NJAS - Wageningen Journal of Life Sciences 60–63 (2012) 91–99

Contents lists available at SciVerse ScienceDirect

NJAS - Wageningen Journal of Life Sciences

journal homepage: www.elsevier.com/locate/njas

# The political ecology of land management in the oil palm based cropping system on the Adja plateau in Benin

R.H. Yemadje[a,b,*], T.A. Crane[c], P.V. Vissoh[b], R.L. Mongbo[b], P. Richards[c], D.K. Kossou[b], T.W. Kuyper[a,b]

[a] Department of Soil Quality, Wageningen University, P.O. Box 47, NL-6700 AA, Wageningen, The Netherlands
[b] Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, 01 BP 526 Cotonou, Benin
[c] Technology and Agrarian Development Group, Wageningen University, P.O. Box 8110, 6700 EW, Wageningen, The Netherlands

ARTICLE INFO

*Article history:*
Received 30 September 2011
Accepted 24 June 2012
Available online 28 July 2012

*Keywords:*
Bricolage
Customary land rights
Institutions
Oil palm fallow
Political ecology
Benin

ABSTRACT

The Adja plateau (Benin) is densely populated by tenant and landowner farmers engaged in oil palm based cropping. Landowners use oil palm sap for the production of *sodabi* (a local spirit), and an oil palm fallow (if no crops are grown beneath the palms) to restore soil fertility. In this area, growing oil palm for its oil is uncommon. Tenants access the land under specific contracts but are not allowed to plant oil palm. They grow food crops beneath the oil palm and extend the cropping period by severely pruning the palms because their right to grow food crops terminates when the palms reach a height of 2 m. The competing claims between landowners and tenants and between oil palm and annual food crops result in conflicts over practices that either degrade or restore soil fertility. Using a political ecology perspective, we examined how two overlapping institutions shape access to and management of the land: the customary tenure system and the legal system that was introduced to regulate titling and contracting. These institutions have divergent implications for tenants and landowners, in terms of both social equity and land management practices. The implications of this institutional patchwork (*bricolage*) for joint learning to achieve sustainable agriculture are discussed.



## 1. Introduction

Oil palm (*Elaeis guineensis*) is native to West Africa [1] but the world's largest production centres are now in Indonesia (36% of global production) and Malaysia (47%) [2]. The crop has long been of strategic importance in Benin. In 1856, King Ghezo of Dahomey (in the south of present-day Benin) initiated the palm oil trade and passed a law forbidding his subjects from cutting down oil palms. He allowed farmers to crop the land under the palms until these were so tall that other crops were shaded out. This rule resulted in farmers pruning the palm trees to slow their growth. When no crops are grown beneath the palms the land use is known as oil palm fallow [3]. Under conditions of land sufficiency and hence long fallow cycles the oil palm fallow is sustainable. Technically the Adja plateau oil palm system is considered an agroforestry system constituted by complementary economic and ecological relationships between the crops and the palms. The decision by the Benin government in 1993 to make the oil palm sector a national priority and the subsequent revival of oil palm as a mono-crop have contributed to intensification of land conflicts [4], even in areas that are marginal for oil palm because of insufficient rainfall. Increased land scarcity and intensification of cropping in turn has resulted in more intensive oil palm pruning (and hence lower palm productivity), intensifying conflicts between landowners and tenants.

South Benin has the highest population growth rate in Benin and hosts 50% of the country's population on only 7.7% of the national territory [5]. The high population pressure on the Adja plateau, where both the Adja and Fon ethnic groups live, implies that oil palm monocropping in commercial plantations would compete directly with food production. In fact, oil palm is not grown on the plateau primarily for its oil because the average annual rainfall (less than 1100 mm and highly variable, both spatially and temporally [6]) is not conducive to high levels of palm oil production. The climate is sub-equatorial with a bimodal rainfall distribution. The soils are classified as Nitisols (*terre de barre*; sandy to sandy loam soils, according to the FAO soil classification) and as *sols ferralitiques de dominance rouge* (in the French classification system) [7]. Such soils are intrinsically fertile (which explains in part the high population density on the plateau).

The oil palm based cropping system (OPBCS; for a list of acronyms, see Appendix A) combines oil palm grown by landowners for *sodabi* (a local commercial spirit) and food crops grown by tenants between the palms [2]. The landless tenants view any

* Corresponding author at: Faculté des Sciences Agronomiques, Université d'Abomey-Calavi, 01 BP 526 Cotonou, Benin. Tel.: +229 94208649.
*E-mail address:* rolandyemadje@yahoo.fr (R.H. Yemadje).

1573-5214/$ – see front matter 
http://dx.doi.org/10.1016/j.njas.2012.06.007

intrusion of commercial oil palm plantations into the OPBCS on the plateau as a threat to food production.

The intercropping practice traditionally consisted of a relatively long cultivation period during which the land was used for food crops, followed by a fallow period in which only oil palm trees were grown in dense stands, typically lasting 15 years [8]. Such extensive oil palm fallow periods are known as *palmier jachère* (similar to the *jachère de manioc* described by Saidou et al. [9]). Technically, the oil palm stage is not a fallow but a component of a contested cropping system. According to Brouwers [8], the OPBCS can be considered sequentially as two stages: an oil palm fallow stage and an intercropping stage with juvenile or more mature (but pruned) palm trees. The oil palm fallow restores soil fertility [8] and controls the aggressive cogon grass (*Imperata cylindrica*) [2,10]. At the end of the fallow period, the palms are cut down to extract the sap to make palm wine and spirits [11]; non-destructive tapping techniques are not commonly practised in this area. Thereafter, a new cycle can start based on the cultivation of food crops and palm seedlings on the same fields. The young palms of local provenance (*dura* type) are intercropped, with the permission of the landowner, with food crops such as cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogaea*), pigeonpea (*Cajanus cajan*), maize (*Zea mays*) and cassava (*Manihot esculenta*). The tenants try to prolong the period in which they are allowed to cultivate food crops by pruning the palm leaves. In contrast, in the oil palm belt of south-eastern Benin where higher rainfall allows intensive cultivation and encourages the use of improved oil palm cultivars (*tenera* type), food cropping underneath the palms typically is carried out for less than 5 years.

The high population density on the Adja plateau has implications for land access and tenure arrangements [8], which in turn have major implications for soil fertility management. Ownership of the land (and hence right of access) implies ownership of the oil palm trees planted on that land. The long-term social and technical sustainability of the OPBCS depends on the willingness of landowners to allow extended intercropping (and the consequent pruning practice) as long as soil fertility, supposedly built up during the fallow period, is maintained. However, Brouwers' study [8] did not show recovery of soil fertility as a result of fallowing, suggesting that the oil palm fallow may be driven more by landowners' concerns about maintaining their right of access to land than by agronomic considerations. Alternative tenurial arrangements do exist but appear to provide insufficient incentives to tenants to invest in soil fertility maintenance [12]. Land use practices have become politically charged and a cause of increasing tension between landowners and tenants. Soil fertility and land tenure issues are high on the development agenda on the Adja plateau. Technical advice about good practices is provided to landowners by both the governmental extension service and the research group supporting local initiatives for sustainable development (*Groupe de Recherche et d'Appui aux Initiatives de Base pour un Développement Durable*—GRAIB). An American-led programme, the *Millennium Challenge Account* (MCA), has implemented a land titling project from November 2007 to April 2011, that aimed to create a system of formal titling and registration (*plans fonciers ruraux*) throughout Benin (including 34 villages on the Adja plateau). The MCA attempted to demonstrate how to create effective and transparent governance of land, reduce the time and cost of obtaining a land title, and reduce the number of land disputes.

The present study examined, from a political ecology perspective, how the aforementioned pressures affect the social and agroecological dynamics of the OPBCS and identified options for soil fertility maintenance and land use under changing conditions. We document in this article the knowledge and practices of landowners and tenants and the ways in which their land management and tenure contracting practices are connected. Our analysis concludes that the conditions for sustainable development of the OPBCS depend on both technical and institutional conditions. We applied a political ecology framework [13,14] to analyse the relationships between land and soil management practices and socio-institutional processes. Following a presentation of our methodology the remainder of the article is structured in terms of performance constraints, soil fertility management practices, tenure arrangements, land tenure conflicts and state interventions.

## 2. Methodology

An overriding question guided this research. What are the constraints and opportunities for landowners' and tenants' farming practices in the oil palm based cropping system on the Adja plateau? Field research was conducted from March 2010 through March 2011. The term Adja plateau throughout this paper refers to the entire geographic area of the six administrative districts of Klouekanme, Toviklin, Lalo, Aplahoue, Dogbo and Djakotome (Fig. 1). The term *Adja farmer* refers to *ethnic Adja*. Similarly, the term *Fon* refers to *ethnic Fon* settled on the Adja plateau. The tenancy and ownership arrangements described are not specific to either ethnic group.

The diagnostic study was conducted following a literature review and archival research. In collaboration with the extension service, GRAIB, MCA, and with reference to relevant literature about the Adja plateau [15,16], two districts were chosen: Klouekanme and Toviklin. The choice was based on the following criteria: (1) OPBCS is the prevailing system of oil palm production [15,16], (2) local land tenure arrangements that determine rights to grow and rights to harvest oil palm and food crops [17], and (3) recent interventions in land tenure arrangements.

A short preliminary visit allowed the first author to introduce himself to key persons and to explore the area's characteristics – such as farmers' participation in the titling programme, customary tenure, and ethnicity – through discussions with key informants (farmers, local leaders, market dealers, and extension staff). Subsequently, a transect line across the area was drawn at random on a map and a mega-transect of 20 km aligned northeast to southwest was constructed with the aid of a global positioning instrument. The five villages positioned along the transect were selected as research sites; two of these villages had participated in the MCA programme (Agbago and Sognonouhoue) and three had not (Akouegbadja, Sogadjihoue and Tossahoue). The latter two villages turned out to be small and to share the same landscape; subsequently the farmers of both villages participated in joint focus group discussions [FDGs], and the results were combined in the analysis. This allowed us to use the MCA programme as an experimental treatment so as to enable comparison.

Fifteen focus group discussions [18] were held, three in each of the five study villages; each group consisted, on average, of 15 male landowners, 15 male tenants and 15 female tenants in order to provide detailed information on important local issues. The participants in each case were asked about growing food crops underneath the oil palm trees, about land tenure, conflicts, types of soils/land, criteria used to evaluate soil fertility, and innovations in soil and land management. The perceived constraints, their causes, and opportunities were then ranked by the participants and options for techno-institutional solutions to alleviate the main constraints were jointly analysed.

Next, a survey with 90 randomly chosen farming households was implemented, using a semi-structured questionnaire. The random selection of respondents was based on a list of household heads that was drawn up for each village, and triangulated with the chiefs and key informants in the villages. The randomly selected respondents represented a 20% sampling from the list of household heads. Each interview lasted about 1 h. As dependent household

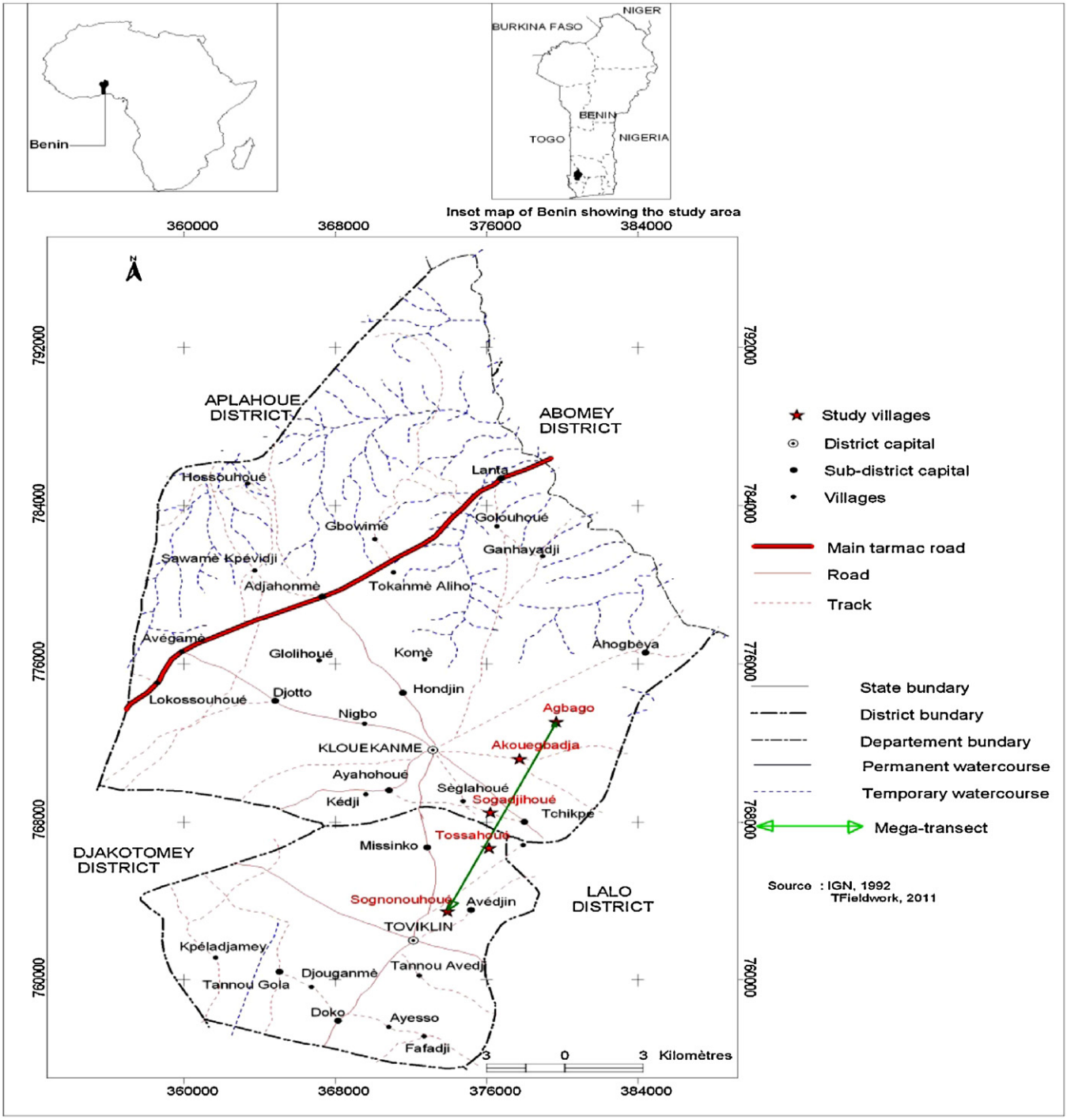


**Fig. 1.** Map showing the study districts and the mega-transect.
*Sources*: Data from IGN, 1992, and fieldwork for this study, 2011.

members could have different insights and options, we used additional information from the FDGs. A joint workshop with farmers (3 village chiefs from Agbago, Akouegbadja and Sognonnouhoue, the president of the oil palm growers from Klouekanme, 5 landowners and 5 tenants per village) was held at the end of the fieldwork to validate the findings.

The qualitative data from the key informants and FDGs were transcribed from field diaries, flipcharts and a tape recorder into English and stored electronically; thereafter, related information has been sorted and organized to generate a qualitative description. The quantitative data (relating to conflict resolution, nature of tenancy agreements, and number of plots under various land tenure arrangements) from the survey were entered in EpiData (EpiData Association, Odense, Denmark; version 3.1) to calculate percentages of occurrence.

## 3. Results

### 3.1. The OPBCS performance constraints

The landowners and the male tenants ranked poor soil fertility (Table 1) as the first constraint in all study villages, except

**Table 1**
Landowners' and tenants' ranking of perceived factors shaping the oil palm based cropping system. The higher the priority, the lower the score.

| Constraints | Agbago ($n=55$) | | | Akouegbadja ($n=70$) | | | Sogadjihoue and Tossahoue ($n=30$) | | | Sognonnouhoue ($n=50$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant |
| Poor soil fertility | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 3 |
| Poor rainfall | 2 | 2 | 2 | 3 | 4 | 5 | 2 | 2 | 2 | 1 | 1 | 2 |
| Unavailability of fertilizer | 3 | 4 | 4 | 2 | 3 | 3 | 3 | 5 | 5 | 3 | 4 | 4 |
| Lack of land and no access to land | 5 | 5 | 1 | 6 | 2 | 1 | 7 | 3 | 3 | 6 | 5 | 1 |
| Weed damage | 4 | 7 | 5 | 7 | 7 | 8 | 6 | 3 | 3 | 4 | 7 | 5 |
| Pest damage | 6 | 6 | 6 | 8 | 8 | 9 | 4 | 6 | 6 | 5 | 6 | 6 |
| Lack of credit | 7 | 3 | 7 | 9 | 9 | 4 | 5 | 7 | 7 | 7 | 3 | 7 |
| Field flooded | – | – | – | 5 | 6 | 7 | – | – | – | – | – | – |
| Lack of market to sell food crop | – | – | – | 4 | 5 | 6 | – | – | – | – | – | – |

*Source*: Farmer discussion groups: male landowners, male and female tenants, April–October 2010.

**Table 2**
Landowners' and tenants' ranking of perceived causes of soil fertility degradation. The lower the ranking, the more important is the cause of soil fertility degradation.

| Possible causes | Agbago ($n=55$) | | | Akouegbadja ($n=70$) | | | Sognonnouhoue ($n=50$) | | | Sogadjihoue and Tossahoue ($n=30$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant |
| Demographic pressure on limited lands | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Lack of rotation | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 |
| Ploughing[a] | 4 | 4 | 4 | 4 | 4 | 4 | | | | | | |
| Lack of crop residues to cover soil with | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 4 | 2 | 4 | 4 | 4 |
| Burning of pruned oil palm leaves | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 3 | 4 | 3 | 3 | 3 |

*Source*: Male landowners' and male and female tenants' focus group discussions, April–October 2010.
[a] Farmers in Sognonouhoue and Sogadjihoue and Tossahoue do not practise ploughing or ridging.

Sognonnouhoue where low rainfall was ranked first. Low rainfall was identified as the second most important problem. The female tenants ranked access to land as their first constraint, except in Sogadjihoue and Tossahoue. The landowners often ranked unavailability of inorganic fertilizers third. In general, only tenants listed land tenure arrangements as a constraint. Poor soil fertility was attributed to several factors (Table 2). In Agbago and Akouegbadja, the burning of crop residues (including pruned oil palm leaves) in itself was thought to reduce soil fertility in the long term. In the three other villages residue burning was not valued so negatively; landowners in these villages ranked oil palm fallow high as a soil fertility management strategy (Table 3). These phenomena are linked.

### 3.2. Soil fertility management practices

The respondents listed numerous practices (Table 3) for maintaining soil fertility. Inorganic fertilizer is used and was ranked

**Table 3**
Landowners' and tenants' ranking of strategies to cope with low yields and poor soil fertility. The lower the ranking of a land management practice, the higher its priority.

| Land management practices | Agbago ($n=55$) | | | Akouegbadja ($n=70$) | | | Sognonouhoue ($n=50$) | | | Sogadjihoue and Tossahoue ($n=30$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Landowner | Male tenant | Female tenant | Landowners | Male tenant | Female tenant | Landowner | Male tenant | Female tenant | Landowner | Male tenant | Female tenant |
| Household waste | 2 | – | 2 | 2 | – | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Inorganic fertilizer | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Oil palm fallow | 10 | – | – | 10 | – | – | 3 | – | – | 3 | – | – |
| Rotation cowpea/maize | 3 | 2 | 5 | 3 | 2 | 5 | 4 | 3 | 3 | 4 | 3 | 3 |
| Rotation groundnut/maize | 3ex | 6 | 6 | 3ex | 6 | 6 | 4ex | 3ex | 3ex | 4ex | 3ex | 3ex |
| Residue burning | – | – | – | – | – | – | 6 | 5 | 5 | 6 | 5 | 5 |
| Non-burning of on-field biomass | 11 | – | 7 | 11 | – | 7 | 9 | – | – | 9 | – | – |
| Pigeonpea | 7 | – | – | 7 | – | – | 7 | – | – | 7 | – | – |
| Cassava fallow | 5 | 5 | 3 | 5 | 5 | 3 | 8 | – | – | 8 | – | – |
| Mucuna | – | – | – | – | – | – | 10 | – | – | 10 | – | – |
| *Acacia* spp. fallow | – | – | – | – | – | – | 11 | – | – | 11 | – | – |
| Sweet potato | – | 4 | – | – | 4 | – | – | – | – | – | – | – |
| Natural fallow | 8 | – | – | 8 | – | – | 12 | – | – | 12 | – | – |
| Tomato | 6 | 3 | 4 | 6 | 3 | 4 | – | – | 6 | – | – | 6 |
| Plough/ridges[a] | 9 | 7 | – | 9 | 7 | – | | | | | | |

*Source*: Male landowners', and male and female tenants' focus groups discussions, April–October 2010.
[a] Farmers in Sognonouhoue and Sogadjihoue and Tossahoue do not practise ploughing or ridging.

first as the main strategy for maintaining crop yields by both landowners and tenants in Agbago and Akouegbadja whereas those in Sognonnouhoue and Tossahoue ranked this strategy second in importance after application of household waste (a mixture of compound wastes from many sources). The cultivation of tomato (and, by male tenants only, possibly also sweet potato), a crop that is always fertilized, was mentioned frequently as a response to poor yields of other crops, mainly in Agbago and Akouegbadja, suggesting that the fertilizer used on this market crop was regarded beneficial for subsequent crops. In Agbago and Akouegbadja, the male tenants interviewed said that they did not bring household wastes to the rented fields unless they were assured of the wastes benefiting their crops in the subsequent cropping seasons. Extension agents had observed that when tenants applied wastes on rented fields, some landowners claimed back the fields in order to benefit from the improvement following waste application. Oil palm fallow was ranked third by landowners in the latter two villages. Other forms of fallow that were mentioned by these landowners were *Mucuna* fallow and *Acacia auriculiformis* fallow. Cassava fallow was mentioned especially in Agbago and Akouegbadja and was ranked as important by landowners and tenants, both male and female. Landowners always ranked natural fallow very low. Rotations of maize and legumes (cowpea, groundnut) were ranked relatively high by landowners and tenants in all study villages.

The landowners in Agbago, subsequent to the confidence they gained through land registration that resulted from the MCA's intervention, mentioned their willingness to admit tenants access and crop their land following an oil palm fallow.

The landowners in both Agbago and Akouegbadja did not burn biomass on their oil palm fields (claiming that this practice was detrimental to soil fertility; Tables 2 and 4) whereas this practice was still followed in the other villages, where it was considered to contribute to soil fertility. Some landowners, and in some villages also female tenants, referred to the importance of using the palm leaves as mulch; male tenants did not rank this practice.

In Agbago and Akouegbadja, both villages with a Fon population, ridging was practised by both landowners and male tenants. In the villages where the Adja are dominant, ridging was not practised. A sharp hoe blade is used in the Fon ridging technique, which consists of cutting deep into the soil and piling the dirt into the ridges. The earth of the old ridges is cut and turned over at the start of each season, one half into the furrow to the left and the other half to the right. In this way the soil and decomposing organic matter from lower levels are brought to the surface and form a substratum for the new crops planted on top of the ridges.

Female tenants in all the study villages reported growing a cowpea variety (*egbamonlou* in the Adja language) that is perceived by both male and female tenants to have a negative effect on soil fertility but that fetches the highest market price of all cowpea varieties. In the discussions many farmers mentioned (Table 4) their willingness to experiment with cowpea varieties, including *egbamonlou*. Landowners, preferring to combine household waste application with the addition of a small amount of inorganic fertilizer, also showed interest in experimenting with soil fertility management options; however, their favoured practice, being partly a function of the nature/quality of the organic matter, demands a long-term experimental design. In addition, landowners and tenants wish to evaluate the practice of ridging in relation to soil fertility management, since there is a clear difference in practice between Adja and Fon farmers.

### 3.3. Land tenure regimes at village level

Access to land for farming is unequal. Land can be accessed under a number of arrangements, resting on permanent or non-permanent rights (Table 5). Two main types of permanent landholding were identified: family lands and individual lands (either by patriarchal and matriarchal inheritance or by purchase, *doukohwoue*). There were no chiefs' holdings or government lands in the study villages. Adja women have no land inheritance rights and have to rely for access on one of the non-permanent arrangements described in the next section. The *doudeasso* tenure arrangement (Table 5) was found only in Sogadjihoue, Sognonnouhoue and Tossahoue. The farmers in Agbago and Akouegbadja knew about this system of tenure, but had abandoned it.

### 3.4. Land tenure conflicts at village level

The ambiguity and non-respect of tenure arrangements (Table 5) are often sources of conflict over land. Conflicts occur between tenants and landowners in the case of *doudeasso* when tenants are reluctant to quit the land. In order to keep the land for a longer period than implied by the agreement, tenants severely prune the palms to prevent them from reaching the critical height of 2 m. Landowners, realizing that intensive pruning can substantially prolong the time that tenants can remain on the land, have decided that tenants have to give up the tenancy and leave the land after 25 years. One tenant in a village where *doudeasso* is still practised shared his case: *I got this land through* doudeasso *in 1986. I have been cropping since then by severely pruning the oil palm trees, which never grew over 1 m. Now I am almost at the end of the rental period. In previous times, the planting of oil palm trees was included in the* doudeasso *arrangement and, if lucky, one could plant oil palm on the rented land before conflict arose, and one's rights were saved. If not, the risks of losing the land before the end of the 25 years were not negligible. Nowadays, the right to plant oil palm trees has been removed from* doudeasso *and the renter has only the right to grow food crops*. (A farmer from Sognonouhoue, 26/04/2010).

In the case of *deman* (sharecropping), the risk of conflict arises when the tenant tries to take all the profit from the harvest without sharing it with the landowner. As soon as a landowner is aware of this happening, he forces the tenant off the land even if the term of the contract has not expired. *Ahaya*, renting, is also a source of conflict. Land is rented out usually for a period of up to 5 years. After one year the landowner might rent out the same land to another tenant who then tends to fight over their cultivation rights and acts of vandalism occur. The conflict often ends in negotiations with the landowner; typically, the resolution means that the 'surviving' tenant must pay two to three times the fee originally agreed. Another practice is that if the landowner is in need of cash he sends one of his relatives to argue that the tenant is using family land, and threatens to claim it back; in this case, the tenant is also forced to pay extra to retain access to the land and the right to cultivate.

Two thirds of the respondents (landowners and tenants) stated that they had resorted to the political administration to resolve their conflict (Table 6). Only 6.6% said that they had tried to reach a friendly settlement, 7.7% had gone to the law court, a few had tried to resolve the conflict through the police office and 18.6% said that they tried to find a solution by discussion with the families involved. The disputes are hard to resolve because 93% of the contracts in our sample were oral and only 7% were written. Of the six written contracts, only one had been witnessed by the legally designated authority. The oral contracts were witnessed more often than not. Witnessing was very common in Sogadjihoue, but it occurred infrequently in Tossahoue.

### 3.5. State intervention related to land tenure on the Adja plateau

State intervention in land tenure started in the early colonial era and the colonial land tenure laws remained effective after Benin became independent in 1960. Articles 711, 712, and 716 of the

**Table 4**
Options jointly identified for technical and institutional innovation.

| Farmers | Technical options | Institutional options |
|---|---|---|
| Landowners | - A learning platform<br>- The use of household waste<br>- The use of inorganic fertilizer<br>- Effect of oil palm fallow on subsequent crops | - Written contracts (to avoid tenants establishing claims on the land). Reduction of duration of rental agreement to 3–4 years<br>- Land registration |
| Male and female tenants | - Stop burning pruned leaves in the field<br>- The rotation of cereals with legumes<br>- Use of cow dung/household refuse<br>- Burying crop residues in the soil<br>- Use of inorganic fertilizer | - Written contract (to prevent landowners chasing them off the land).<br>- Involve the village chief in any transaction.<br>- Written contract to clarify the custom of 'land gifts' so that children can inherit securely |

*Source*: Akouegbadja village group discussions ($n = 70$), April–October 2010.

**Table 5**
Land tenure arrangements for access to land and oil palm trees.

| Tenure arrangements | Type of land, crops | Tenure rights | Other terms and conditions |
|---|---|---|---|
| *Doudeasso*, pledge or mortgage | Food crop land, oil palm land | All cultivation rights, including oil palm trees. The land is to be returned after the trees reach a height of 2 m. Not used in Klouekanme anymore.<br>Nowadays, it is fixed at 20 or 25 years by landowners. | In the past, the critical height was not well-defined; landowners do not use a tool to measure height. The practical guideline was that it is reached when the tenant or landowner is not able anymore to touch the first palm leaf or fruits while standing under the tree. This marks the end of the contractual arrangement for tenants. When the tenant is taller than the landowner, the critical height does not have the same meaning for both of them; this has caused many conflicts in the past. The 2 m rule has been institutionalized and marks the end of the contract; it has evolved from a tenants' right to plant oil palm as well as food crops, and become restricted to only food crops. |
| *Deman (2/3)*, and *deman (1/2)*, sharecropping | Food crops land, oil palm land, oil palm trees | 40–50 years ago, a cultivation right that included oil palm trees. The palm fruits were shared between the tenant and the landowner. Nowadays, it covers only the crop harvest. There is no right to tap palm wine, nor sell trees or collect fruits.<br>The tenant is not allowed to transfer the right of cultivation to a third party. | In 1945–1950, the rate of 2/3 of the yield went to the tenant and 1/3 to the landowner. Nowadays, because of shortage of land, landowners claim half of the yield and agree to purchase the inorganic fertilizer. Obligations are shared when shift in deman nature occurs. |
| *Ahaya*, rental | Farm land with severely pruned oil palm trees | Cultivation right against a yearly payment. Cultivation right can be transferred to a third party. Food crops can be cultivated but there is no right to plants oil palm trees on the land. The land must be returned at the end of the contract (typically, 3–5 years). | The crops are managed by the renter only. The fee is paid annually; the level depends on land fertility. 5000 FCFA per bowive per year for fertile land; 2000 FCFA per bowive per year for less fertile land. |
| *Dekanhlouehloue*, oil palm contract | Oil palm fallow (*dekan*), oil palm trees | The purchase of young palm trees gives a right to harvest the trees and the tapped wine. The land beneath the trees might be farmed by the landowner. | The purchase is often made by an alcohol distiller in need of a secured sap supply. |
| *Aikougbanwhihoue*, Borrowing | Farm land | All cultivation rights, not including trees.<br>No delegation to a third party. | |

*Source*: Villages group discussions and key informant discussions, April–October 2010. Format of table inspired by Delville [30].
Notes: *bowive* is an Adja unit of length, 1 *bowive* is approximately 2 m. 1 *kanti* is equivalent to a square of 12 × 12 *bowive* or approximately 576 $m^2$. 1 € = 655 FCFA.

**Table 6**
Conflict resolution, by institution regulating resolution.

| Participation in land titling programmes | Number of resolved conflicts, by the institutions regulating the resolution | | | | | |
|---|---|---|---|---|---|---|
| | Study villages | Between family members | Political administration | Police office | Law court | Through friends |
| MCA | Agbago | 4 | 24 | – | – | – |
| – | Akouegbadja | 3 | 17 | – | 5 | 1 |
| – | Sogadjihoue | – | 5 | – | – | 2 |
| – | Tossahoue | – | 8 | – | – | 3 |
| MCA | Sognonnouhoue | 9 | 6 | 1 | 2 | – |
| | Total no. (% of total) | 16 (18.6) | 60 (66) | 1 (1.1) | 7 (7.7) | 6 (6.6) |

*Source*: Heads of Households survey ($n = 90$), April–October 2010.
*Notes*: Agbago, Akouegbadja and Sogadjihoue in Klouekanme had been influenced by *PGTRN* land titling intervention in the past. The numbers represent cases of conflict, which had recourse to the specific institution noted. Empty cells mean no information.

French civil code, and the 1935 decree on landholding rules and regulations in the French West African colonies (dated 15 November 1935) are the main legal provisions applicable to the identification and management of property; they fall under the administration of the state and local authorities. The decree of 2 May 1906 in its first, second and third articles, which set up a system for recording written agreements between indigenous parties, is another example of colonial legislation that persisted into the independence era.

In addition, in 1931, the government of Dahomey signed a circular (Circular 128AP of 19 March) on customary tenure, which until recently has served as reference. In 2007, a new law (law 03 of 16 October) and in 2008 a decree (law 618 of 22 October) were approved and signed. The law of 2007 is the latest that governs land tenure in Benin. However, several of its articles do not take into account the actual conditions that have been revealed in our study of landowners and tenants. Article 73, for example, does not recognize a fallow period longer than 5 years and as a consequence oil palm fallow (*dekan*) is omitted entirely. Article 68 does not recognize farmlands smaller than 2 ha, excluding almost all of the Adja plateau's smallholders. Article 43 refers to the creation of multi-level structures (on which the MCA has based its land tenure measures) and article 47 forbids contracts that are not written and not witnessed, thereby effectively making illegal the personal oral agreements encountered in our study.

In 1995, a government programme was initiated for the management of territories and natural resources (*Programme de Gestion des Terroirs et Resources Naturelles*—PGTRN) that began to issue and register land titles, starting in six villages in Klouekanme. In 2006, the MCA's land titling and registration programme, in collaboration with the Benin government, was initiated in association with GRAIB, which became the local executor of the land titling programme. GRAIB is connected to various multi-level state services such as the village level land management service (*Service villageois de gestion foncière*—SVGF), the sub-district level land management committee (*Sous-commission de gestion foncière d'arrondissement*—SCGFA) and the district level land management committee (*Comité de gestion foncière*—CoGeF).

Table 6 describes the impact of the titling programmes. The data suggest that only in Agbago, Akouegbadja and Sogadjihoue, where both land titling programmes were undertaken, written contracts have begun to be used. It is interesting to note that these three villages also record the most frequent resort to the political administration for conflict resolution. Tossahoue, which did not benefit from either of the titling programmes, records the largest number of cases of contracts based on oral agreement without witnesses. However, in a nearby village, Sogadjihoue, which has been influenced by the PGTRN titling programme, the number of oral contracts without witnesses has substantially decreased and oral contracts are now as a rule witnessed by legally designated authorities. This study recorded a case of a written contract witnessed by the authorities in Agbago, a village whose practices have been influenced by both titling programmes.

Currently, subsequent to the titling and registration programmes, tenants in Agbago and Sognonnouhoue (where the MCA land titling programme took place) find themselves excluded from access to land and cultivation rights. Tenants who have been excluded from the titling and registration effort, reported that they were chased off the land they were cultivating when land registration became imminent: they are not the landowner and their cropping rights were not taken into account when no witness could attest to their tenurial contract. This negative consequence of land titling underlies tenants' perceptions of the interventions that might benefit them (Table 4) by securing their access to land and cultivation rights in the OPBCS.

## 4. Discussion

This study analysed a situation in which landowners use a long fallow for various purposes: soil fertility regeneration, weed suppression and to back up their claims to the land. Tenants have access to the land for cropping on the basis of short-term tenure but try to prolong the tenure period through the (sometimes severe) pruning of the oil palms to prevent the trees growing to a height of 2 m. However, presently the OPBCS is not a win–win situation; rather, it can be described as an arena in which competing claims on cropping practices and land ownership are linked with beliefs about decline and restoration of soil fertility.

Brouwers [8] described the fallow period primarily as a soil fertility management strategy in an integrated agroforestry system. Our analysis points instead towards an explanation based primarily on landowners' interests in long-term control over land. The differences between owners' and renters' perspectives and practices regarding land access issues highlight the ways in which the oil palm fallow emerges from tensions among divergent actors rather than by design as an integrated agroforestry practice. Changes in agronomic practices, production constraints and local land tenure regimes are closely intertwined with the socio-political dynamic between landowners and land-renters. Complex interactions between customary and formal legal land titling and tenure further complicate the dynamic.

This study has analysed the actors' rankings of constraints (Tables 1 and 2) and thereby revealed discrepancies between the five villages. We speculate that differing perceptions of the importance of (declining) rainfall may not indicate differences in weather patterns between the villages so much so that differences in the ability of the soil to retain water, i.e., in water-holding capacity, are related to different levels of soil organic matter. In Agbago and Akouegbadja, farmers link the practice of pruning and burning oil palm leaves to the claim that the soil is becoming impoverished. This claim suggests that the idea that continuous pruning is in itself bad for the soil is a common belief, which they then rationalize by linking soil fertility to the practice of burning rather than pruning. Landowners as well as tenants perceive that household waste (an important source of organic matter) is generally ineffective for the subsequent crop in the first year and effective in boosting yields only in the second and third year. Their perception of a delayed effect partly explains the fact that tenants (contracting cultivation rights under only three-year tenure) do not apply household waste. This response has been found also among tenants in Ghana [19,20] where migrants with insecure rights do not invest in long-term soil fertility management.

Two important institutions shape access to and management of land on the Adja plateau: customary tenure and formal, legal land rights and contracts. Elsewhere, these two categories have been opposed respectively as informal versus formal, traditional versus modern, or socially embedded versus bureaucratic constructs [21]. Each set of terms has its own connotations concerning the desirable pathways for institutional evolution. North [22] has defined institutions as the rules of the game that remove uncertainty in human interaction, a definition that emphasizes reduced uncertainty and lower ambiguity. However, West African tenure systems seem to be characterized by ambiguity. Adjei-Nsiah [23], for instance, has shown that ambiguity is integral to the tenure system around Wenchi, Ghana. The ambiguity of the current situation – with both customary tenure and the more recent efforts to put in place a formal, legal tenure system – has the potential to increase competing claims on the Adja plateau, as has occurred elsewhere under comparable circumstances [23]. Formal legal land titling and contracts are seen to disadvantage tenant farmers because the formal contracts increase the power of those who are already in stronger positions (i.e., the landowners). Cleaver [21] introduced

the concept of institutional *bricolage* (patchwork) to recognize the coexistence of institutions that are likely to co-evolve in indeterminable ways rather than to evolve in predictable linear fashion whereby one institution is replaced by another more modern one. A consequence of *bricolage* is that the institutions governing tenure do not reduce or remove uncertainty but to some extent maintain it. Institutional innovation through formal titling programmes runs the risk of increasing tenants' insecurity because the power to manoeuvre in such ambiguous situations is not equally divided between landowners and tenants. The landowners effectively use the patchwork of institutions as political tools.

Currently, the two tenure systems exist uncomfortably side by side. The *doudeasso* land arrangement, found only in Sognonnouhoue, has been abandoned by landowners in Agbago and Akouegbadja because they considered that it reduced their power and gave too many land rights to the tenants, who thus could keep pruning and cropping at their own convenience. The *ahaya* and the *deman* are currently the dominant land tenure arrangements in our study area and both are of short duration. Tenants typically have limited rights on these lands and are sometimes chased off the land in which they have invested to improve soil fertility. Similar cases have been reported from Ghana and central Benin [19,24]. These instances continue to occur despite the fact that tenants and landowners may live in the same village or sometimes even in the same household. These tenants, short of land, do not have enough security under these tenure arrangements to invest in long-term soil fertility management and because it is evident that the landowners will take the profit from the improved soil fertility (especially if the perceived delayed effect of household waste proves to be true).

Although the land titling and registration effort seeks to reduce uncertainty, the social equity of its effects may be questioned. At present, the patchwork of access rules and cultivation rights in the oil palm agroforestry system allow tenants to access land and grow food crops but the cost is paid both in terms of soil fertility and tenants' security. Our data suggest that these tensions could be relaxed by clearer agreements between both parties, based on a clarification of rights and non-authorized practices, and a formalization of the rights enshrined in the customary land tenure arrangements between owners and tenants.

The diagnostic study made use of a natural experiment in the form of MCA's formal land titling programme, which contributed to the exclusion of tenants operating under customary arrangements for access to land and the right to grow food crops Changes in land tenure are shown in our study to undermine the long-term oil palm fallow land use system, echoing findings from other political ecology research [25,26]. State intervention by means of formal land titling and registration has allowed landowners to use their land as collateral for credit. However, the intervention also opens up the possibility that others will lose land through default and by the sale of land to people outside the farming community. A common consequence of such a dynamic is that it can be expected to concentrate land ownership and disenfranchise smallholders and renters. The local policy on claims to titles on land, in practice privileges landowners and undermines the flexibility of the local land tenure system. Male and female tenants are the losers. Furthermore, registration penalizes the holders of secondary land rights, especially women and herders; these rights are not recorded in the register and are more easily dismissed in disputed claims [27]. The social dynamics in this case closely echo those described by Schroeder [25] in the Gambia, where male landholders effectively took control over land through practices promoted by a development project that did not pay attention to the female gardeners' rights [28].

The government of Benin has added to the pressure created by the changes in land tenure and titling by launching a national oil palm plantation policy designed to increase oil production. However, this policy has overlooked the fact that the Adja plateau is not suitable for large-scale plantations aiming to produce palm oil. It does not take into account the aspirations of landowners and tenants in the OPBCS, thereby in effect creating another potential source of competing claims, as has occurred elsewhere under comparable circumstances [29]. Under the conditions described in this article, actions to regulate the tension between landowners and tenants through consultation and negotiation that also involve the local authorities [30], could be encouraged. Such consultation and negotiation have proven to be successful elsewhere in Benin [9].

Written contracts between landowners and tenants are beginning to be used though still somewhat sparingly and the resort of both parties to witnesses and administrative authorities (Table 6) is increasing. The written contracts that existed during our study relate to (1) the *doudeasso*, a pledging agreement, (2) the *dekanhlouehloue*, relating to palm tree contracts, and (3), land purchases. However, written contracts that express the rules of customary land tenure are never a perfect solution because of the rigidity they bring to local land transactions. Written contracts also must be registered with and enforced by legal authorities, implying additional costs in the form of fees and observance of the letter of laws such as the land tenure law of 2007. Moreover, it is not exactly clear what kind of endorsement written contracts dealing with customary arrangements might need, because (at present) they do not resemble a formal legal document [31]. There are so many omissions and unwritten conditions in the certificates drawn up by farmers that the exact nature of the rights they confer is unclear. Similarly, the legal inconsistencies in Benin's land tenure law of 2007 raise questions about its applicability and functioning.

## 5. Conclusions

Our diagnostic study has demonstrated how the technical and institutional dimensions of the OPBCS are intertwined, with negative consequences for tenant security and soil fertility.

The challenge of sustaining or improving the OPBCS on the Adja plateau requires further research in several fields. The nature of the biophysical and social dynamics of soil fertility in the oil palm fallow remains an unsolved contextual question. For example, the mechanisms by which soil fertility is affected by the use of inorganic fertilizer and organic amendments, the choice of crop species and crop varieties, and the power balance between landlords and tenants, are not yet known. An ethnography on soil fertility management practice, including analysis of the actors' knowledge about soil fertility and the social organization and performance of those practices, would help to provide an answer [32,33]. The various land management practices offer the possibility of creating a research design for identifying and measuring the mechanisms of soil degradation or soil fertility maintenance [34]. Participatory soil fertility experiments could be conducted with landowners and tenants in the villages of Akouegbadja and Agbago to study oil palm fallow in relation to the various ways of using household waste in order to co-produce effective technologies that are biophysically effective and socially acceptable within the given institutional context.

Tenants and landowners recognize that land tenure, state intervention and the law to an important extent determine their capacity to produce oil palm products. It is argued in this article that the challenge is not only to develop soil fertility management strategies for higher yield but also to bring about institutional transformations within which such strategies would become rational for tenants and landowners. The current patchwork of socially embedded customary land tenure arrangements and bureaucratic formal

titling programmes would need to be blended, to create a hybrid system, if the negative effects of replacing informal tenure systems by formal ones are to be avoided. While studies suggest that promoting tenure security is the efficient way to promote investment in land management [35], such changes might transform the OPBCS from a zero-sum agroforestry system based on competing claims into a win–win situation.

## Acknowledgements

We gratefully acknowledge stimulating discussions with Professor Niels Röling. We also acknowledge the discussions during the field visits with Dr Anastase Azontonde and Dr Aliou Saïdou. We wish to thank Dr Dorothea Wartena for putting at our disposal her vast knowledge about the Adja plateau, and two anonymous referees for their critical comments on an earlier version of this paper. Finally, we are grateful to the local collaborators who made this research possible and exciting.

## Appendix A. List of acronyms

| Acronym | French meaning | English meaning |
|---|---|---|
| OPBCS | – | Oil palm based cropping system |
| NGO | – | Non-governmental organization |
| GRAIB | Groupe de Recherche et d'Appui aux Initiatives de Base pour un Développement Durable | Research group of support to local initiatives for sustainable development |
| MCA | – | Millennium challenge account |
| FAO | – | World Food and Agriculture Organization |
| FDGs | – | Focus group discussions |
| PGTRN | Programme de Gestion des Terroirs et des Ressources Naturelles | Management of territories and natural resources programme |
| SVGF | Service Villageois de Gestion Foncière | Village level land management service |
| SCGFA | Sous-Commission de Gestion Foncière d'Arrondissement | Sub-district level land management committee |
| CoGEF | Comité de Gestion Foncière | District level land management committee |
| *Kanti* unit of area | – | Equals 576 $m^2$ or approximately 0.06 ha |
| FCFA | – | 1 € = 655 FCFA |
| *Bowive* | – | *Adja* unit of length; approximately 2 m |

## References

[1] R. Portères, Berceaux agricoles primaires sur le continent africain, Journal African History 3 (1962) 195–210.
[2] P.V. Vissoh, S.A. Adjei-Nsiah, A. van Huis, N. Röling, Opportunities for oil palm development in Benin and Ghana: institutional conditions for technological change, in: A.o.A. Biology (Ed.), Agriculture: Africa's Engine for Growth—Plant Science & Biotechnology Hold the Key, Rothamsted Research, Harpenden, 2010, p. 8.
[3] B.T. Kang, M.N. Versteeg, O. Osiname, M. Gichuru, L'agroforesterie dans la zone humide de l'Afrique: trois réussites, L'agroforesterie aujourd'hui 3 (2) (1991) 4–6.
[4] S. Fournier, C. Jannot, A. Okounla-Biaou, E. Pede, La transformation artisanale de l'huile de palme au Bénin et au Nigeria, Freie Universitat Berlin, SRPH, Berlin, 2001.
[5] A.C. Mondjannagni, Campagnes et villes au Sud de la République Populaire du Bénin, Mouton, Paris, 1977, 615 pp.
[6] E. Amoussou, V.S.H. Totin, M. Boko, P. Camberlin, J. Pérard, Instability of space–time rainfall regimes in the payment of basin Mono-Couffo and its impact on the flow of 1961 to 2000, in: 3rd International Conference, African Monsoon Multidisciplinary Analysis (AMMA), Ouagadougou, 2009.
[7] V. Koudokpon, J. Brouwers, M.N. Versteeg, A. Budelman, Priority setting in research for sustainable land use: the case of the Adja Plateau, Benin, Agroforestry Systems 26 (1994) 101–122.
[8] J.H.A.M. Brouwers, Rural People's Knowledge and its Response to Declining Soil Fertility. The Adja Case (Benin), Wageningen Agricultural University, Wageningen, 1993, 157 pp.
[9] A. Saïdou, D. Kossou, A. Azontonde, Deo-G.J.M. Hougni, Effet de la nature de la jachère sur la colonisation de la culture subséquente par les champignons endomycorhiziens: cas du système 'jachère' manioc sur sols ferrugineux tropicaux du Bénin, International Journal of Biological and Chemical Sciences 3 (2009) 587–597.
[10] P.V. Vissoh, Participatory Development of Weed Management Technology in Benin, WUR, Wageningen University, Wageningen, 2006.
[11] A. van den Broek, I.T. Gbego, Sustainability of small ruminant production on the Adja Plateau, South Benin, NJAS: Wageningen Journal of Life Sciences 42 (1994) 69–76.
[12] G. Biaou, Régime foncier et gestion des exploitations agricoles sur le Plateau Adja au Bénin, in: Economie Rurale du CIRES, CIRES, Côte d'Ivoire, 1991, pp. 207.
[13] T.A. Benjaminsen, J.B. Aune, D. Sidibé, A critical political ecology of cotton and soil fertility in Mali, Geoforum 41 (2010) 647–656.
[14] P.M. Blaikie, The Political Economy of Soil Erosion in Developing Countries, Longman Scientific, London, 1985.
[15] N.E. Houngbo, B. Sinsin, A. Floquet, Pauvreté chronique et pauvreté transitoire sur le plateau Adja au Bénin: caractéristiques et influence sur la mise en œuvre des pratiques agricoles de conservation des terres, Tropicultura 26 (2008) 186–189.
[16] L. Kater, Agroforesterie avec le palmier a huile sur le plateau Adja, in: Synthèse de littérature, KIT/IITA, 1993, pp. 54.
[17] D. Wartena, Styles of making a living and ecological change on the Fon and Adja plateau in South Benin, ca. 1600–1990, WUR, Wageningen Agricultural University, Wageningen, 2006, pp. 700.
[18] E.F. Fern, in: E.F. Fern (Ed.), Advanced Focus Group Research, Sage, 2001, p. 254.
[19] S.A. Adjei-Nsiah, C. Leeuwis, K.E. Giller, O. Sakyi-Dawson, J. Cobbina, T.W. Kuyper, M. Abekoe, W. van der Werf, Land tenure and differential soil fertility management practices in Wenchi, Ghana: implication for interdisciplinary action research, NJAS: Wageningen Journal of Life Sciences 52 (2004) 331–348.
[20] O.I. Oladele, A. Kolawole, T. Wakatsuki, Land tenure, investment and adoption of Sawah rice production technology in Nigeria and Ghana: a qualitative approach, African Journal of Agricultural Research 6 (2011) 1519–1524.
[21] F. Cleaver, Reinventing institutions: bricolage and the social embeddedness of natural resource management, The European Journal of Development Research 14 (2002) 11–30.
[22] D.C. North, Understanding the Process of Economic Change, Princeton University Press, Princeton, 2005.
[23] S. Adjei-Nsiah, C. Leeuwis, K.E. Giller, T.W. Kuyper, Action research on alternative tenure arrangements in Wenchi, Ghana: learning from ambiguous social dynamics and self-organized institutional innovation, Agriculture and Human Values 25 (2008) 389–403.
[24] A. Saïdou, T.W. Kuyper, D. Kossou, R. Tossou, P. Richards, Sustainable soil fertility management in Benin: learning from farmers, NJAS: Wageningen Journal of Life Sciences 52 (2004) 349–369.
[25] M.K. Steinberg, Political ecology and cultural change: impacts on swidden-fallow agroforestry practices among the Mopan Maya in Southern Belize, The Professional Geographer 50 (1998) 407–417.
[26] K. Zimmerer, The regional biogeography of native potato cultivars in highland Peru, Journal of Biogeography 18 (1990) 165–178.
[27] C. Toulmin, Securing land and property rights in subSaharan Africa: the role of local institutions, Land Use Policy 26 (2008) 10–19.
[28] R.A. Schroeder, Shady practice: gender and the political ecology of resource stabilization in Gambian Garden/Orchards, Economic Geography 69 (1993) 349–365.
[29] J. Carney, Converting the wetlands, engendering the environment: the intersection of gender with agrarian change in the Gambia, Economic Geography 69 (1993) 329–348.
[30] P.L. Delville, C. Toulmin, J.-P. Collin, J.-P. Chauveau, Negotiating Access to Land in West Africa: A Synthesis of Findings from Research on Derived Rights to Land, IIED, London, 2002.
[31] P. Lavigne-Delville, When farmers use 'pieces of paper' to record their land transactions in Francophone rural Africa: insights into the dynamics of institutional innovation, The European Journal for Development Research 14 (2002) 89–108.
[32] K. Jansen, S. Vellema, What is technography? NJAS: Wageningen Journal of Life Sciences 57 (2011) 169–177.
[33] P. Richards, Cultivation: knowledge or performance? in: M. Hobart (Ed.), An Anthropological Critique of Development: The Growth of Ignorance, Routledge, New York, 1993, pp. 61–78.
[34] E. Nuijten, Combining research styles of the natural and social sciences in agricultural research NJAS: Wageningen Journal of Life Sciences 57 (2011) 197–205.
[35] G. Beekman, E.H. Bulte, Social norms, tenure security and soil conservation: evidence from Burundi, Agricultural Systems 108 (2012) 50–63.