multiplied by 100 and divided by the length of the cycle of land utilization, i.e., sum of the number of years of farming plus the number of fallow years) to distinguish between what he calls long-fallow (R less than 33), medium fallow (R between 33 and 66) and permanent cultivation (R greater than 66). He then splits "shifting cultivation" from other fallow systems, the former being characterized by long fallows in which less than 33% of the arable and temporarily used land is cultivated annually [2]. However, he does not acknowledge that the same class of R value can be obtained with markedly different crop and fallow lengths and that – according to the agro-ecological conditions and the techniques used – some combinations might cause rather dissimilar environmental stresses, namely diverse rates of tree regrowth during fallow.

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Despite the R value equation being a measure of time, and not of space, short fallows have been associated with increasing population densities, unsustainable deforestation, soil depletion and the breakdown of shifting cultivation [e.g.,13,14,15]. According to Boserup [15] hypothesis, as population grows and the demand for food increases, a more intensive land use incrementally reduces fallows until their complete elimination; this process triggers environmental degradation and will eventually lead to technological progress. However – as many authors claimed later [e.g.,8,12,11,16,17] –, shorter fallows do not necessarily imply decreasing output due to soil degradation, since other management factors can as well affect productivity.

Furthermore, different fallow lengths may allow the sustainable use of fields depending upon the former vegetation type and final cover, and climate and soil conditions, among other factors. Consequently, the environmental impact of shifting cultivation cannot be exclusively based on the length of the fallow period or the crop-fallow time ratio [e.g.,13,14]; the agro-ecological conditions, the diversity of practices used [e.g.,7,10,9] – such as techniques of clearing and burning, crop associations and sequences, use of livestock –, as well as farmers' needs, preferences and objectives [e.g.,5,7,18] have to be taken into account. Indeed, farmers may decide to adopt shorter fallows even when plenty of land is available [e.g.,18,19]. Long fallows reduce the time spent on weeding, but the trees will be bigger and the fields further from the villages [e.g.,5,11]. As so, farmers may opt to spend more time in weeding and less in clearing the fields, walking and watching. Land tenure issues can also interfere in the use of different fallow lengths [5,18]. Likewise, farmers might want to abandon shifting cultivation without being forced by land scarcity and soil depletion – following Boserup's [15] model of agricultural intensification – or government's policies. In sum, the use of short or long fallow lengths or crop-fallow time ratios *per se* may not be strong enough indicators of either agriculture intensification or sustainability of land use and have to be put into context.

In this article we put into test the validity of crop-fallow time ratios and R value classes as proxies of the intensity of land use and of the sustainability of shifting cultivation. We intend to show firstly, that the same class of R value can include diverse crop and fallow lengths causing different environmental stresses; secondly, that a diversity of crop and fallow lengths and ratios can be used in different villages of the same social and agro-ecological relatively homogenous region; thirdly, that even when plenty of land is available and/or long fallows are being used, farmers may opt to abandon shifting cultivation in favor of a less environmentally-friendly (though agroforestry) alternative, in response to social, economic, political and environmental changes; finally, that the demise of shifting cultivation can be temporary and farmers may return to it again as a "safety net" in times of food crisis [e.g.,20].

1.1. Material and methods

1.1.1. Study area

The area under study is located in Eastern Guinea-Bissau (about 18,000 km^2), which is its most homogeneous region both in agro-ecological and ethnic terms (Fig. 1). It is a hinterland region covered by savannah woodlands and extensive grasslands and has the lowest rainfall, the highest temperatures and the poorest lateritic soils [21]. The highest point reaches 298 m altitude in the Boé ills. According to FAO [22] classification, the main upland agricultural soils where shifting cultivation is practiced are ferralsols and the flooded lowlands where freshwater swamp rice is annually cultivated are gleysols. Studying climate characteristics of this region between 1950 and 2001, Embalo [23] concluded that: the average monthly highest temperature is 41.7 °C and occurs between April and May; the highest and lowest temperatures increased 0.8 °C during the last fifty years; and the average annual rainfall is 1169 mm, with a minimum of 314 mm and a maximum of 1885 mm. He argues that during the last twenty years a reduction occurred in the precipitation amounts and in the length of the rainy season (at present the rainy season usually starts in June and ends at the beginning of September/early start of October), as well as an increase in the variability of the distribution of the rains [23].

The dominant ethnic groups in the East are the Fula (also known as Fulbe or Peul in other West African countries) – the second largest ethnic group of Guinea-Bissau, amounting to 25.4% of the country's population in 1991–and the Mandinga (also known as Mandinka and Mandingo in other countries) – amounting to 13.7% of the country's population [24]. The average population density in the East is 28.6 people per km^2, but it ranges from 3.3 to 49.0 among the different administrative sectors in which the provinces are divided [25].

During colonial times, the production of peanuts for export under shifting cultivation practices greatly contributed to the deforestation and soil degradation of the region [26]. By 1959, a reforestation plan was elaborated and cashew trees were included due to their rusticity and high tolerance to drought and poor soils [27]. The colonial government tried to boost the plantation of cashews, but at that time farmers did not find any advantages in producing the cash crop [28]. After independence in 1974, but especially after the adoption of structural adjustment measures (mid-1980s) which promoted the increase of the country's exports, farmers progressively started to plant cashew trees. They adopted an "agricultural frontier" process, in which every field slashed is no longer left fallow anymore; instead, cashews are cultivated together with food crops during three to four years, until the field becomes an orchard, when the cashew trees canopy closes, and a new area must be slashed and burnt [28]. In this process, all fallow fields, woodlands and savannah woodlands of the country are being converted into cashew orchards, concomitantly with a progressive expansion of the agricultural area [28]. Customary land tenure rules, the absence of a land market and low population densities in most rural areas facilitated this process of land-use cover change [29].

1.1.2. Study design, sampling and data collection

Based on the results of our own long-term field research coupled with Catarino [30] division of the country in phytogeographical regions, we divided the territory of Guinea-Bissau into three social and agro-ecological relatively homogeneous regions: North and South on the coast and East in the interior (see Fig. 1). The main difference to the usually adopted division consists in including the Farim and Mansabá sectors of Oio province in the East, instead of in the North.

During six weeks in 2008 and 2009, qualitative research (focus group discussions, key informants interviews, informal conversations, transects and visits to agricultural fields) was conducted by the first author in forty eight villages of Eastern Guinea-Bissau, within a project that covered the whole country aiming to monitor deforestation and land use-cover changes (1990–2007). The ethno-agronomic component characterized farming systems and fire practices in a context of land use-cover and socio-economic rapid change. This research provided not only important qualitative data for the characterization of shifting cultivation, but also the knowledge that the system was being substituted by cashew trees plantation. The research occurred at a time when shifting cultivation was no longer used by farmers and no more land was being left fallow anymore. Despite the use of remote sensing technologies in this multidisciplinary project [31], the spatial and spectral resolution of Landsat satellite images and the classification trees' classifiers did not allow to distinguish woodlands from cashew orchards (carboveg-gb.dpp.pt), making it not possible to calculate