2013 SCIENTIFIC ACTIVITIES REPORT OF THE LABORATORY OF APPLIED ECOLOGY (LEA)

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Foreword

The Laboratory of Applied Ecology (LEA) of the Faculty of Agronomic Sciences (FSA, University of Abomey-Calavi, UAC-Benin) was created in 1994 by Professor Brice Sinsin.

LEA is one of the leading institutions of research on natural resources management in Benin. The major research fields in which LEA is currently involved include (i) desertification and land degradation, biodiversity and climate change, (ii) carbon stock measurement and monitoring of carbon sequestration, (iii) agriculture productivity and capacity building in organic agriculture, (iv) ethnobotany and new crops development; (v) management of traditional agroforestry systems and humid zones; (vi) ecological restoration of degraded areas; (vii) conservation and sustainable management of wild palms; (viii) management of Non Timber Forests Products; (ix) management of protected areas (National Parks, hunting zones, community conservation areas); (x) bio Monitoring of wildlife; (xi) red list of threatened plants and wildlife; (xii) Pasture Science; (xiii) Ecological and organic agriculture.

Scientific research at LEA up to now has yielded more than 350 scientific publications in peer-reviewed international journals, books and proceedings of scientific conferences. Moreover, LEA has executed and been involved in several projects (e.g DADOBAT-UE; SUN-UE; BIOTA-West; LOEWE; UNDESERT-EU; Edulink-European Union; Global Climate Change Alliance) on sustainable management of natural resources or/and tree domestication in Africa.

Up to date, the major achievements of LEA are the following: (i) climate change, vulnerability assessment and natural/climatic risk management in the coastal area of Benin, (ii) conservation and management of more than 10 forest genetic resources in Benin (e.g: *Adansonia digitata; Blighia sapida*; *Caesalpinia bonduc ; Irvingia gabonensis ; Pentadesma butyracea ; Sclerocarya birrea; Tamarindus indica; Borassus aethiopum; Raphia soudanica, Dialium guineense, etc.) ;* (iii) management of more than 10 traditional agroforestry systems involving medicinal plants in Northern Benin (e.g Community gardens of Papatia, Monts Kouffé, Dangbo, Porga, etc.) ; (iv) ecological restoration of more than 5 degraded areas (E.g. Lama forest reserve and Swampy forest of Lokoli in Southern Benin ; Dry dense forest of Bassila and Wari Maro in Northern Benin; etc.) ; (v) management of at least 5 protected areas in Benin (Biosphere Reserves of Pendjari and W in Northern Benin ; three forests reserves, Goungoun and Sota forests in Northern Benin ; Lama Forest reserve in Southern Benin ; etc.) ; (vi) Red list of threatened plants and wildlife in Benin (IUCN Red Book of Benin) ; (vii) remote sensing and mapping of vegetation (Swampy Forest of Lokoli, Dense Forest of Lama; Biosphere Reserves of Pendjari and W; etc.); (vii) atlas of biodiversity of Benin.

LEA works closely with many international and natonal partners (research institutions, NGOs, local communities and decision makers). LEA networks and working groups include:

- About 5 full Professors and 20 Associate Professors from many Departments (Regional Planning, Geography, Chemistry, Soil Science, Botany, Socio-economics, etc.) at the University of Abomey-Calavi ;
- International Scientific Groups such as AETFAT, IUCN (WCPA;SSC ; CWRSG), etc.;
- International Institutions involved in nature conservation and biodiversity management i.e. World Union for Nature Conservation (IUCN), Bioversity International (ex-IPGRI), World Agroforestry Centre (ex. ICRAF), Wildlife Management etc.;
- Networks such as the South Saharan African Forest Genetic Program (SSAFOGP), Society for Ecological Restoration International (SERI-USA), African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE / ICRAF), African Forest Forum (AFF), etc.
- NGOs and Universities (Belgium, Burkina-Faso, Cameroon, Canada, Côte d'Ivoire, Denmark, France, Ghana, Germany, Japan, Mali, Niger, Nigeria, The Netherlands, Senegal, Sierra Leone, Switzerland, Togo, US, Uganda, South Africa, Kenya, Mozanbique etc.).

This report is the seventh edition following six consecutive previous reports since 2007.It is intended for several audiences of researchers in Benin and abroad, partners, developers, donators and other professionals interested in the fields of applied ecology. It summarizes the research activities which were performed at the laboratory in 2013 and is organized into nine major sections. Section 1 relies on the methodology used to gather information included in the report and shows how various indices have been calculated. Section 2 focuses on the types of research (individual, national teams, regional teams and international teams), types of publications (thesis, peer review articles, proceedings, technical reports, and newsletter), trends of publications for the last fourteen years (1998 – 2013) and the analysis of language of publications according to the types of publications at the laboratory. Section 3 provides a summary of conferences and seminars organized by the LEA in 2013 and those attended by researchers from LEA. Section 4 describes the research projects and research grants obtained at the laboratory in 2013 whereas section 5 shows details about active human resources at LEA as well as visitors who were in the laboratory in the framework of bilateral collaboration. Section 6 discusses the research activities performed at the laboratory in 2013 while section 7 shows the used references. The appendixes are presented in the section 8, showing full details on references of the different types of publications, research projects and grants as well as on conferences and visiting research in the laboratory. Finally, abstracts of publications in 2013 in peer review journals have been presented in the section 9 to allow easy searching and understanding of the full length papers.

1. Data collection

The methodology used for this report was mainly based on the research activities performed by researchers and students from the laboratory in 2013.

Firstly, information related to dissertations (PhD and masters' students), scientific articles (published, in press or under review) in peer-review journals and those published through proceedings, books of abstracts and technical reports were used. For each category of publication, the indices of specialization related to the scientific fields in which the works have been performed were assessed. Also, as far as the published papers in peer-review journals are concerned, two groups of papers were established:articles with Impact Factor and those without Impact Factor (Web of Science of Thomson). Only the publications of which address of authors and/or co-authors refer to LEA were considered. Furthermore, collaborations and co-publications with scientists from developed countries and African countries have been detailed throughout the report.
The types of research were expressed respectively as the ratio between the number of publications produced individually or by co-publication with national, regional or international teams and the total number of publications in the laboratory.

Trends of publications from 1998 to 2013 were assessed both for proceedings and published articles in peer review journals (with Impact Factor or not). The ratio French/English was computed for various types of publications including the ones in press.

For data processing, the following indices were calculated:

- *Specialization Index of publications* which is the ratio between the number of publications in a given field or discipline and the total number of publications when considering all disciplines;
- *Impact Factor (IF) Index of Publications* for a given field of publication which is the ratio between the number of publications having an Impact Factor and the total number of publications in peer review journals related to the considered field of publication;
- *Weighted Impact Factor Indexof a given field of publication* which is the product of the Impact Factor Index of Publications and the arithmetic sum of impact factor indices as described in the web of science of Thomson;
- *Index of co-publication at country vs. continental level* which is the ratio between the number of co-publications at country vs. international level and the total number of co-publications in the laboratory.
- *Estimated cost per publication* which is the ratio between the estimated budget of LEA for a given year and the total number of publications in the Lab at this year.
- *Estimated cost per impact factor unit* is the ratio between the estimated budget of LEA for a given year and the arithmetic sum of impact factor indices
- *Contribution of LEA to scientific publication at Faculty of Agronomic Sciences (FSA) and University of Abomey-Calavi (UAC)* which is the ratio beween the total number of publications produced by researchrs from LEA and the total number of publications at FSA or UAC the same year.

Information related to the conferences and seminars (organized by the laboratory and the ones to which the researchers from the laboratory have participated), research projects, grants, prices and awards are presented in the report.

To allow the assessment of the full references used to compute this report, a so called session “appendixes” has been inserted at the end of the report as well as the abstracts of the published papers in the peer review journals.

2. Types of research and publications at LEA in the year 2013

2.1 Type of research at LEA

In the year 2013, the published articles were mostly produced through national teams (23 papers out of 55). Globally, 36.36% of original research papers from LEA were published in international journals having an Impact Factor. In most cases, these papers involved international partners (Figure 1).

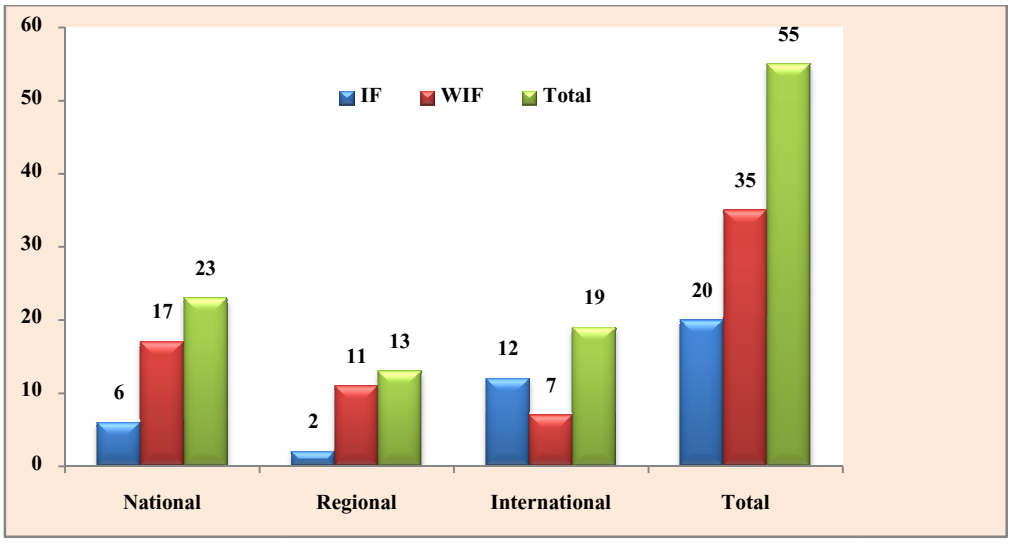

Figure 1: Spatial context of research activities in LEA in the year 2013

Legend: IF = Impact Factor; WIF = Without Impact Factor

2.2 Type of publications at the LEA in the year 2013

2.2.1 Theses at the LEA

The number of enrolled students in MSc degrees in 2013 (31 students) is the highest since 2007. This is due to the system LMD started at the University of Abomey-Calavi since 2007 which allow more students to attend the course. The first degree in the system LMD is The BSc in which 38 students were enrolled in 2013 at LEA.The number of enrolled students in PhD degrees at LEA has globally increased from 2007 to 2013 (Figure 2). Eight PhD students have defended their PhD in LEA in 2013. The professors of LEA (full and associate) are actively involved in promotion and supervision of PhD and MSc theses (figure 3). One professor supervised at least 3 ongoing PhD and 6 MSc theses in 2013. The same trend is also observed between associate and assistant professors for the supervision of BSc thesis in 2013 (8 students per associate or assistant professor).

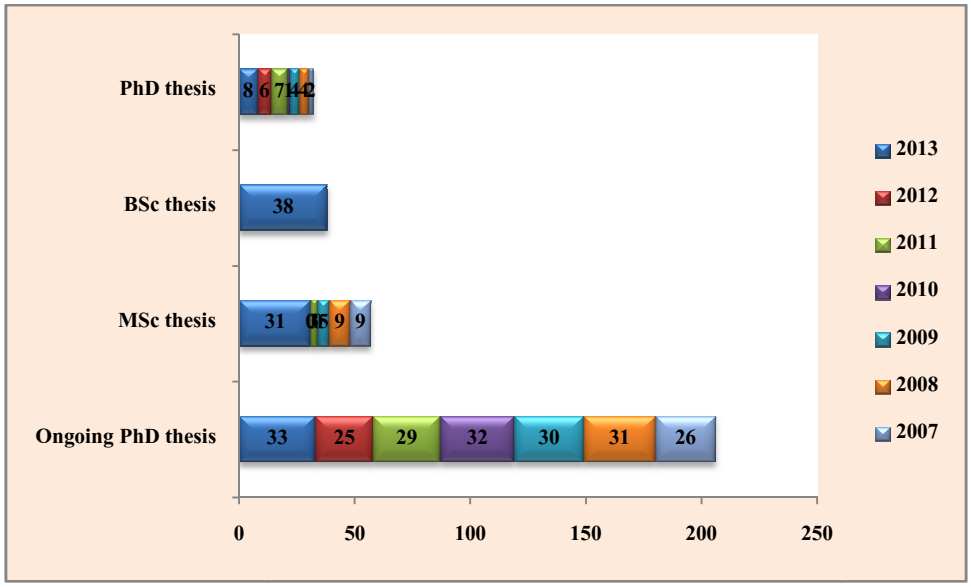

Figure 2: Trends of types of defended and ongoing PhD Theses from 2007 to 2013

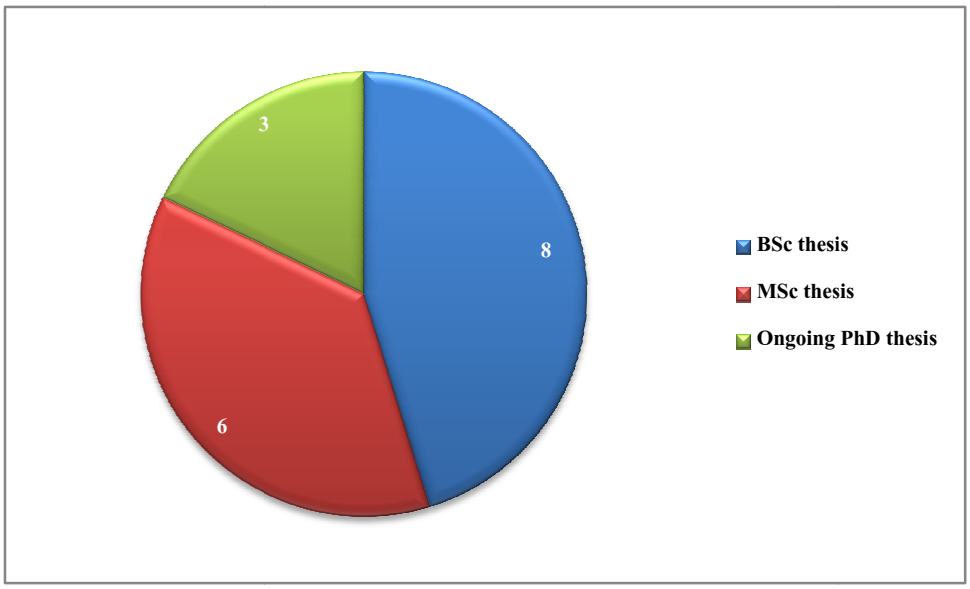

Figure 3: Mean number of students supervised per professor at LEA in 2013

Ongoing PhD theses at LEA in 2013

In 2013, six main fields of research were covered by the PhD students at LEA, with Forest and Plant Ecology management and Biological Agriculture and Horticulture being respectively the most and less represented (Figure 4). Figure 5 highlights that LEA research teams have mainly focused their activities in the fields of: Forest and Plant ecology, Wildlife management, Agroforestry and NTFPs (Figure 5). This is congruent with the laboratory's main research projects.

Fifthty percent (50 %) of the students enrolled in PhD have already spent more than 5 years for their research activities (Figure 6). Among the drivers of such low working speed is that

many PhD students at LEA are simultaneously working in the public administration and used to spend more or less half of their time for their research activities. These students are not grantees in contrary to the others who are involved in research projects at LEA. The grantees PhD students have published more articles in impact factor journal than non grantees students; while non grantees PhD students have more papers published in peer review journal without impact factor except in 2010 (figure 7). Each year, the grantees PhD students published more articles than non grantees students. Thus PhD students need to be granted in order to have more time of research work and publish paper in peer review journal particularly in impact factor journal.

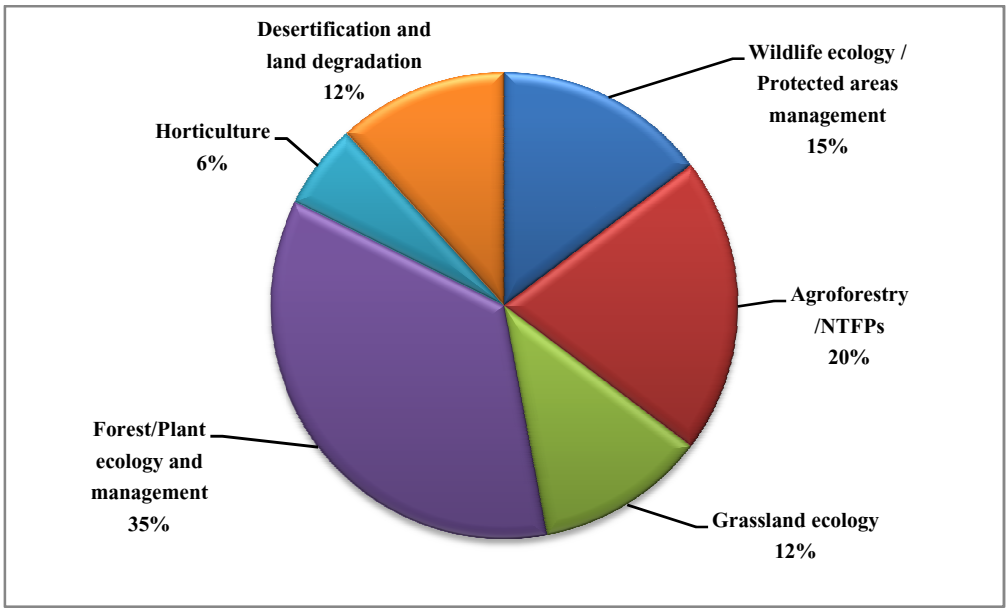

Figure 4: Spectrum of ongoing PhD thesis and related field of research in 2013

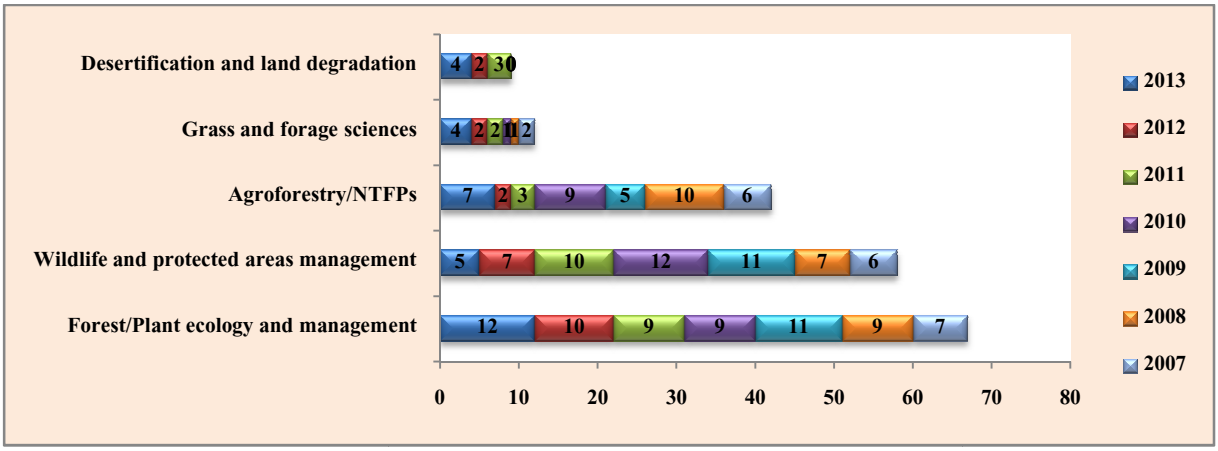

Figure 5 : Trends of ongoing PhD thesis according to the fields of research from 2007 to 2013

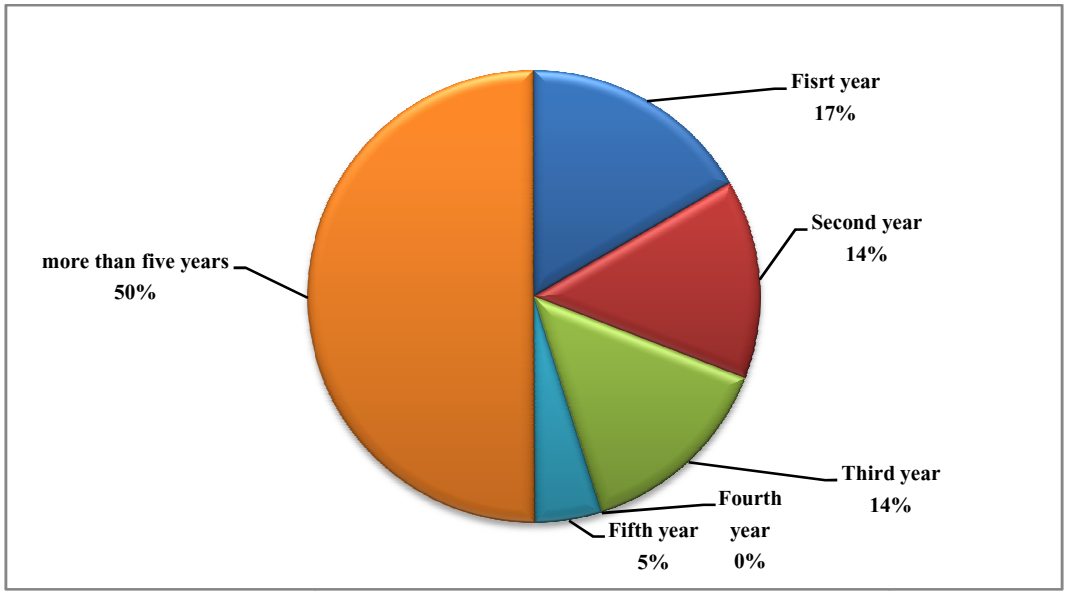

Figure 6: Typology of PhD students in LEA based on the number of year related to their research activities

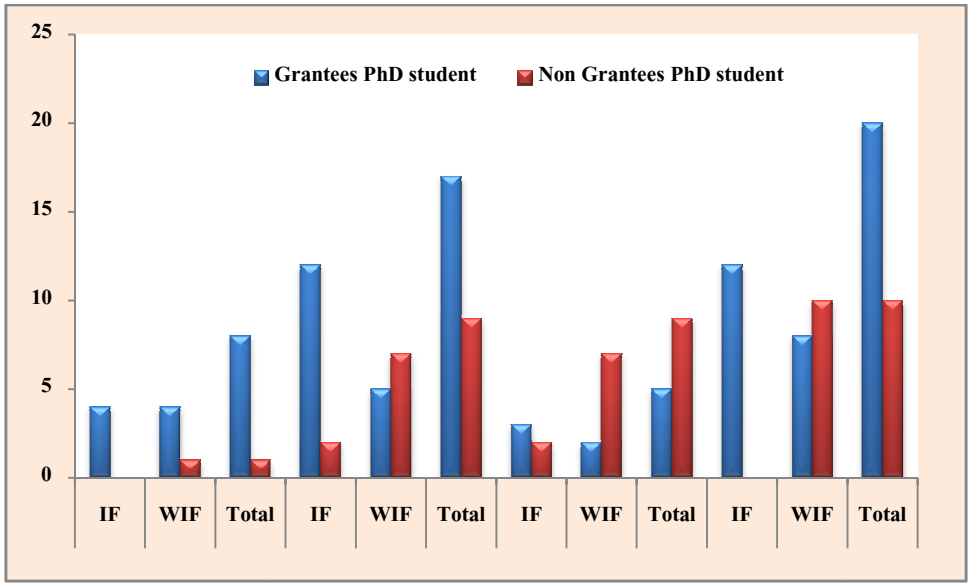

Figure 7: Published articles according to the grantees and none grantees PhD from 2010 to 2013

2.2.2 Scientific productions at LEA in 2013

In 2013, 89 scientific publications were produced by teams of LEA in peer-reviewed journals: 55 published; 11 in press and 23 under review. Moreover, 24 abstracts were published in the books of abstracts and 1 as technical report.

2.2.2.1 Publications in peer review journals

(i) Number, categories and impact factor indexes of publications

The published articles in 2013 are mostly in the peer review journals without IF (63.63 %) compared to the number of published papers in reviews with Impact Factor (36.36 %), (Figure 8). The number of articles in press and under review in the journals with Impact Factor in 2013 is higher than the ones without Impact Factor (29 vs. 5). The same trend was observed in previous years. As such, we can assume that researchers of LEA are improving their scientific capacities in publishing their papers in peer review journals with IF. Full references (authors, journals, etc.) of those publications are shown in appendices 4, 5, 6, 7, 8 and 9.

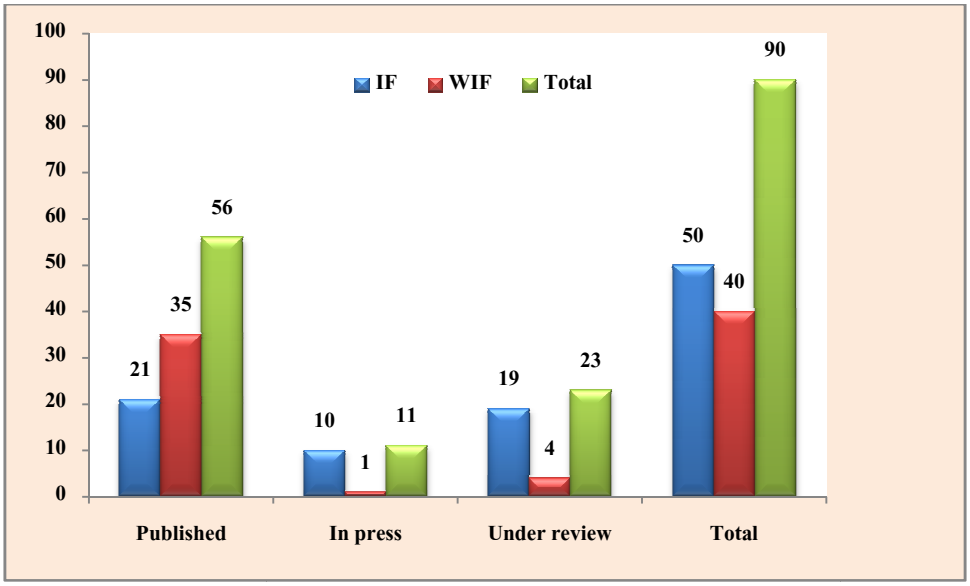

Figure 8: Spectrum of scientific productions of LEA in 2013

(ii) Specialization Indexes of publications

a) Published articles

The published articles in 2013 cover as the previous year various fields of research including Wildlife and Grassland (38%), Agriculture and Agroforestry (21 %), Forest and Plant ecology (14 %), Risk assessment and Climate change (11 %), Plants Biodiversity (7 %), Biometry (5 %), and Ethnobiology (4 %). Most articles were published in Wildlife and Grassland, Agriculture and Agroforestry, and Forest and Plant ecology, which are the main research's field of LEA.

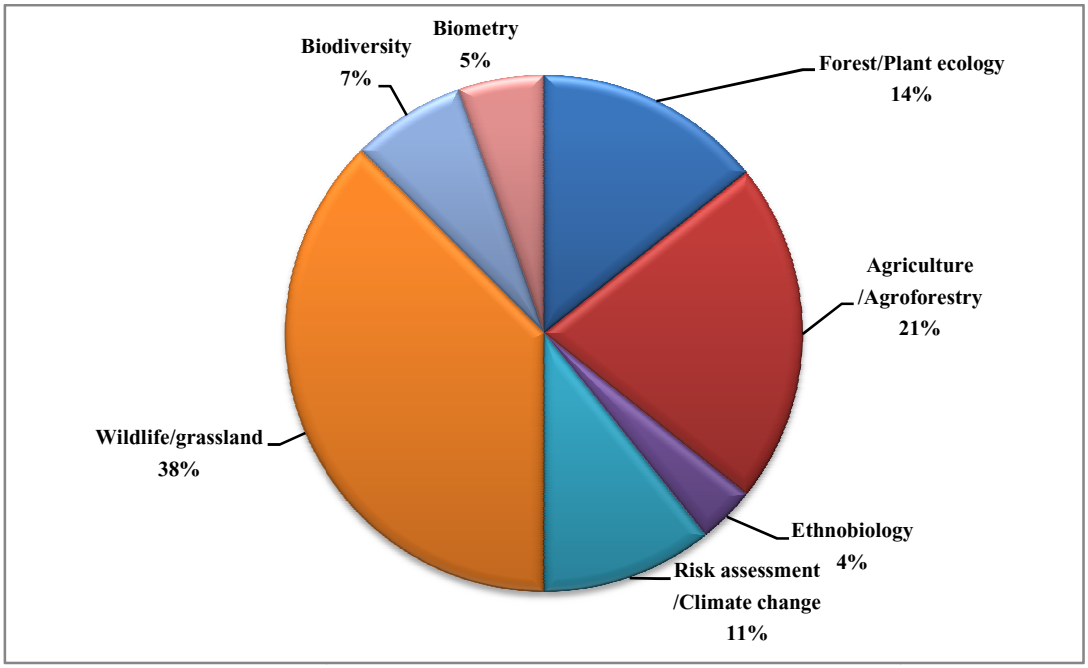

Figure 9 : Published articles according to the fields of research in 2013

b) Articles in press

Wildlife and Grassland (37%), Agriculture and Agroforestry (18%), Risk assessment and Climate change (18%) are likely to provide more original research papers in the next year than Forest and Plant ecology (9 %), Economic Botany (9%) and Biometry (9%), (Figure 9).

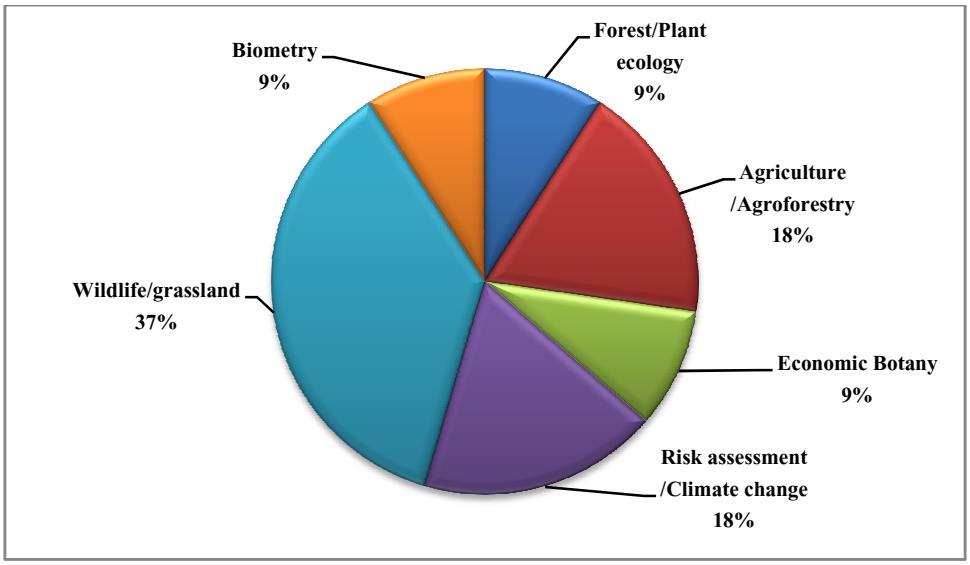

Figure 10 : Articles in press according to the fields of research in 2013

c) Articles under review

The articles under review also cover the same fields of disciplines as the ones published and in press. Fields having more articles under review were Risk assessment and Climate change (22 %), Agriculture and Agroforestry (22 %), Forest and Plant ecology (18 %), Ethnobiology

(17 %), Wildlife and Grassland (17 %), and Economic Botany (4%). These fields were also found to contribute more in articles published and in press confirming these areas as the more scientifically productive within LEA.

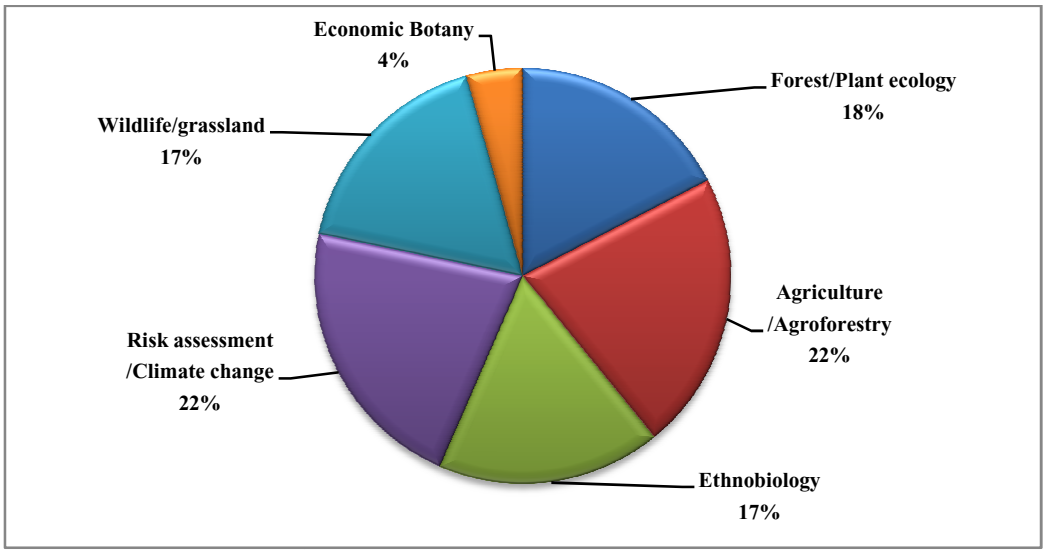

Figure 11: Articles under review according to the fields of research in 2013

(iii) Weighted Impact Factor Index of publications

Publications which have highly contributed to gain the Impact Factor of the laboratory in 2013 were related to Forest and Plant ecology followed by publications in Plant Biodiversity and Ethnobiology (table 1). Therefore, these fields of publication are the ones in which the recorded scientific publications in LEA had the highest Impact Factor in 2013.

Table 1: Weighted Impact Factor Indices of publications according to the disciplines of specialization

Field of publication	*Total number of publications related to the field in peer review journal*	*Total number of publications related to the field in the reviews having an impact factor*	Weighted Impact Factor indices
Wildlife/grassland	21	6	**0.938**(0.960, 0.294, 0.9, 0.581, 0.286, 0.263)
Ethnobiology	2	1	**1.507**(3.014)
Forest/Plant ecology	8	4	**2.776**(1.401, 1.57, 1.926, 0.655)
Agriculture/Agroforestry	12	5	**0.959** (0.764, 0.637, 0.26, 0.32, 0.32)
Risk assessement /Climate change	6	2	**1.313**(0.512, 0.426)
Biodiversity	4	2	**1.554** (1.554, 1.554)
Biometry	3	1	**0.54**(1.629)

(): The numbers in bracket are the Impact Factor (IF) recorded respectively for each article having an IF in a given field of publication

(iv) Indices of co-publications in peer review journals

a) Country level

LEA works with a wide partnership at local and international training and research institutions. Research teams within LEA used to publish their research papers in collaboration with national and international scientists (figure 12). At country level, most of the publications were written with researchers from Benin (62%).

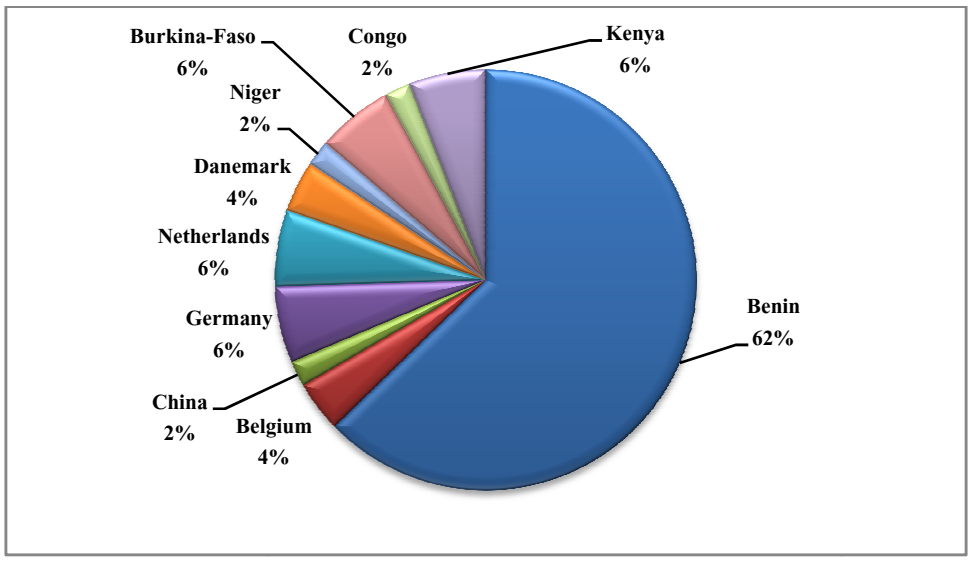

Figure 12: Diversity in indices of the LEA co-publications in peer review journals at countries scale in 2013

b) Continental level

At continental scale, the most important articles were co-published with Africans (71%: mainly Beninese), European scientists (27 %) and Asian scientists (2%), (Figure 13).

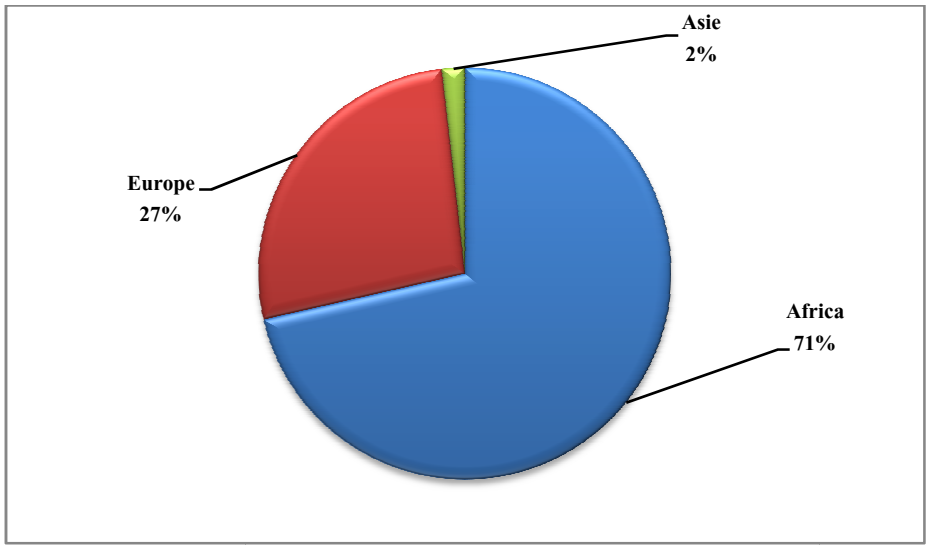

Figure 13 : Diversity in indices of LEA co-publications in peer review journals at continental level in 2013

2.2.2.2 Trends of publications in peer review journals and proceedings from 1998 to 2013

Publications in peer review journals have globally increased from 1998 to 2013 with the highest peak in 2011 and 2013. Publishing in peer review journals with Impact Factor has started in the laboratory in 1994 with 1 to 3 publications per year till 2005. For a given year, the publications in peer review journals with Impact Factor were generally lower compared to the ones in peer review journals without Impact Factor (Figures 14a). In 2013, except for the proceedings, the number of published scientific articles is higher compared to the last years (Figure 14a).

Wildlife and Grassland, Ethnobiology, Forest and Plant ecology, Agriculture and Agroforestry are the research fields in which the most publications are obtained since 2009 at LEA (Figure 14b). This confirms these areas as the main research's field of LEA.

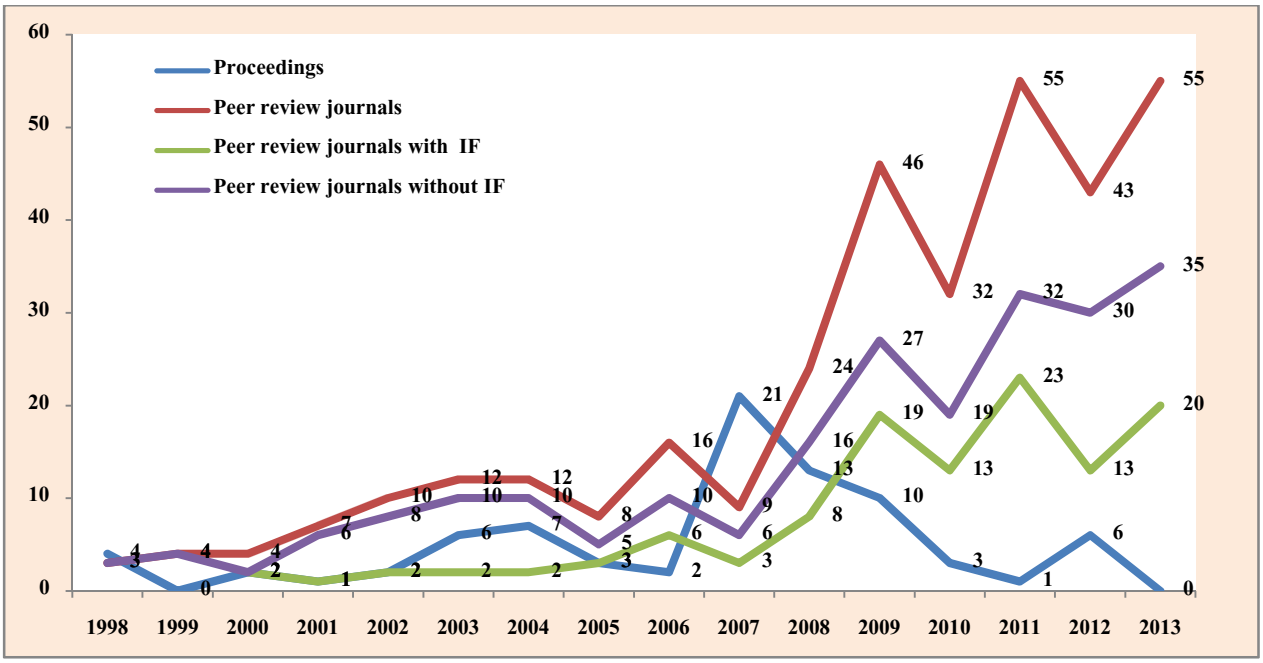

Figure 14a: Trends per types of publications from 1998 to 2013

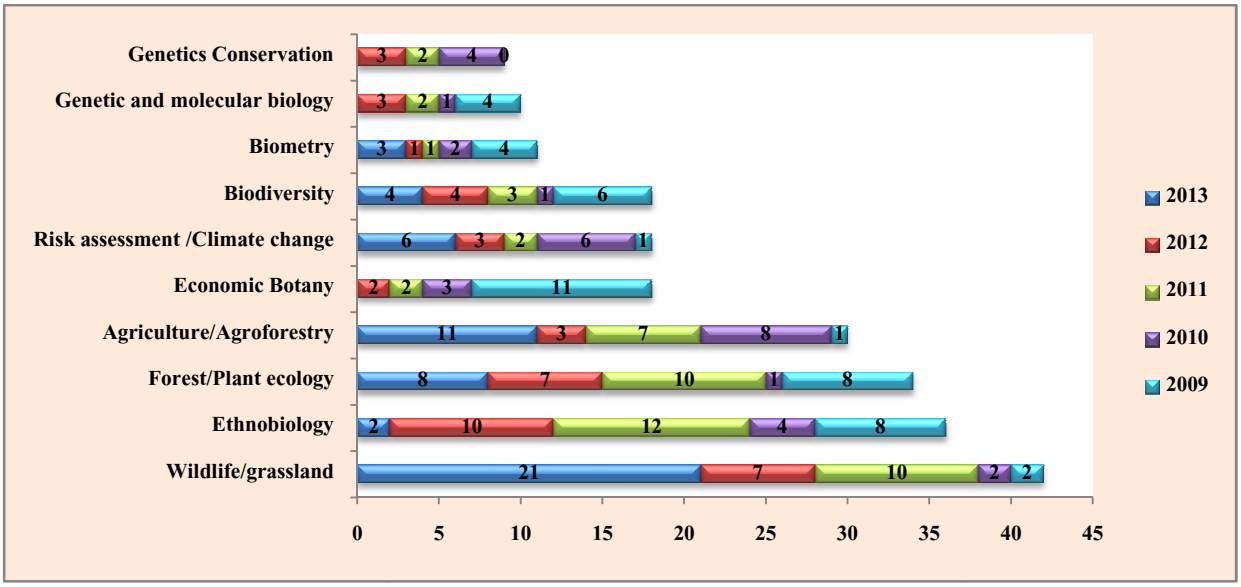

Figure 14b : Spectra of publications according to the fields of research from 2009 to 2013

2.2.2.3 Trends of research projects, research grants and publications in peer review journals from 2009 to 2013

The research projects and small grants have increased at LEA since 2009 (figure 15). The highest the number of research projects and small grants, the highest the paper published in peer reviewed journals in the laboratory. This trend is more observed with the number of publication in impact factor journals which vary from 19 with 8 research projets and small grants to 35 with 26 projects and small grants.

The yearly budget of LEA from 2009 to 2013 varies from 125 000 Euro to 165 000 Euro. While the buget increase, the cost per publication decrease (table 2). In addition the total number of impact factor journals increase with lower cost of publication per impact factor unit. This is due to the increasing number of grantees PhD and MSc students involved in the research projects and small grants who use to allocate more time for research and publication. Thus with more funds, more scientific papers are published with lower cost.

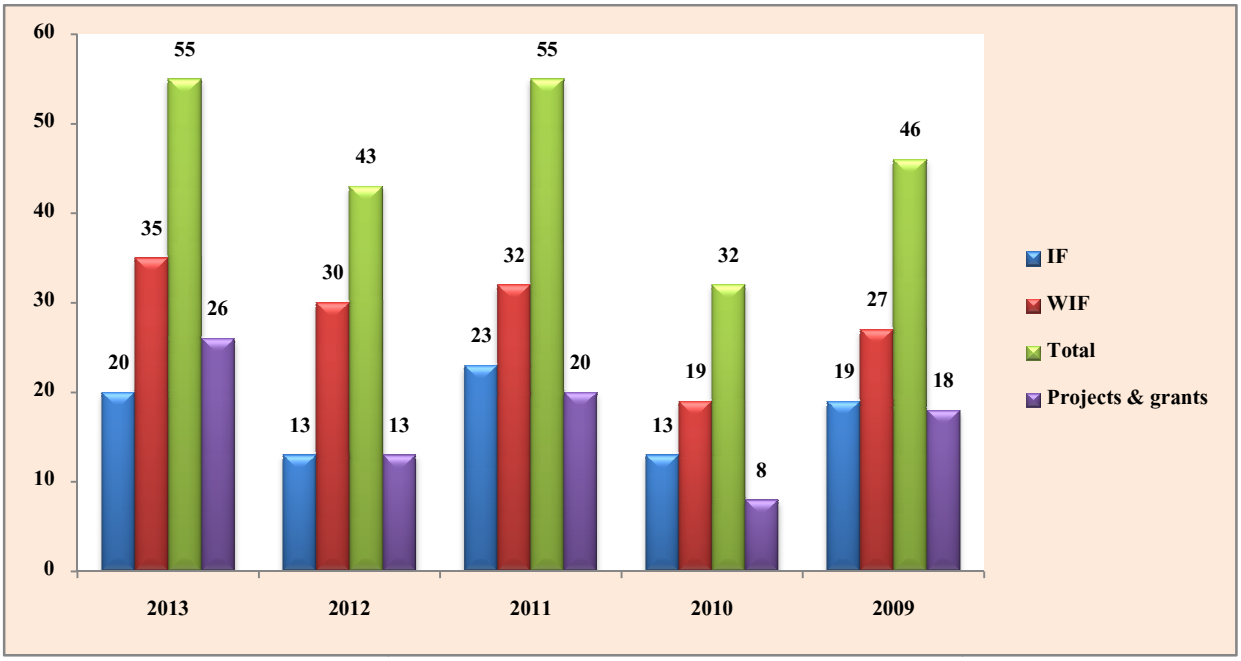

Figure 15: Spectra of publications, projets and small grants from 2009 to 2013

Table 2: Estimated cost per publication and per IF unit from 2009 to 2013

Year	Total Publication	Total IF unit	Estimated budget of LEA/year (€)	Cost (€) / publication	Cost (€) / IF unit
2013	55	19.826	165 000	3000	8322
2012	43	11.6355	155 000	3605	13321
2011	55	27.0247	160 000	2909	5921
2010	32	12.628	125 000	3906	9899
2009	46	21.498	145 000	3152	6745

Mean budget of projects per year ≈ 100 000 Euro; Mean budget of grants per year ≈ 5000 Euro

2.2.2.4. Contribution of LEA to the scientific publication of Faculty of Agronomic Sciences (FSA) and University of Abomey-Calavi (UAC)

LEA has contributed to the scientific publication at FSA and UAC from 2010 to 2012 with the higest pick in 2011 (figure 16; table 3). In 2011, 47% of the total scientific publication at FSA was produced at LEA while 44% of the publication in impact factor journal at FSA was from LEA. At the university level, respectively 13% and 26% of the total scientific publication and the publication in impact factor were produced at LEA. In 2011, more projects and small grants were conducted at LEA than 2010 and 2012. This may explain the higest contribution of LEA at this year as more funds induce more publication at LEA then more contribution to scientific publication at FSA and UAC.

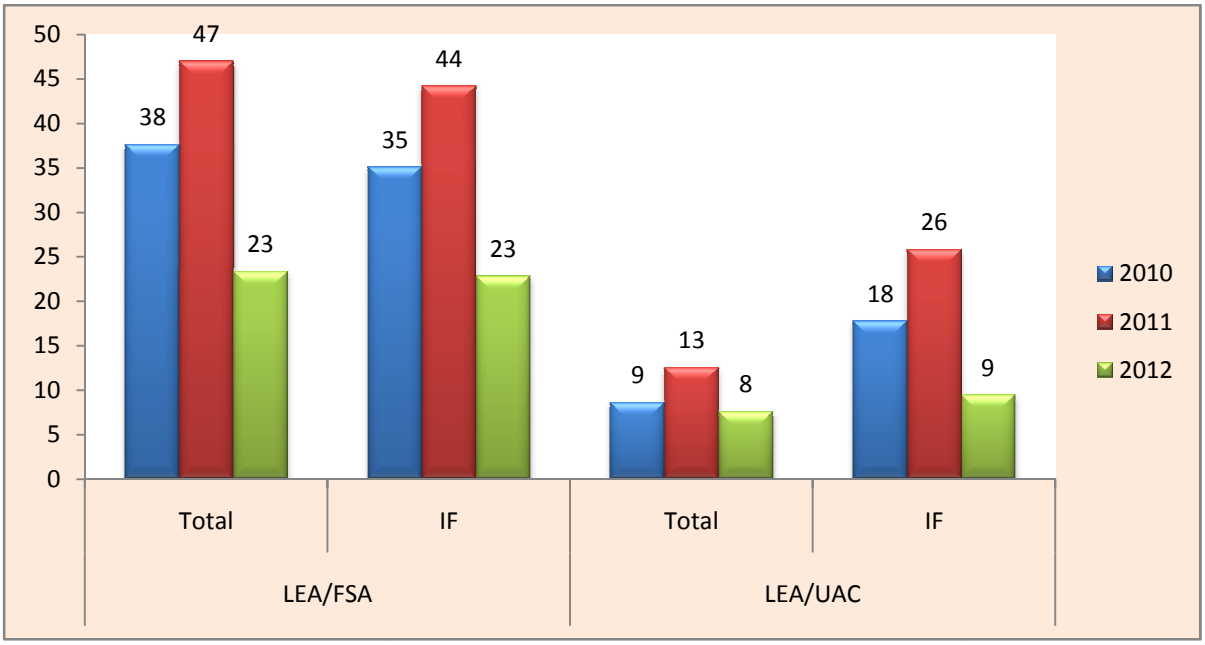

Figure 16: Contribution (%) of LEA to the publication at FSA and UAC from 2010 to 2012

Table 3: Publication at LEA, FSA and UAC from 2010 to 2012

Year	LEA		FSA		UAC	
	Total publication	Impact Factor	Total Publication	Impact Factor	Total publication	Impact Factor
2010	32	13	85	37	371	73
2011	55	23	117	52	438	89
2012	43	13	184	57	566	137

2.2.2.5 French/English ratio according to the types of publications

Except for PhD dissertations which were more written in French, articles in peer journal with impact factor, and without impact factor were most written in English (Figure 17). This suggests that English is increasingly being adopted by scientists in LEA.

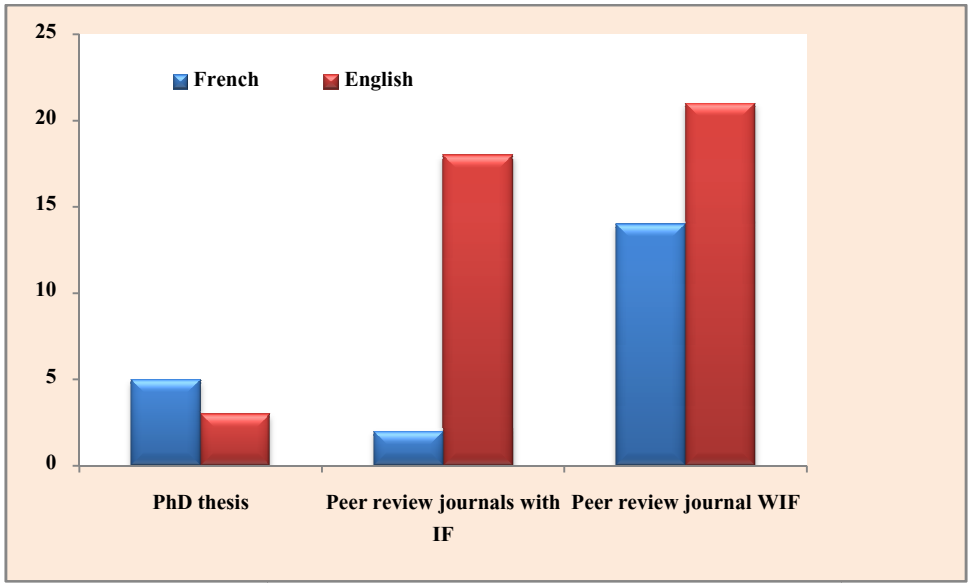

Figure 17: French/English ratio for various types of publications in LEA in 2013

2.2.2.6: Abstracts: number of publications and indexes of specialization

Twenty four (24) abstracts were published in books of abstracts of scientific conferences in 2013. These abstracts were linked to various disciplines as illustrated in figure 18. Agriculture and Agroforestry (36 %), Wildlife and Grassland (18 %), Risk assessment and Climate change (18 %) Forest and Plant ecology (18 %), showed the highest index of publications followed by Biometry and Ethnobiology (5 % respectively). Full references of these publications are shown in appendix 11.

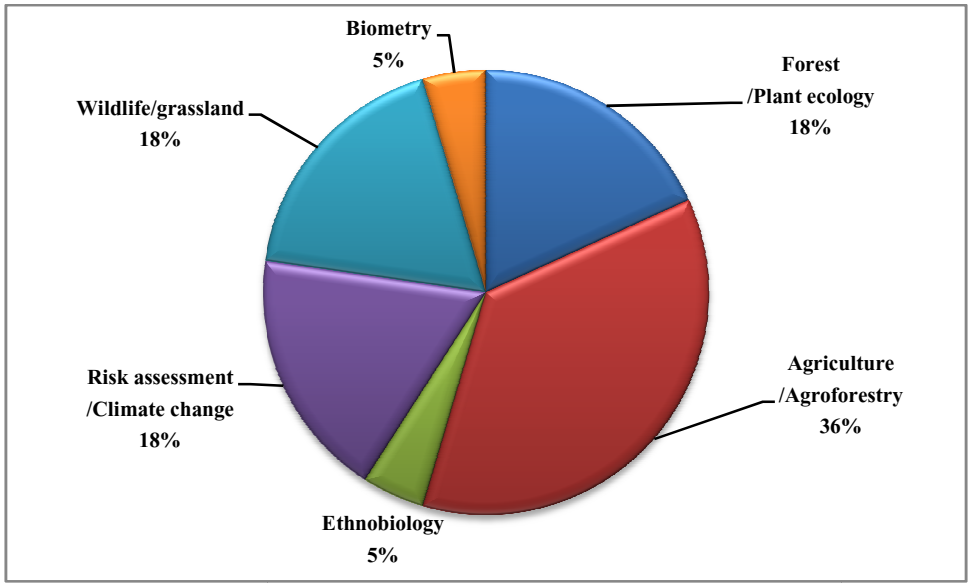

Figure 18: Indices of publications specialization in books of abstracts in 2013

3. Conferences and seminars from 2009 to 2013

The participation of researchers at LEA to conference and seminar has increased from 2009 to 2013 (figure 20) with the highest peak in 2013. The researchers at LEA have more participated to conferences and seminars in Africa than the others continents. In 2013, researchers at LEA have participated to 47 conferences. About 84 % of these conferences were held in Africa, 8 % in Europe, 4 % in Asia, and 4 % in USA (Figure 19). Details related to these conferences/workshops are listed in appendix 13. Most of the conferences and seminars at which the researchers at LEA have participated were financially supported (table 4). The LEA has started internal seminars focusing on scientific information since 2012. Seven communications were developed in 2013 during the seminars. These seminars mainly addressed model in ecology and data analysis (4 communications), gap analysis of protected area system in conservation biology (1 communication), principals and application of dendrochronology in ecology (1 communication) and the environmental friendly agriculture based on community resources (1 communication).

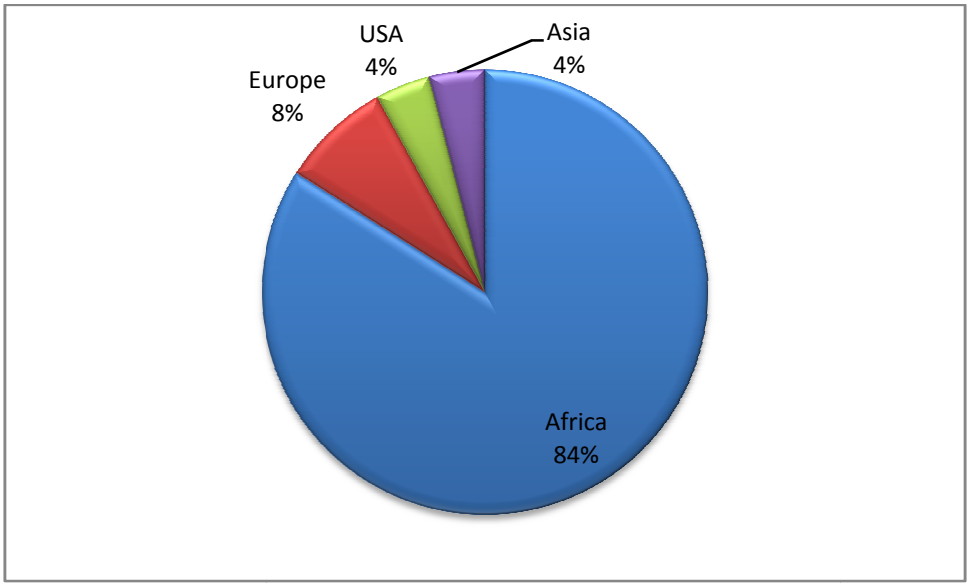

Figure 19 : Level of participation of LEA's researchers to international conferences in 2013

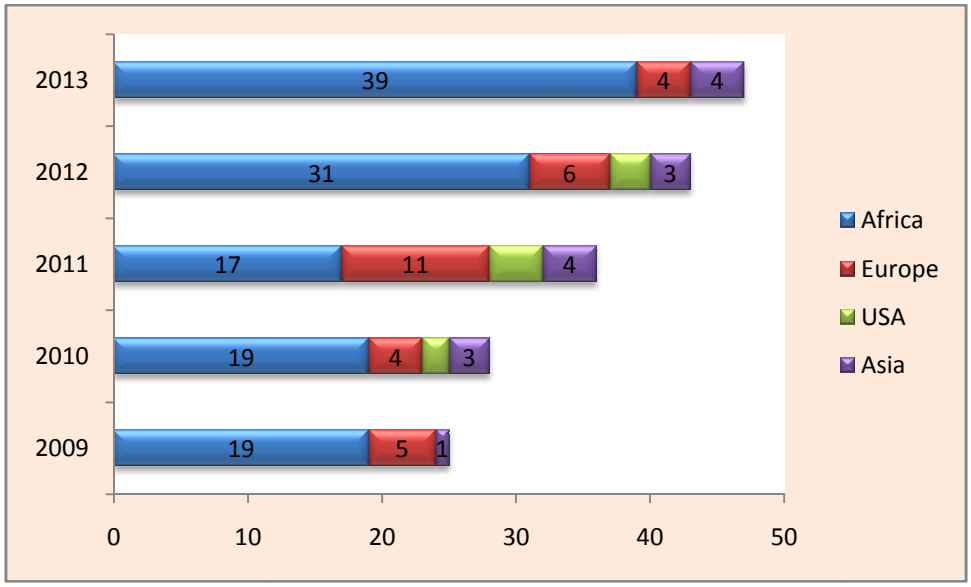

Figure 20: Trends of participation of LEA's researchers to international conferences from 2009 to 2013

Table 4: Cost* of participation to conferences and seminars from 2009 to 2013

Year	Africa	Europe	USA	Asia	Total	financial support	Contribution of LEA/UAC or participant
2009	19000	12500	0	2500	34000	27667	6333
2010	19000	10000	5000	7500	41500	35165	6333
2011	17000	27500	10000	10000	64500	58833	5667
2012	31000	15000	7500	7500	61000	50667	10333
2013	39000	10000	0	10000	59000	46000	13000

*Cost per conference: Africa ≈ 1000 Euro; International (Europe, USA, Asia) ≈ 2500 Euro

4. Research projects, research grants and prize at the LEA in 2013

The research activities undertaken by LEA were mainly funded by Local institution in Benin (University of Abomey Calavi and INRAB: 27%), European Union (UNDESERT, WANOART/ROAFRAB, Global Climate Change Alliance: 19 %), regional and international co-operation projects (VPMAP, CORAF/WECARD and PJUA: 12 %), and international foundations and institutions (small research grants: 42 %), (Figure 20). WANOART is the only one project which has no PhD students. Most of the PhD as well as senior scientists at LEA are involved in these projects for their research activities. Details (objectives, beneficiaries, etc.) on these projects and grants are described in appendixes 14 and 15. Moreover, seven international recognitions have been awarded to the researchers from LEA in 2013 (appendix 16).

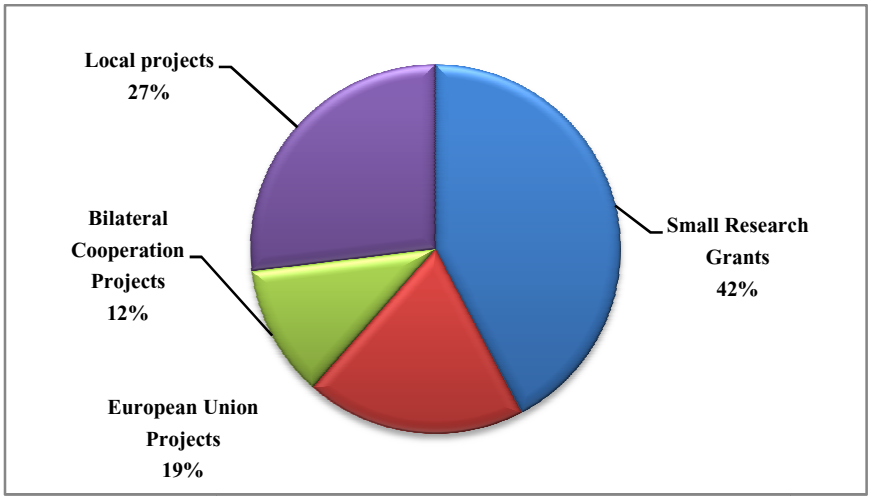

Figure 21: Spectrum of research funding in 2013

5. Human resources and visiting research in the LEA in 2013

Human resources in the LEA in 2013 are about 30 main investigators and senior scientists, 34 PhD students, actively participating to research activities within the laboratory. Moreover, 5 technicians and 3 drivers are used on permanent basis for the fieldworks. Specifically, LEA houses 5 Full Professors (Professeur Titulaire Conseil Africain et Malgache pour l'Enseignement Supérieur CAMES), 20 associate Professors (Maître-Conférences/CAMES), several assistant Professors (Maître-Assistant/CAMES), assistant (PhD) and junior researchers (MSc and BSc students). Details about these human resources are shown on the web site of LEA (www.leabenin-fsauac.net).

Furthermore, in the course of the year 2013, LEA has welcomed 6 researchers as visitors vs. 69 in 2009, 63 in 2008 and 51 in 2007, (Figure 21). The vistors welcomed in the previous years (2007, 2008 and 2009) were mainly students through NGOs while since 2010; the visitors welcomed were Professors through collaboration or project.

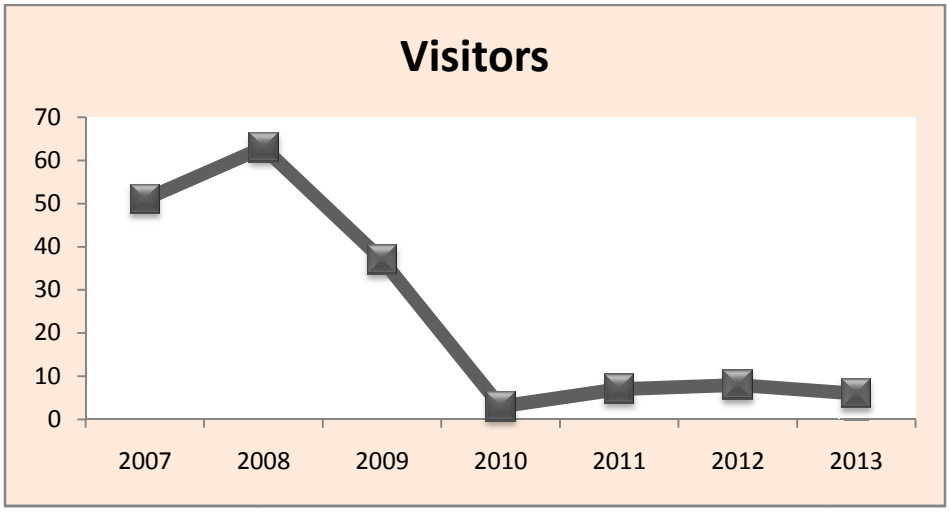

Figure 22 : Trends of visiting researchers welcomed in the LEA from 2007 to 2013

6. General discussion and conclusion

Various types of publications were produced by LEA's researchers in 2013 as it was the case in previous years. It is important to notice that the total number of published papers in peer review journal in 2013 is similar to the published papers in 2011. The global trend of published papers in peer review journal in LEA, increase since 1998. This can be explained by the increase of researchers, research projects and grants holding a PhD, PhD students and MSc student since 2006. Indeed, with more projects and grants, more papers are published with lower cost per publication and impact factor unit. The number of published articles in journals with Impact Factor has considerably increased since 2008. This means that researchers are improving their publication skills and the quality of their investigation. Another driver for this is the change in the requirements before defending a PhD thesis at the Faculty of Agronomic Sciences which hosts LEA (having at least two published original research paper). In the other hand, requirements for upgrading academics grades within the CAMES system *(Conseil Africain et Malgache pour l'Enseignement Supérieur*) is another important driver for increasing high quality papers within LEA. As such, the scientific capacity of LEA research teams is increasing. Published articles in 2013 were mostly produced in team at African level (71 % mainly Beninese). Published article in peer journal with impact factor were mostly co-written with international colleagues while published articles in peer journal without impact factor were morelikely written by teams at national level. A reason for that could be the requirements for writing in English for original papers to be submitted in most impact factor journals.Field research such as Wildlife and Grassland, Agriculture and Agroforestry, Forest and Plant ecology were the most to contribute to original research papers. This trend is expected to remain the same in 2014.

Publications which have highly contributed to gain the Impact Factor of the laboratory in 2013 were related to Forest and Plant ecology followed by publications in Plant Biodiversity and Ethnobiology (table 1). These disciplines are then the most important in terms of scientific impact of LEA in 2013.

LEA has variously contributed to the scientific publication at FSA and UAC from 2010 to 2012. The highest pick of the contribution of LEA to the scientific publication of the host institution (FSA and UAC) during this period is observed in 2011 where more research projects and small grants were conducted at LEA than the other year (2010 and 2012). Thus with more funds, more contribution is expected from LEA to the scientific publication of FSA and UAC.

To date, almost no scientific works was done with the scientists from Latino America, Australia, Middle East China and even Northern Africa. This suggests the need of more and sustainable efforts for building cooperative research networks basically using interactive research topics and funds from these parts of the world. Moreover, since 2007, few scientific papers have been published with scientists at a regional level (West Africa). In 2013, 62% of the articles have been co-published within national team while 29% of them have been co-

published with European and Asian scientists (41 %). As such, regional scientific collaborations should be developed for the following years since Benin shares with its neighboring countries similar research problems which need regional solutions and then should be solved regionally through research activities involving laboratories in the region.

Based on the findings from the present report, it is suggested that LEA:

(1) helps for capacity building among its research teams in order to be able to publish more scientific papers in peer review journals having a high IF;
(2) develop more research collaboration at regional level ;
(3) develop curricula in the fields of applied ecology for regional training purposes;
(4) continue monitoring biodiversity at continental level;
(6) develop conservation and domestication strategies for some edible and medicinal forest and savannah resources;
(7) develop guidelines for fieldwork in applied ecology for para ecologists;
(8) monitor threatened and endangered plants and animals species at regional level.

7. References

- http://scientific.thomson.com/products/wos/

- www.leabenin-fsauac.net

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Publications in LEA in 2012-2013 (cf. appendices)

Proceedings in LEA in 2012-2013 (cf. appendices)

Theses in LEA in 2013 (cf.appendices: PhD, MSc and agronomist degree).
Publication in UAC in 2010 – 2012.

8. APPENDIXES

2013 SCIENTIFIC ACTIVITIES REPORT OF THE LABORATORY OF APPLIED ECOLOGY

Appendix 1: Ongoing PhD thesis in LEA

N°	Student full name	Number of year since the start of the PhD	Research topics	Fields of Research
1	ASSEDE Emeline P.S.	more than 5th year	Ecology of Plant community in Biosphere Reserve of Pendjari	*Forest/Plant ecology and management*
2	SARE Baké Adissatou	3rd year	Climatic variability and dynamic of agroforesterie parks in the W Transboundary of biosphere reserve in Benin.	*Agroforestry/NTFPs*
3	BIO Anselme	1st year	Ethnobotanique, distribution spatiale et écologie des plantes entrant dans le traitement de l'hypertension artérielle au Bénin	*Agroforestry/NTFPs*
4	GBESSO G. H. François	3rd year	Ecologie, ethnobotanique et importance socio-économique de *Chrysophyllum albidum* G. Don (Sapotaceae) au Bénin	*Agroforestry/NTFPs*
5	EDON Aderomou Tinuadé Solange	5th year	Baobab regeneration in Benin	*Forest/Plant ecology and management*
6	PADONOU Elie Antoine	2nd year	Bowe occurrence patterns and their predictive extension above ground with respect to plant species diversification	*Desertification and land degradation*
7	KOMBIENOU Pocoum Damè	3rd year	Impacts des systèmesagricoles et de l'occupationdesterresen zone montagneuse de la chaîne de l'Atacora au Nord-Ouest du Bénin	*Agroforestry/NTFPs*
8	HOUNDANTODE Justin	more than 5th year	Problématique de gestion et valorisation des eaux usées du Bénin en cultures maraîchères : cas de l'amarante dans la commune de Sème Kpodji.	*Horticulture*
9	AHOUDJI Carmelle Myrèse	1st year	Grasslands ecosystem functioning: patterns of establishment of dominant plant species, grass tussock growth, ecology and fire impacts on grassland dynamics	*Grassland ecology*
10	NAGO Sèdjro Gilles Armel	more than 5th year	Savannah amphibians along a disturbance gradient	*Wildlife ecology/Protected areas management*
11	OKOU Farris Aurlus Yissegnon	2rd year	The Atacora mountain under the drivers of land use and their impacts on species establishment	*Desertification and land degradation*
12	IDOHOU Alix Frank Rodrigue	1st year	Distribution, traditional knowledge, threats and conservation of wild palm species in Benin (West Africa)	*Forest/Plant ecology and management*
13	KPERA Gnanki Nathalie	5th year	Human and crocodile interaction around agro-pastoral dams in Northern Bénin.	*Wildlife ecology/ Protected areasmanagement*
14	KOURA Bossima Ivan	1styear	Improvement of livestock productivity through the promotion of products and by-products of soybean, peanut and corn from integrated production systems	*Grassland ecology*
15	AVAKOUDJO Julien	more than 5th year	Assessment of soil degradation: Process and resilience as mastered by aridity factors and land use practices inside and around the W National Park (Benin).	*Desertification and land degradation*
16	AZIZOU El-Hadj Issa	more than 5th year	Facteurs déterminants de cogestion pour la conservation des ressources naturelles de la réserve de biosphère transfrontalière du W/Bénin.	*Wildlife /protected areas management*

17	TOUDONOU A. S. Christian	more than 5th year	Utilisation and conservation of snakes: case study from ball python (*Python regius*) in Benin.	*Wildlife /protected areas management*
18	MAMA Djaouga	more than 5th year	Mutations spatio-fonctionnelles des systèmes agropastoraux dans les communes de Kalalé-Nikki, Gogounou-Kandi au Nord-Est du Bénin: essai de cartographie et de modélisation.	*Wildlife /protected areas management*
19	AGONYISSA Didier	more than 5th year	Species diversity variation in sudanian *Isoberlinia doka* and *Isoberlinia tomentosa* woodland in relation to plot sizes and landuse pressure in Benin	*Plant ecology and management*
20	AGBANI Onodjè Pierre	more than 5th year	Etat de conservation et viabilité des populations de quelques espècesligneuses soudaniennesmenacées du Bénin.	*Plant ecology and management*
21	SINSIN C. A. Franck	more than 5th year	Tree Ring Analysis; Population Structure and Sustainable Forest Management: Investigation of Selected Tropical Tree Species in Three Phytogeographical Regions of Benin.	*Plant ecology and management*
22	AÏTONDJI Akouavi Léa	1st year	Evaluation des impacts écologique, socio-économique et paysager des carrières non sableuses au Bénin	*Desertification and land degradation*
23	ASSONGBA Faustin	3rd year	Répartition Spatiale, Ecologie et Statut de conservation du tamarinier noir (Dialium guineense) Au Bénin	*Forest/Plant ecology and management*
24	GBEMAVO Charlemagne	3rd year	Etude de la variabilité écologique et morphologique du pourghère (*Jatropha curcas*)au Bénin	*Agroforestry/NTFPs*
25	SINASSON Sanni Koupamba Gisèle	2nd year	Distribution, structure and dynamics of Mimusops andongensis Hiern in Benin	*Forest/Plant ecology and management*
26	LESSE Paolo	1st year	Modelisation et gestion des parcours de transhumance dans un context de changement climatique au nord –Est du Bénin	*Grassland Ecology*
27	SALAKO Kolawolé Valère	1st year	Ecology and conservation of the wild palm *Borassus aethiopum* Mart. in Benin	*Forest/Plant ecology and management*
28	SEWADE Clément	1st year	Gestion rationnelle des ligneux fourragers dans les terres de parcours pour la conservation de la biodiversité au Bénin	*Grassland ecology*
29	KOURA Tatiana	3rd year	Sustainable uses of palm oil mills wastes and organic vegetables production through composting in southern Benin republic, west Africa	*Biological Agriculture and Horticulture*
30	YAOITCHA Alain Sèakpo	2nd year	Biologie de Conservation et Ethnopharmacologie des Ligneux médicinaux de la pharmacopée béninoise pour l'amélioration de la santé animale et humaine	*Agroforestry/NTFPs*

Appendix 2: Completed BSc and Master Degrees in 2013

N°	Student full name	Research topics	Fields of Research
1	AZONTONDE Urielle Claudia	Etude diagnostique de la Direction du Parc National du W (DPNW) et mode de gestion des fruitiers sauvages au sein des terroirs riverains	*Ethnobiology*
2	DAÏ Emilienne Houévo	Etude diagnostique de la Direction du Parc National de la Pendjari et problématique de gestion des plantes aromatiques, des épices et des colorants dans les terroirs riverains	*Ethnobiology*
3	DONHOUEDE Janine Conforte Fifonssi	Etude diagnostique du fonctionnement du campement forestier d'Abomey et problématique liée à la création d'activité alternative génératrice de revenu pour limiter les pressions sur la forêt	*Ethnobiology*
4	FANOU Coffi Firmin	Etude diagnostique de la Direction du Parc National de Pendjari et problématique de gestion des plantes utilisées dans le traitement de diabète dans les terroirs riverains.	*Ethnobiology*
5	HOUESSOU Ariel Hardy K. Essenam	Diagnostic du Parc National de la Pendjari et problématique de l'utilisation des fruitiers sauvages dans les terroirs riverains du Parc National de la Pendjari	*Ethnobiology*
6	HOUNSOU-DINDIN Guillaune	Etude diagnostique de la Direction du Parc National du W (DPNW) et problématique de gestion des plantes aromatiques, épices et colorants spontanés dans les terroirs riverains	*Ethnobiology*
7	SOSSOU Hospice Samson	Etude diagnostique de la Direction du Parc National W (DPNW) et problématique de gestion des plantes utilisées traitement de diabète dans les terroirs riverains	*Ethnobiology*
8	AGLISSI Janvier	Diagnostic du secteur forestier de koto (lama) et evaluation sommaire du commerce de viande de brousse au sud Benin	*Wildlife*
9	ABDOU ABOUBACAR Zouera	Conflits Homme-Girafe dans l'aire centrale de répartition de la girafe (*Giraffa camelopardalis* peralta, Linnaeus 1758) au Niger.	*Wildlife*
10	AYIFIMI O.Jamail	Etude de la réponse de la tomate (*Lycopersicon esculentum* Mill.) aux composts à bases de différents ferments sur sols ferralitiques au Sud-Bénin.	*Organic agriculture*
11	MESSSEKOJ.P Appolinaire.	Effet de trois composts et de leur the sur la croissance et le rendement de la tomate *(Lycopersicon esculentum)* sur sol ferralitique au sud-Benin	*Organic agriculture*
12	ASSEA D. Emilienne	Effet de différents composts à base de résidus de noix de palme et de déjections animales sur la production de l'amarante (*Amaranthus hybridus)* sur sol ferralitique au Sud Bénin	*Organic agriculture*
13	HOUENOU A. Crépin	Effet de trois composts et de leurs thés sur la croissance, le rendement et les nuisibles du *Solanum macrocarpon*	*Organic agriculture*
14	AFORAM. Ruth	Effets de differents compost à base de résidus de noix de palme sur la production du crin-crin (*Corchorus olitorius*) sur sol ferralitique au sud-Benin	*Organic agriculture*

Appendix 3: Completed Doctorate thesis in 2013

N°	Student full name	Diploma (Doctor, PhD, etc.)	Research topics	Institution/Specialisation
1	AZIHOU Akomian Fortuné	Doctor in Agronomy (Plant Ecology)	Ecology of isolated individuals of gregarious species in the tropics: modeling of plant species distribution and niche colonization based on the concept of dispersal	University of Abomey Calavi / FSA / AGRN
2	DJAGOUN Chabi Adéyèmi Marc Sylvestre	Doctor in Agronomy (Animal Ecology)	Co-evolutionofthefeedingandforagingecologyofbovidspeciesinthe Pendjari Biosphere Reserve, Northern Benin.	University of Abomey Calavi / FSA / AGRN
3	DJEGO-DJOSSOU Sylvie	Doctor in Sciences (Animal Ecology)	Aires d'occurrence et comportements socio-écologiques des colobes au Bénin	University of Abomey Calavi / FAST
4	HOUESSOU Laurent Gbenato	Doctor in Agronomy (Biodiversity and Conservation)	Assessing land use impact and biodiversity indicators in W Biosphere Reserve and its bordering areas in Benin (West Africa)	Faculty of Agricultural Sciences/Protected Area Management
5	TOSSOU Cocou Christophe	Doctor in Agronomy (Horticulture)	Dimensions socio économique et environnementale des espèces fruitières cultivées sur le Plateau d'Allada au sud du Bénin	University of Abomey Calavi / FSA / AGRN
6	ZOUNMENOU Aurelle Mahudo Y.	Doctor in Pharmacy	Contribution à l'étude ethnobotanique et pharmacologique des plantes utilisées en médecine traditionnelle pour le traitement de hypertension arttérielle dans les départements de l'Atlantique et du Littoral	FSS/UAC
7	DOUGNON Godfried	Doctor in Pharmacy	Etudes ethnobotanique et ethnopharmacologique des plantes utilisées dans le traitement traditionnel de l'HTA au Centre-Bénin	FSS/UAC
8	AMADJI Nathalie	Doctor in Pharmacy	Evaluations ethnobotanique et d'effets antihypertenseurs des plantes présumées antihypersensives de la Basse Vallée de l'Ouémé (Bénin).	FSS/UAC

Appendix 4: Articles published in peer-review journal with Impact Factor (IF) in 2013

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
Forest/Plant ecology	1	AZIHOU A. F., GLELE KAKAÏ R.,BELLEFONTAINE R., SINSIN B.	Distribution of tree species along a gallery forest–savannah gradient: patterns, overlaps and ecological thresholds	*Journal of Tropical Ecology29:1 (2013): 25-37*	1.401
Forest/Plant ecology	2	AZIHOU A. F., GLELE KAKAÏ R.,SINSIN B.	Do isolated gallery-forest trees facilitate recruitment of forest seedlings and saplings in savanna?	*Acta Oecologica 53 (2013): 11-18*	1.57
Risk assessment /Climate change	3	FANDOHAN B, GOUWAKINNOU GN, FONTON NH, SINSIN B, LIU	Impact des changements climatiques sur la répartition géographique des aires favorables à la culture et à la conservation des fruitiers sous-utilisés: cas du Tamarinier au Bénin	*Biotechnology Agronomy Society and Environment* 17(3): 450–462	0.512

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
Biodiversity	4	IDOHOU R., ASSOGBADJO A. E., FANDOHAN B., GOUWAKINNOU G. N., GLELE KAKAI R. L., SINSIN B., MAXTED N.	National Inventory and Prioritization of Crop Wild Relatives: case study for Benin	*Genetic Resources and Crop Evolution*	1.554
Agriculture /Agroforestry	5	HOUEHANOUD. T., KINDOMIHOU V., STEVART T., TENTE B., HOUINATO M., SINSIN B.	Variation of mistletoes impact on fruit yield of shea tree in contrasting habitats and implication for its conservation.	*Fruits* 68: (2013): 109–120	0.764
Forest/Plant ecology	6	HOUEHANOU D. T., ASSOGBADJO A. E., GLÈLÈ KAKAÏ R., KYNDT T., SINSIN B.	How far a protected area contributes to conserve habitat species composition and population structure of endangered African tree species.	*Ecological Complexity* 13 (2013): 60-68.	1.926
Forest/Plant ecology	7	HOUEHANOU T. D., GLÈLÈ KAKAÏ R. L., ASSOGBADJO A. E., KINDOMIHOU V., HOUINATO M., WITTIG R., SINSIN B. A.	Change in the woody floristic composition, diversity and structure from protected to unprotected savannahs in Pendjari Biosphere Reserve (Benin, West Africa).	*African Journal of Ecology* 51: 358-365. DOI: 10.1111/aje.12046**.**	0.655
Biodiversity	8	SALAKO V. K., FANDOHAN B., KASSA B., ASSOGBADJO A. E., IDOHOU A. F. R., GBEDOMON R. C., CHAKEREDZA S., DULLOO M. E., GLELE KAKAI R.	Home gardens: an assessment of their biodiversity and potential contribution to conservation of threatened species and crop wild relatives in Benin	*Genetic Resources Crop Evoutio*,DOI 10.1007/s10722-013-0035-8	1.554
Risk assessment /Climate change	9	TEKA O., HOUESSOU G. L., OUMOROU M., VOGT J., SINSIN B.	An assessment of climate variation risks on agricultural production: Perceptions and adaptation options in Benin	*International Journal of Climate Change Strategies and Management* 5: 2 (2013): 166-180	0.426
Ethnobiology	10	YETEIN H. M., HOUESSOU L.G., LOUGBEGNON O.T., TEKA O., TENTE B.	Ethnobotanical study of medicinal plants used for the treatment of malaria in plateau of Allada, Benin (West Africa)	*Journal of Ethnopharmacology* 146 (2013): 154-163	3.014
Agriculture /Agroforestry	11	PADONOU E. A., KASSA B., ASSOGBADJO A.E., BABATOUNDÉ S., GLÈLÈ KAKAÏ R.	Differences in germination capacity and seedling growth between different seed morphotypes of *Afzelia africana* Sm. species in Benin (West Africa).	*Journal of Horticulural Sciences and Biothecnology* (2013) 88 (6) 679–684	0.637
Biometry	12	SALAKO V. K, GLELE KAKAÏ R. L, ASSOGBADJO A. E., FANDOHAN B., HOUINATO M.,PALM R.	Efficiency of inventory plot patterns in quantitative analysis of vegetation: a case study of tropical woodland and dense forest in Benin	*Southern Forests*2013, 75(3): 137–143	0.567
Agriculture /Agroforestry	13	ADJOLOHOUN S., BINDELLE J., ADANDEDJAN C., TOLÉBA S.S., HOUINATO M., KINDOMIHOU V., NONFON M.R.V., SINSIN B.	Impact of row spacing and nitrogen fertilization on the yield and quality of *Brachiaria ruziziensis* seeds in humid subtropical climates.	*Fourrages 216*: (2013): 339-345	0.26
Wildlife/grassland	14	KPÉRA G.N., AARTS N., SAÏDOU A., TOSSOUR.C., EILERS C.H. A. M., MENSAH G.A., SINSIN B.A., KOSSOU D.K. VAN DER ZIJPP A.J.	Management of agro-pastoral dams in Benin: Stakeholders, institutions and rehabilitation research.	*NJAS - Wageningen Journal of Life Sciences*	0.960
Wildlife/grassland	15	DJAGOUN C. A. M. S., CODRON D., SEALY J., MENSAH G. A., SINSIN B. A.	Stable carbon isotope analysis of the diets of West African bovids in Pendjari Biosphere Reserve (Northern Benin).	*South African Journal of Wildlife Research 43:33-43,*	0.294
Wildlife/grassland	16	DJAGOUN C. A. M. S., KASSA B., MENSAH G.A., SINSINB. A.	Seasonal habitat and diet partitioning between two sympatric bovid species in Pendjari Biosphere Reserve (Northern Benin): waterbuck and western kob.	*African Zoology* 48(2): 279-289	0.9
Wildlife/grassland	17	DJAGOUN C. A. M. S., DJOSSA B. A., MENSAH G.A., SINSIN B. A.	Vigilance efficiency and behaviour of Bohor reedbuck *Redunca redunca* (Pallas 1767) in a savanna environment	*Mammal Study 38:81-89*	0.581

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
			of Pendjari Biosphere Reserve (Northern Benin).		
Wildlife/grassland	18	TEHOU C. A., KOSSOU E., MENSAH G. A., HOUINATOM.,SINSIN A.B	Indentification et caractérisation des formations végétalesexploitées par l'éléphant *Loxodonta africana* dans la Réserve deBiosphère de la Pendjari au Nord-Ouest de la République du Bénin	*Pachyderm* .52 July–December 2012	0.286
Agriculture /Agroforestry	19	DAGBENONBAKIN D.G, KINDOMIHOU V., AGBANGBA E.C., SOKPON N., SINSIN B.	Diagnosis and recommendation integrated system (DRIS) model establishment for diagnosing Sorghum (*Sorghum bicolor*) nutrient status in Benin (West Africa).	*Scientific Research and Essays* 8(32): (2013): 1562-1569	0.32
Wildlife/grassland	20	ADJOLOHOUN S., DAHOUDA M., ADANDEDJAN C., TOLEBA S. S., KINDOMIHOU V., SINSIN B.	Evaluation of biomass production and nutritive value of nine *Panicum maximum* ecotypes in Central region	*African Journal of Agricultural Research* 8(17): (2013): 1661-1668	0.263
Wildlife/grassland	21	SOGBOHOSSOU E.A., BAUER H., LOVERIDGE A., FUNSTON P.J., de SNOO G.R., SINSIN B. de IONGH H. H.	Social structure of lions (*Panthera leo*) is affected by management in Pendjari Biosphere Reserve.	*Plos One* 9(1): e84674. doi:10.1371/journal.pone.0084674	4.092
Wildlife/grassland	22	KASSA B. D., FANDOHAN B, AZIHOU AF, ASSOGBADJO AE, ODUOR AMO, KIDJO FC, BABATOUNDÉ S., LIU J., GLÈLÈ KAKAÏ R.	Survey of *Loxodonta Africana* (Elephantidae)-caused bark injury on Adansonia digitata (Malvaceae) within Pendjari Biosphere Reserve, Benin	*African Journal Ecology* doi: 10.1111/aje.12131	0.655
Risk assessment /Climate change	23	BAUDOIN M-A., CUNI SANCHEZ A., FANDOHAN B.	Small scale farmers' vulnerability to climatic changes in southern Benin: the importance of farmers' perceptions of existing institutions	*Mitigation and Adaptation Strategies for Global Change DOI 10.1007/s11027-013-9468-9*	1.234
Risk assessment /Climate change	24	PADONOU E. A., FANDOHAN B., BACHMANN Y., SINSIN B.	How farmers perceive and cope with bowalization: a case study from West Africa	*Land Use Policy 36 (2014) 461– 467*	2.346
Agriculture/Agroforestry	25	PADONOU E. A., GLÈLÈ KAKAÏ R., ASSOGBADJO A. E., FANDOHAN B., CHAKEREDZA S., SINSIN B.	Natural variation in fruit characteristics and seed germination of *Jatropha curcas* (Euphorbiaceae)	*Journal of Horticulural Sciences and Biothecnology (2014) 89 (1) 69-73*	0.637
Forest/Plant ecology	26	OUÉDRAOGO A., GLÈLÈ KAKAÏ R., THIOMBIANO A.	Demographic response of the widespread species, *Anogeissus leiocarapa* (DC.) Guill. & Perr. to the climatic gradient in West Africa semi-arid area	*South African Journal of Botany*	1,09

Appendix 5: Articles published in peer-review journal without IF in 2013

Disciplines	N°	Authors' Names	Title of the article	Journals
Biodiversity	1	YOKA ., LOUMETO J. J., DJEGO J., VOUIDIBIO J., EPRON D.l	Évaluation de la diversité floristique en herbacées des savanes de la cuvette congolaise (République du Congo)	*Afrique SCIENCE*
Forest/Plant ecology	2	ASSONGBA Y. F., DJÈGO G. J., SINSIN B.	Distribution des habitats de Dialium guineense (willd) (Fabaceae: Caesalpinioideae) dans les phytodistricts Est du Sud-Bénin	*Bulletin scientifique de l'Institutnational pour l'environnementet la conservation de la nature*
Ethnobiology	3	HOUNGBO E. N., DJEGO J. G., OREKAN V., LOUGBEGNON T., MONGBO R.,SINSIN B.	*Could Sacredness Contribute to Forest Conservation in African Urban Areas?*	*Annales des Sciences Agronomiques du Bénin*
Wildlife/grassland	4	SOGBOHOSSOU E.A., KASSA B.D., ABOUBACAR Z., MAHAMANE A.	Les conflits homme-girafe dans l'aire centrale de répartition de la girafe (Giraffa camelopardalis peralta Linnaeus 1758) au Niger	*Annales des Sciences Agronomiques 17 (2) : 107-119, 2013*

Disciplines	N°	Authors' Names	Title of the article	Journals
Forest/Plant ecology	5	GBESSO F. G. H.,LOUGBEGNON T. O.,TENTE B. A.H.,MENSAH G. A. etSINSIN B. A.	Caractérisations phytoécologique et structurale des groupements végétaux abritant Chrysophyllum albidum (G. Don) sur le plateau d'Allada au Sud-Benin	*AfriqueSCIENCE* 09(3) : 147 – 158(2013)
Risk assessment /Climate change	6	GBESSO F. H. G., TENTE B. H. A., GOUWAKINNOU N. G., SINSIN B. A.	Influence des changements climatiques sur ladistributiongéographique de Chrysophyllum albidum G. Don (Sapotaceae) au Benin	*International Journal of Biological and Chemical Sciences*7(5): 2007-2018, October 2013
Wildlife/grassland	7	ZOFFOUN A. G., ABOH A. B., ADJOLOHOUN S., HOUINATO M., SINSIN B.	Effet de l'âge et de l'intensité de pâture sur le développement des touffes et la production de biomasse de Panicum maximum var. C1 dans les pâturages artificiels en zone soudanienne et subéquatoriale	*International Journal of Biological and Chemical Sciences*7(3): 1168-1179, June 2013.
Wildlife/grassland	8	ADJOLOHOUN S., HOUNDONOUGBO F., ADANDEDJAN C., TOLEBA S. S., HOUINATO M., NONFON W. R., SINSIN B. A.	Influence of vegetative and seed establishment methods on seed yield and quality of *Arachis pintoi* CIAT 17434 in Soudanian region of Benin	*Bulletin de la Recherche Agronomique du Bénin (BRAB)* Numéro 73 – Juin 2013
Wildlife/grassland	9	ADJOLOHOUN S., BINDELLE J., ADANDEDJAN C., TOLEBA S. S., HOUINATO M., SINSIN B.	Variety and environmental effects on crude protein concentration and mineral composition of *Arachis pintoi* (Kaprovickas & Gregory) in Benin (West Africa)	*Journal of Applied Biology & Biotechnology* 1 (03): 24-28, October, 2013
Wildlife/grassland	10	ADJOLOHOUN S., BINDELLE J., ADANDEDJAN C., TOLÉBA S.S., HOUINATO M., SINSIN B.	Growth and Forage Production of Four *Arachis Pintoi* (Kaprovickas & Gregory) Genotypes in Two Contrasting Ecological Regions of Benin (West Africa)	*International Journal of Agriculture Innovations and Research*, Volume 2, Issue 2,
Wildlife/grassland	11	AWOHOUEDJID.Y.G., LESSE P., HOUINATO M., HOUNZANGBE-ADOTÉ S.	Medicinal forage present in the natural pasture in Benin: a Review	*Journal of Animal Production Advances*, 3(11): 301-310 (2013)
Wildlife/grassland	12	AWOHOUEDJI G., BABATOUNDE S., ADOUNKPE J.G., HOUINATO M.,HOUNZANGBE-ADOTÉ S.	Supplementing panicum maximum with two medicinal forages in the diet of Djallonke sheep at Benin national sheep center	*Scientific journal of animal Science* 2(11) 284-295(2013
Biodiversity	13	AMAHOWE O.I., HOUESSOU G. L., ASHANTI S., TEHOU C. A.	Transboundary protected areas management: experiences from W-Arly-Pendjari parks in West Africa	*Parks*19:2: 95-105(2013)
Risk assessment /Climate change	14	HOUESSOU G. L., TEKA O., TOKO I.., LYKKE A.M., SINSIN B	Land Use and Land-cover change at "W" Biosphere Reserve and its surroundings areas in Benin Republic (West Africa)	*Environment and Natural Resources Research*3:2: 88-101 (2013)
Biometry	15	SALAKO V.K., ADEBANJI A., GLÈLÈ KAKAÏ R.	On The Empirical Performance Of Non-Metric Multidimensional Scaling In Vegetation Studies.	*International Journal of Applied Mathematics and Statistics*
Agriculture/Agroforestry	16	KOURA T.W., ADEDOKUN T., AIYELAAGBE I.O.O., KINDOMIHOU V., HARRIS P., SINSIN B.	Growth and Yield of Three Indigenous Vegetables (*Amaranthus caudatus*, *Celosia argentea* L., *Corchorus olitorius* L.) Grown in Soil Supplemented with Poultry Manure.	*Nigerian Society for Experimental Biology Journal*13(1&2): 13-18. (2013)
Agriculture/Agroforestry	17	AVAKOUDJO J., KINDOMIHOU V., AKPONIKPE P.I., THIOMBIANO A., SINSIN B.	Essences végétales et techniques de restauration des zones d'érosion (dongas) du Parc W et de sa périphérie à Karimama (Nord-Bénin).	*Journal of Applied Biosciences* 69: 5496 – 5509(2013) :
Wildlife/grassland	18	KINDOMIHOU M.V., GLELE KAKAI L.R., ASSOGBADJO A.E., HOLOU R.A.Y.,	Environmentally induced variation in germination percentage and energy of naked caryopses of *Loxodera ledermannii*(Pilger) W.D.	*Advances in Environmental Biology* 7(2): 320-329, (2013)

Disciplines	N°	Authors' Names	Title of the article	Journals
		SINSIN B.A.	Clayton ex Launert in subhumid Benin (West Africa).	
Agriculture/Agroforestry	19	AFFOKPON A., DJÈNONTIN J. A. P.,ZOFFOUN **A. G**, ALLAGBE M. C., AKONDÉ T. P., AÏHOU K., KPAGBIN G., GOTOECHAN-HODONOU H., DÉTONGNON J. , MENSAH G. A.	Effets des variétés de niébé à buts multiples comme précédent cultural sur le rendement du maïs cultivé sur terres de barre dégradées au Sud-Bénin	*Bulletin de la Recherche Agronomique du Bénin (BRAB)Numéro* spécial Fertilité du maïs – Janvier 2013
Wildlife/grassland	20	ZOFFOUN A. G., ABOH A. B., ADJOLOHOUN S., HOUINATO M. SINSIN B.	Effet de l'âge et de l'intensité de pâture sur le développement des touffes et la production de biomasse de *Panicum maximum* var. C1 dans les pâturages artificiels en zone soudanienne et subéquatoriale	*International Journal of Biological and Chemical Sciences*7(3): 1168-1179, June 2013
Wildlife/grassland	21	ZOFFOUN G. A., ABOH B. A., MBANZAMIHIGO L., FIEVEZ V.	Composition chimique, dégradabilité *in sacco* et produits de fermentation *in vitro* de la fétuque élevée (*Festuca arundinacea*).	*Journal of Applied Biosciences*7: *5173-5182* July 2013,
Wildlife/grassland	22	ABOH A. B., ZOFFOUN G. A., DJENONTIN A. J. P., BABATOUNDE S. , MENSAH G. A.	Effect of graded levels of dry pineapple peel in the diet on digestibility and growth performance of rabbit.	*Journal of Applied Biosciences* 7, 5271-5276 July 2013,
Risk assessment /Climate change	23	AINA M. P., ADOUNKPE J., MAMA D., CHOUTI W., MOUDACHIROU M., MATEJKA G.	Evaluation of Flow of Waste Electrical and Electronic Equipment in Benin	*British Journal of Science*
Agriculture/Agroforestry	24	GBESSO F. H. G., AKOGNONGBE A. J.S., TENTE B. H. A.	Implications de l'utilisation des ligneux comme bois-énergie dans la commune d'Abomey	*Revue Ivoirienne de Science et Technologie (REVIST)*., 21&22 (2013)263 - 276
Agriculture/Agroforestry	25	AHOLOUKPE H., VISSOH V. P., AMADJI G., DELEPORTE P., DUBOS B., NODICHAO L., GLELE KAKAÏ R., CHOTTE J.L. BLAVET D	Typologie des plantations villageoises de palmier à huile (*Elaeis guineensis* Jacq.) dans le département du Plateau au Bénin	*International Journal of Biological Chemical Sciences*
Risk assessment /Climate change	26	AZONHÈ T., GLÈLÈ KAKAÏ R., ATIDEGLA S., AGBOSSOU K. E.	On the Patterns of the Occurrence of Diarrheas in the Southern Benin	*Journal of Environmental Protection*
Biometry	27	BAAH P., ADEBANJI A. R. GLELE KAKAÏ	Optimal Ratio of Continuous to Categorical Variables for the Two Group Location Model	*International journal of applied mathematics and statistics*
Agriculture/Agroforestry	28	HOLOU R.A.Y., STEVENS G., KINDOMIHOU V.	Return of aboveground nutrients by switchgrass into surrounding soil during senescence.	*Biofuels* 4(2): 169-183(2013):
Wildlife/grassland	29	ADJOLOHOUN S., ZOFFOUN A. G., ADANDEDJAN C., TOLÉBA S. S., DAGBÉNONBAKIN G.,SINSIN B.	Influence of *Panicum maximum* ecotypes on plant root growth and soil chemical characteristics after 3-year study in Sudanian region of West Africa	*Archives of Agronomy and Soil Science*
Wildlife/grassland	30	IDOHOU R., DJAGOUN C. A. M. S., KASSA B., ASSOGBADJO A. E., CODJIA J. T. C.	Soil factors affecting density of three giant land snail species in different habitats of Dassa-Zoumè district (Central Benin)	*QScience Connect*2013:31 http://dx.doi.org/10.5339/connect.2013.31
Forest/Plant ecology	31	GOUSSANOU C. A., ASSOGBADJO A. E., GOUWAKINNOU G. N., GLÈLÈ-KAKAÏ R. L., CHAKEREDZA S., SINSIN, B.	Biomass, root structure and morphological characteristics of the medicinal *Sarcocephalus latifolius* (Sm) EA Bruce shrub across different ecologies in Benin.	*QScience Connect*

Appendix 6: Articles in press in peer-review journal with IFin 2013

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
Wildlife/grassland	1	DJAGOUN C. A. M. S., DJOSSA B. A., COULSON T., MENSAH G.A., SINSIN, B. A.	Hunting affects dry season habitat selection by several Bovid species in Northern Benin.	Wildlife Biology	0.989
Wildlife/grassland	2	KPÉRA G.N., AARTS N., TOSSOU R.C., MENSAH G.A., SAÏDOU A., KOSSOU D.K, SINSIN, A.B., VAN DER ZIJPP, A. J.	Is the crocodile the heart of the water? a frame analysis of human-crocodile relationships in agro-pastoral dams in Northern Benin	*International Journal of Agricultural sustainability (IJAS)*	1.696
Forest/Plant ecology	3	HOUETO G., GLELE KAKAI R., SALAKO V., FANDOHAN B.ASSOGBADJO A. E., SINSIN B., PALM R.	Effect of inventory plot patterns in the floristic analysis of tropical woodland and dense forest	*African Journal of Ecology*	0.655
Economic Botany	4	VIHOTOGBE R, GLELE KAKAÏ R., BONGERS F., VAN ANDEL B., VAN DEN BERG R. G., SINSIN B., SOSEF M. S. M.	Impacts of the diversity of traditional uses and potential economic value on food tree species conservation status: case study of African bush mango trees (Irvingiaceae) in the Dahomey Gap (West Africa)	*Plant Ecology and Evolution*	1.192
Agriculture/Agroforestry	5	KOURA TW, DAGBENONBAKIN GD, KINDOMIHOU MV, HOUNGNANDAN P., SINSINB.	Farmers' background and uses diversity of Palm oil Wastes for sustainable agriculture in Southern Benin Republic	*African Journal of Agricultural Research*	0.263

Appendix 7: Articles in press in peer-review journal without IF in 2013

Disciplines	N°	Authors' Names	Title of the article	Journals
Biometry	1	ODAME OWIREDU E., ATINUKE O. A., GLELE KAKAÏ R.	Arima-noise model for a segmented intervention analysis of maternal health policy on assisted delivery	*International journal of applied mathematics and statistics*

Appendix 8: Articles under review in peer-review journal with IF in 2013

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
Forest/Plant ecology	1	AZIHOU A. F., GLELE KAKAÏ R., SINSIN B.	Importance of functional traits and regional species pool in predicting long distance dispersal in savanna ecosystems	*Plant Ecology*	1.534
Risk assessment /Climate change	2	OKOU F. A. Y, ASSOGBADJO A. E., BACHMANN Y., SINSIN B.	Ecological factors influencing physical soil degradation in the Atacora Mountain range of West Africa	*Mountain Research and Development*	0.934
Risk assessment /Climate change	3	OKOU F. A. Y., FANDOHAN B., BACHMANN Y., SINSIN B.	How far does physical soil degradation influence plant communities: Study case of Atacora Mountain range (West Africa)	*African Journal of Ecology*	0.631
Agriculture/Agroforestry	4	KOURA B. I., DOSSA L. H., HOUINATO M.	Adaptation of periurban cattle production systems to environmental changes: Feeding strategies of herdsmen in southern-Benin	*Journal of Sustainable Agriculture*	0.673
Ethnobiology	5	YAOITCHA A.S., HOUEHANOU T., HOUINATO M., ARBONNIER M., SINSIN B.	Importance and vulnerability of ligneous medicinal plants used in Benin and its surroundings countries in Africa: literature review and quantitative approach	*Journal of Ethnopharmacology*	2,755
Forest/Plant ecology	6	AHOUDJI M. C., HOUNDANON R., FANDOHAN B., TEKA O., AXELSEN J., HOUINATO M.	Contribution to efforts to protect the Transboundary Biosphere Reserve in the rangeland vegetation dynamic	*Acta Botanica Gallica*	0.31
Risk assessment /Climate change	7	PADONOU E.A., BACHMANN Y., GLÈLÈ KAKAÏ R., SINSIN B.	Spatial distribution of bowal and differences in physicochemical characteristics between bowal and woodland areas in Benin, West Africa	*CATENA*	2.528
Risk assessment /Climate change	8	PADONOU E.A., Teka O., BACHMANN Y., SCHMIDT M., SINSIN B.	Using species distribution models to select climate change resistant species for ecological restoration of bowé in West Africa	*Restoration Ecology.*	1.934
Risk assessment /Climate change	9	PADONOU E. A., ADOMOU A., BACHMANN Y., SINSIN B.	Determination of the role of bowé in plant distribution patterns in West Africa, Benin	*Acta Botanica Gallica.*	0.310
Agriculture/Agroforestry	10	PADONOU E. A., OKOU F.O.Y., ASSOGBADJO A.E., GLELE KAKAÏ R., AMADJI G., CHAKEREDZA S	Effect of seed morphology on seed germination, seedling and plant growth, and carbon sequestration among Caesalpinia bonduc L. populations in Benin.	*Journal of Horticulural Sciences and Biothecnology.*	0.637
Agriculture/Agroforestry	11	KOURA T.W, DAGBENONBAKIN G.D., KINDOMIHOU M.V., HOUNGNANDAN P., SINSIN B.	Farmers' perception of Palm oil Wastes use in agriculture in Southern Benin Republic.	*Biological Agriculture and Horticulture*	0.38
Agriculture/Agroforestry	12	KOURA T.W., G.D. DAGBENONBAKIN V.M. KINDOMIHOU, B. SINSIN	Palm oil mill waste management and sustainability in Southern Benin.	*Agriculture, Ecosystems and Environment*	2.79
Agriculture/Agroforestry	13	KOURA T.W., V. M. KINDOMIHOU, G. D. DAGBENONBAKIN B. SINSIN	Sustainable palm oil mill solid wastes management through	*Scientific research and Essays*	0.32

Disciplines	N°	Authors' Names	Title of the article	Journals	Impact Factor
			organic *Solanum macrocarpon* production in Benin Republic.		
Forest/Plant ecology	14	KINDOMIHOU V., ADJOLOHOUN S., HOLOU R., SINSIN B., MEERTS P.	*Pennisetum polystachion* foliar silicification: seasonal variations, covariations with minerals and forage value in sudanian Benin	*Journal of Agricultural Science and Technology*	0.69
Wildlife/grassland	15	KINDOMIHOU V., AGBANGBA E. C., DAGBENONBAKIN D.G., HOLOU R., SINSIN B., MEERTS P.	The nutritive value of *Andropogon* accessions accessions) as affected by silica concentration in sudanian Benin	*Plant Production Science*	0.80
Wildlife/grassland	16	KINDOMIHOU V., DAGBENONBAKIN D.G, AGBANGBA E.C., ADJOLOHOUN S., HOLOU R., SINSIN B., MEERTS P.	The nutritive value of *Panicum* accessions as affected by silica concentration in sudanian Benin	*Scientia Agricola*	0.79
Forest/Plant ecology	17	KINDOMIHOU V., MA J.F., SINSIN B., MEERTS P.	Effect of silica gel supply on Si accumulation and relations with leaf traits of 6 tropical grass species in humid conditions	*Plant, Soil and Environment*	1.21
Ethnobiology	18	YAOITCHA A.S., HOUEHANOU T., HOUINATO M., ARBONNIEr M., SINSIN B.	Importance and vulnerability of ligneous medicinal plants used in Benin and its surroundings countries in Africa: literature review and quantitative approach	*Journal of Ethnopharmacology*	2,755
Wildlife/grassland	19	DJAGOUN C. A. M. S., CODRON D., SEALY J., SINSIN, B. A.	Stable isotope analysis provides evidence that low density bovid population can result in non-structured herbivore communities.	*Plos One*	4.09

Appendix 9: Articles under review in peer-review journal without IF in 2013

Disciplines	N°	Authors' Names	Title of the article	Journals
Ethnobiology	1	IDOHOU R., FANDOHAN B., KASSA B., ASSOGBADJO A.E., YEDOMONHAN H., GBEDOMON R.C., SALAKO V., GLELE KAKAI R.L.	Traditional knowledge on home gardens species: case study for Benin (West Africa)	*International Journal of Biodiversity Science, Ecosystem Services & Management.*
Economic Botany	2	HOUNGBO N. E., HAMADOU D. Y., MONGBO R., SINSIN B.	Contribution de la croissance économique à la réduction de la pauvreté en milieu rural au Bénin (Afrique de l'Ouest)	*Annales des Sciences Agronomiques*
Ethnobiology	3	AKOUEHOU G., GOUSSANOU C. A., IDOHOU R.	Ethnobotanique et Importance socioculturelle de *Artocarpus altilis* (Parkinson) Fosberg (arbre à pain) au Sud-Bénin	*Annales des Sciences Agronomiques*
Wildlife/grassland	4	AHOUDJIM. C., TEKA O., XELSENJ., HOUINATO M.	Current floristic composition, life form and productivity of the grasslands in the Hunting Zone of Djona(Benin)	*Biogeosciences Journal*

Appendix 10: Abstracts in books of abstracts in 2013

Field of research	N°	Authors' Name	Title	Full References
Forest/Plant ecology	1	ASSÉDÉ E. P.S., ADOMOU A. C., SINSIN B.	Effect of stand regime on the population structure of *Pseudocedrela kotschyi* (Meliaceae) and *Terminalia macroptera* (Combretaceae) in the Biosphere Reserve of Pendjari (Benin, West Africa)	SADA'13. Applied Statistics for Development in Africa. 4-8 March 2013. Cotonou, Benin.
Forest/Plant ecology	2	GOUWAKINNOU N. G, SALAKO V,SINSIN B.	Pattern of Phenology and fruit production of *Sclerocarya birrea* subsp. birrea in Northern Benin	XXeme AETFAT Congress South Africa, 13-17 January 2014. Biodiversity of African Plants, Challenges in a Changing World.
Ethnobiology	3	AMADOU A., HOUEHANOU T., YAOÏTCHA A., HOUINATO M.,MAHAMANE A., SINSIN B.	Diversification and valorization of Non Timber Forest Products of plants resources in Torodi department (Niger, West Africa): social variation and implications for perspectives policies	http://www.nuscommunity.org/fileadmin/NUS_Docs/documents/publications/books/book-of-abstracts_web_small.pdf
Wildlife/grassland	4	LESSE D. P. A. A., OREKAN V., DJENONTIN A. J., HOUINATO M.	Analysis of the Pastoral Management and the Adaptation of the Breeder TranshumantsFacing the Climatic Fluctuation in the Administrative District Bording the Park W (Benin)	Tropentag 2013 International Research on Food Security, Natural Resource Management and Rural DevelopmentResilience of agricultural systems against crisesBook of abstracts; ISBN: 978-3-95404-215-9
Wildlife/grassland	5	KOURA I. B., DOSSA L. H., HOUINATO M.	Adaptation of peri-urban cattle production feeding strategies to environmental changes in Southern Benin	Ivan B. Koura, Luc Hippolyte Dossa, Marcel Houinato, 2013. Adaptation of peri-urban cattle production feeding strategies to environmental changes in Southern Benin. Tropentag 2013 - "Agricultural development within the rural-urban continuum" - du 17au 19 Septembre 2013 à Stuttgart en Allemagne, Cuvillier Verlag Göttingen, Book of Abstracts, ISBN 978-3-95404-498-6: 355-355
Wildlife/grassland	6	KOURA B. I., DOSSA H. L., HOUINATO M.	Adaptation des élevages périurbains de bovins aux changements environnementaux: stratégies d'alimentation des bouviers au sud-Bénin	Koura B. Ivan, Dossa H. Luc, Houinato Marcel, 2013. Adaptation des élevages périurbains de bovins aux changements environnementaux: stratégies d'alimentation des bouviers au sud-Bénin. Quatrième colloque de l'université d'Abomey-Calavi des sciences, cultures et technologies – du 23 au 28 Septembre 2013 au campus universitaire d'Abomey-Calavi au Bénin. Livre des résumés 667-667 (pp).
Biodiversity	7	IDOHOU R. , ASSOGBADJO A. E., MAXTED N.	National inventory and prioritization of crop wild relatives: case study for Benin	Richard Hall, Per Rudebjer and Stefano Padulosi (2013). Book of Abstracts. 3rdInternational Conference on Neglected and Underutilized Species: for a Food-Secure Africa Accra, Ghana, 25-27 September 2013; Bioversity International 2013. 178 pages
Wildlife/grassland	8	KPÉRA G.N., AARTSN., MENSAHG.A., MARTIN S., TOSSOU C.R., SINSIN A.B., VAN	Living with crocodiles for sustainable use and management of agro-pastoraldams in Benin: a hope or a scope?	Kpéra, G.N., Aarts, N., Mensah, G.A., Martin, S., Tossou, C.R., Sinsin, A.B., van der Zijpp, A.J. (2013). Living with crocodiles for sustainable use and management of agro-

Field of research	N°	Authors' Name	Title	Full References
		DER ZIJPP A.J.		pastoral dams in Benin: a hope or a scope ?.*In: World Crocodile Conference. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group*. IUCN: Gland,Switzerland, Pp 270.
Risk assessment /Climate change	9	PADONOU E.A. BACHMANN Y., SINSIN B.	Spatial distribution of bowal and differences in physicochemical characteristics between bowal and woodland areas in Benin, West Africa	Programme & Résumés IV Colloque des Sciences, Cultures et Technologies de l'UAC-Bénin (23-28. 09. 2013), UAC. Benin
Risk assessment /Climate change	10	PADONOU E.A. BACHMANN Y., SINSIN B.	Determination of the role of bowé in plant distribution patterns in West Africa	Programme & Résumés IV Colloque des Sciences, Cultures et Technologies de l'UAC-Bénin (23-28. 09. 2013), UAC. Benin
Risk assessment /Climate change	11	PADONOU E.A. BACHMANN Y., SINSIN B.	Bowe occurrence patterns and their predictive extension above ground with respect to plant species diversification in west africa (benin)	Program & abstract 3rd workshop of UNDESERT-EU project. Kombissiri, (3-6. 12. 2013), Burkina-Faso
Risk assessment /Climate change	12	PADONOU E.A. BACHMANN Y., SINSIN B.	Determination of the role of bowé in plant distribution patterns in West Africa	Programme & Résumés 1er Colloque de l4Université de Parakou Bénin (27-29. 11. 2013), UAC. Benin
Biodiversity	13	SALAKO V.K., FANDOHAN B., ASSOGBADJO A.E., IDOHOU F.A.R., GBEDOMON R.C., ABDOU IBRAHIMA W., CHAKEREDZA S., DULLLO M.E., GLÈLÈ KAKAÏ R.	"Home gardens: An assessment of their biodiversity and potential contribution to conservation of threatened species and crop wild relatives in Benin**".**	Talks and Posters. Students Conference on Conservation Science 19-21 March 2013. University of Cambridge. 53p.
Biometry	14	SALAKO V.K., GLÈLÈ KAKAÏ R.	Relative performance of non-metric multidimensional scaling in vegetation studies: case studyof the Lama Forest Reserve (Benin).	*2nd edition of the conference on "Statistics Applied to Development in Africa (SADA)"*. 5-8 March 2013. ISBA, University of Abomey-Calavi, Cotonou, Bénin.
Forest/Plant ecology	15	SINASSON G., SHACKLETON C, SINSIN B.	Distribution, structure and dynamics of *Mimusops* genus (Sapotaceae) in Benin: some results from field	Department of Environment Sciences Annual Research Forum, 10 & 11 October 2013,Rhodes University, South Africa
Agriculture /Agroforestry	16	KOURA T. W., AMADOU I. E., DAGBENONBAKIN G. D., KINDOMIHOU V. M., HOUINATO M., SINSIN B.	Palm oil mill waste management and sustainability in Southern Benin	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, p.560.
Agriculture /Agroforestry	17	KOURA T. W., ASSEA E. D., DAGBENONBAKIN G. D., KINDOMIHOU V. M., SINSIN B.	Effet de différents composts à base de résidus de noix de palme et de déjections animales sur la production de l'amarante (*Amaranthus hybridus)* sur sol ferralitique au Sud Bénin	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, p.569.
Agriculture /Agroforestry	18	KOURA T. W., AYIFIMI J.O., DAGBENONBAKIN D.G., KINDOMIHOU V., SINSIN B.	Etude de la réponse de la tomate (*Lycopersicon esculentum* Mill.) aux composts à bases de différents ferments sur sols ferralitiques au Sud Benin	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, pp.569-570.
Agriculture /Agroforestry	19	KOURA T. W., AFORA R. M., KINDOMIHOU V. M., DAGBENONBAKIN G. D.,SINSIN B.	Effets de différents composts à base de résidus de noix de palme sur la production du crincrin (*Corchorus olitorius*) sur sol ferralitique au sud-Benin	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, p.570.
Agriculture/	20	KOURA T. W., HOUENOU C.A.,	Effet de trois composts et de leurs thés sur la croissance, le	4th UAC Colloquium of Sciences, Cultures and

Field of research	N°	Authors' Name	Title	Full References
Agroforestry		DAGBENONBAKIN G. D., KINDOMIHOU V. M., SINSINB.	rendement et les nuisibles du S*olanum macrocarpon*	Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, p.571.
Agriculture /Agroforestry	21	KOURA T.W., DOSSOU T.G., KPAMEGAN N..A., DAGBENONBAKIN D.G., KINDOMIHOU M.V., SINSIN B.	Réponses de 3 cultures maraichères à différentes doses de composts produits à base de divers ferments sur sols ferralitiques au Sud Benin.	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, pp.571-572.
Agriculture /Agroforestry	22	KOURA T.W., ATIGOSSOU, DAGBENONBAKIN D.G., KINDOMIHOU V., SINSIN B.	Effet des déjections de bovins et du compost à base de déjections de bovins sur la croissance et le rendement de la grande morelle (*Solanum macrocarpum*) sur sol ferralitique dans la Commune de Sakété.	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. Abstracts Book, p.572.
Agriculture /Agroforestry	23	KOURA T. W.,Messseko A.J-P; DAGBENONBAKIN G.D., KINDOMIHOU V. M., SINSIN B.	Effet de trois composts et de leur thesur la croissance et le rendement de la tomate *(Lycopersicon esculentum)*Sur sol ferrallitiqueau Sud-Benin.	4th UAC Colloquium of Sciences, Cultures and Technologies, University of Abomey Calavi, 23-28 September, 2013. pp.572-573.
Forest/Plant ecology	24	AKPONA T.J.D., AYIHOUENOU B.E., AKPONA, H.A., DOUCET J.L.	Impact of Land Use Practices on Traits and Production of Shea Butter Tree (*Vitellaria paradoxa* C.F. Gaertn.) in Pendjari Biosphere Reserve, Benin	Akpona, T.J.D., Ayihouenou, B.E., Akpona, H.A. and Doucet, J.L. 2013.Impact of Land Use Practices on Traits and Production of Shea Butter Tree (*Vitellaria paradoxa* C.F. Gaertn.) in Pendjari Biosphere Reserve, Benin. TAAG First African Student's Conference, Book of Abstracts, Nairobi. P48.

Appendix 11: Technical Reports and books in 2013

Field of research	N°	Authors' Name	Title	References
Conservation Genetics	01	BOSSOU B., AKPONA T. J. D.	Inventory and analysis of the regulatory and institutional measures on the access to the biological / genetic resources in the Republic of Benin	Bossou M. B., Akpona T. J. D. 2013. Inventory and analysis of the regulatory and institutional measures on the access to the biological / genetic resources in the Republic of Benin. 24p.

Appendix 12: Participation at workshops/conferences in 2013

N°	Title and period	Type of presentation (oral, poster)	Name of the participants from LEA
1	Climate agriculture ressources in water yesterday to tommoro 3 - 7 september 2013.	Poster	SARE B. Adissatou
2	Iimpact of the variability climatic on the agroforestery packs: perception, strategy of adaptation of the population around the W Transboundary biosphere reserve in Benin. 23 - 28september 2013	Oral	SARE Adissatou B.; HOUESSOU Laurent G.; TEKA Oscar
3	ABePa	Poster	ANAGONOU Polynice G.
4	Développement du pastoralisme dans le contexte du changement climatique au Bénin. 16 November 2013.	Oral	ASSEDE Emeline P.S. ; FANDOHAN Bélarmain
5	SADA'13 (Applied Statistics for Development in Africa): La statistique: un outil d'aide à la décision au service du développement durable de l'Afrique. 4-8 March 2013.	Poster	ASSEDE Emeline P.S.
6	Analyse ethnobotanique des plantes utilisées dans le traitement traditionnel de l'hypertension artérielle à Bassila au Bénin. (ABePa, Novembre 2013)	Oral	BIO Anselme
7	Les Premières Journées Scientifiques du CAMES (JSDC) à l'Université Félix HOUPHOUET-BOIGNY du 05 au 07 Décembre 2013	Oral	DJEGO Julien Gaudence
8	Grantees Meeting of the postdoctoral fellowship programs within the Africa Initiative "Knowledge for Tomorrow – Cooperative Research Projects in Sub-Saharan Africa" in Hanover on 14-15 October 2013	Poster and Oral	DJOSSA Bruno A.
9	Third International Conference on Neglected and Underutilized Species. Accra, Ghana, 25-27 September 2013.	Oral	FANDOHAN Adandé Belarmain
10	Third Workshop of UNDESERT: Strategy of restoration of the biodiversity and its habitats. Burkina Faso, 2013.	Oral	PADONOU Elie ASSOGBADJO Achille TEKA Oscar GBOHAYIDA Sylvain
11	Hommage àFeu Augustin L. BARITSE, Université de Lomé, Lomé, Togo, des27, 28 et 29 juin 2013	Oral	GBESSO François G.H
12	IV^{ème} Colloque des Sciences, Cultures et Technologies de l'UAC, Cotonou, Bénin du 23 au 28 Septembre 2013	Oral	GBESSO François G.H
13	1erColloqueSCIENCES, SOCIETES ET DEVELOPPEMENTdel'UP du 27 au 29 Novembre 2013	oral	GBESSO François G.H
14	XXeme AETFATCongress, Stellenbosch South Africa, 13-17 January 2014	Oral	GOUWAKINNOU Gerard
15	XXeme AETFATCongress, Stellenbosch, South Africa, 13-17 January 2014	Poster	GOUWAKINNOU Gerard
16	3rd International Conference on Neglected and Underutilized Species: for a Food-Secure Africa. Accra, Ghana, 25-27 September 2013	Poster	HOUEHANOU Thierry
17	Quatrième colloque de l'université d'Abomey-Calavi des sciences, cultures et technologies – du 23 au 28 Septembre 2013 au campus universitaire d'Abomey-Calavi au Bénin.	Oral	LESSE Paolo, KOURA Yvan, Houinato marcel
18	XIXème congrès de l'Association Béninoise de Pastoralisme tenue au champ de foire le17 Noveembre 2013	Oral	PAOLO Lesse HOUINATO Marcel

19	Diversification and valorization of Non Timber Forest Products of plants resources in Torodi department (Niger, West Africa): social variation and implications for perspectives policies. 3rd International Conference on Neglected and Underutilized Species, For Food Secure Africa, Accra, Ghana, 25-27 September 2013 (Poster).	Poster	AMADOU A., HOUEHANOUT., YAOITCHA A**.,** HOUINATO M., MAHAMANE A. SINSIN B.
20	Gestion de l'élevage transhumant dans un contexte de Variabilités climatiques au nord-est du Bénin Symposium *"Pastoralism: where does it go in an ever-changingcontext"* Thursday 14 November 2013	Poster	HOUINATO Marcel
21	Effet de l'urbanisation et des systèmes d'élevage bovins sur la structure paysagère du cordon littoral sableux des communes d'Abomey-Calavi etOuidah Symposium *"Pastoralism: where does it go in an ever-changingcontext"* Thursday 14 November 2013.	Poster	HOUINATO Marcel
22	Ecological Niche Modeling Course held from 25-28 February 2013 at ICIPE Campus, Nairobi, Kenya.	Attendency	IDOHOU Rodrigue DJAGOUN Sylvestre KIKI Martial
23	3rd International conference on neglected and underutilizedspecies (NUS): for a food-secure Africa 25 – 27 September 2013, Mensvic Grand Hotel, Accra, Ghana	Oral	IDOHOU Rodrigue ASSOGBADJO Achille Ephrem FANDOHAN Belarmain
24	XXth Congress of Benin Pastoralism Association (ABePa)/Benin, 16 November 2013	Participant	KOURA Ivan
25	How institutions shape human-crocodile interactions: a framing analysis for improving agro-pastoral dam management in northern Benin. *International conference - Cooperation or Conflicts?* –29-31 May, *Wageningen, The Netherlands.*	Oral	KPÉRA G.N.
26	IV Colloque des Sciences, Cultures et Technologies de l'UAC-Bénin (23-28. 09. 2013), UAC. Benin	Oral	PADONOU Elie Antoine
27	3rd workshop of UNDESERT-EU project. Kombissiri, (3-6. 12. 2013), Burkina-Faso	Oral	PADONOU Elie Antoine
28	Student Conference on Conservation Science**.** 19-21 March 2013.	Oral	SALAKO K. Valère
29	Statistique Appliquée pour le Développement en Afrique (SADA'13) Cotonou 05 - 08 Mars 2013.	Oral	SALAKO K. Valère
30	Statistique Appliquée pour le Développement en Afrique (SADA'13) Cotonou 05 - 08 Mars 2013.	Poster	SALAKO K. Valère
31	Bringing together IFS grantees of Benin, Burkina-Faso, Mali and Cameroon for sustainable actions toward promotion of sciences and development in the West and Central Africa. December 11-13, 2013	Attendency	SALAKO K. Valère
32	VertNet Biodiversity Informatics Training Workshop, Boulder, Colorado, USA, 23rd-29th June 2013	Attendency	SINASSON S. K. Gisèle
33	Participation in the First International Conference on Organic Agriculture Research and Training on "Organic Agricultural Research and Training in West Africa: Presence, Challenges and Prospects". Njala University, Njala, Sierra Leone. 18 - 22 March 2013.	Oral	KOURA Tatiana KINDOMIHOU Valentin
34	Scientific visiting at Saint Louis for exchange in publishing research papers on biofuels with a scientific partner from University of Columbia, Missouri, USA. 23 April – 24 May 2013.	Oral and poster	HOLOU Roland KINDOMIHOU Valentin
35	oard of the 9thNational Conference on Organic Agriculture especially addressed to Organic Agriculture for national food security, Conservation of Biodiversity and Climate Change Adaptation. Invited speaker on: "the potentials for developing organic pasture in West Africa". Organic Agriculture Project in Tertiary Institutions in	Oral	KINDOMIHOU Valentin

	Nigeria. Federal University of Abeokuta, Nigeria. 15 November 2013.		
36	Diversification and valorization of Non Timber Forest Products of plants resources in Torodi department (Niger, West Africa): social variation and implications for perspectives policies. 3rd international Conference on Neglected and Underutilized Species, For Food Secure Africa, Accra, Ghana, 25-27 September 2013 (Poster).	Poster	AMADOU A., HOUEHANOUT., YAOITCHA A., HOUINATO M., MAHAMANE A. SINSIN B.
37	"Atelier régional de formation sur le montage de projets carbone MDP et marché volontaire dans le secteur AFOLU (Agriculture, Foresterie et Autres Utilisations des terres) " organisé par le CILSS et le Centre Régional AGRHYMET du 08 au 12 avril 2013 à Niamey, Niger	Oral	ZOFFOUN Gbêliho Alex
38	"Atelier de formation sur l'évaluation des activités et structures de recherche" organisé par la DNRST/MESRS et l'Institut Français du 26 au 28 juin 2013 à Possotomè, Bénin	Attendency	ZOFFOUN Gbêliho Alex
39	14th International Conference of the Association of Institutes for Tropical Veterinary Medicine (AITVM) organisée par l'Université de Prétoria (Afrique du Sud) et l'Institut de Médecine Vétérinaire d'Anvers (Belgique).Johannesburg, Sud Afrique ; 25 au 29 Août 2013	Poster	ZOFFOUN Gbêliho Alex
40	26ème colloque international de climatologie organize par l'Association Internationale de Climatologie (AIC). Cotonou, Bénin ; 03 au 05 Septembre 2013	Oral	ZOFFOUN Gbêliho Alex
41	4ème Colloque des Sciences, Cultures et Technologies de l'UAC-Bénin. Thème : « Recherche et Applications au Servicedu Développement de la Société » organisé par l'Université d'Abomey-Calavi, Bénin. Abomey-Calavi, Bénin; 23 au 28 Septembre 2013	Oral	ZOFFOUN Gbêliho Alex
42	Symposium international de valorisation des résultats de recherche et des innovations, organisé par le Ministère de Recherche Scientifique et de l'Innovation du Burkina-Faso et le CRDI.Ouagadougou, Burkina Faso ; 24 au 27 Septembre 2013	Oral	ZOFFOUN Gbêliho Alex
43	Hommage àFeu Augustin L. BARITSE, Université de Lomédes27, 28 et 29 juin 2013	Oral	GBESSO François G.H
44	IVème Colloque des Sciences, Cultures et Technologies de l'UAC du23au28Septembre2013	Oral	GBESSO François G.H
45	1 erColloque SCIENCES, SOCIETES ET DEVELOPPEMENTdel'UP du 27 au 29 Novembre 2013	Oral	GBESSO François G.H
46	First Student Conference on Conservation Sciences in China, Beijing. November, 1-5, 2013.	Oral	DJAGOUN Chabi A.M.S.
47	IVèmeColloque des Sciences, Cultures et Technologies, Université d'Abomey-Calavi, 23 - 28 Septembre 2013	Oral	DJAGOUN Chabi A.M.S.

Appendix 13: Research projects of LEA in which you have been involved in 2013

N°	Title of the project	Sources of Funding	Objectives of the project	Status (ongoing or ended)
1	HTA-PHYS-PHAR	Université d'Abomey-Calavi	Contribuer à la réduction de la morbidité et de la mortalité liées à l'hypertension artérielle au Bénin.	Ongoing
2	Hessian State Initiative for the Development of Scientific and Economic Excellence LOEWE	Senckenbergische Naturforschende Geselischaft Goethe Universitat Frankfurt am Main	•Carrying out internationally outstanding research on the interactions of biodiversity and climate change at the organism level •Studying of dynamics of savannas and their ecosystem services •Investigating the dynamics of west African savannas under different climate and land use scenarios •Modelling and mapping distribution changes under different services •Combining change scenarios with different parameters of ecosystem services to evaluate the possible consequences of these changes for rural communities •Performing compiling of available data and ecological niche modeling approaches	Ongoing
3	UNDESERT	European Uninon	UNDESERT aims at providing an improved understanding of the effects of desertification and degradation processes by integrating remote sensing information with sound field data on biodiversity and soil as well as socioeconomic and climate data.	Ongoing
4	Fertilization effect on the productivity and resistance to blast disease of five rice varieties in Benin	Project of Agricultural Productivity in West Africa (PPAAO/INRAB)	Increasing rice productivity through mineral fertilization and pest control.	Ongoing
5	The wild palms of Benin: uses, biodiversity, ecology, economic importance and conservation	University of Abomey-Calavi	Enhancing the level of conservation and sustainable management of wild palms of Benin for food and economic security of the rural communities in the current context of genetic resource degradation and climate change	Ongoing
6	Analysis of morphological variability and ecological adaptation of Jatropha curcas in Benin.	African Union	Contribute to the domestication of Jatropha curcas for the valorization of its commercial potential in Benin.	Ongoing
7	Valorisation des plantes locales pour l'amélioration de la santé et de la production des animaux d'élevage (VPMAP) en Afrique de l'ouest.	UEMOA (PAES)	identifier, vérifier scientifiquement l'activité biologique et valoriser les remèdes à base de plantes locales de la pharmacopée africaine supposées être douées de propriétés médicinales (notamment antiparasitaires), nutritionnelles et galactogènes pour améliorer la production et la santé des animaux d'élevage.	Ongoing
8	Valorisation des plantes médicinales de la pharmacopée béninoise pour l'amélioration de la santé animale et humaine (VPMAS)	University of Abomey-Calavi	valoriser les plantes médicinales de la pharmacopée béninoise douées de propriétés antiparasitaires, antibactériennes, antifongiques et antiradicalaires par la mise au point des	Ongoing

N°	Title of the project	Sources of Funding	Objectives of the project	Status (ongoing or ended)
			Médicaments Traditionnels Améliorés (MTA).	
9	Cartographie Et modélisation de la dynamique des parcours naturels et gestion de la transhumance dans un contexte de changements climatiques au Benin (MDP3C).	University of Abomey-Calavi	améliorer les connaissances et à accroître les capacités des différents acteurs sur la dynamique des parcours naturels et la gestion de la transhumance au Bénin dans un contexte de changements climatiques	Ongoing
10	Productivité des systèmes intégrant l'Agriculture et l'élevage au Bénin (PROSAIE)	University of Abomey-Calavi	Augmenter la productivité des systems integrant l'agriculture et l'élevage au Bénin	Ongoing
11	Optimisation de production agricole dans un système intégrant sans intrant (OPASISI)	University of Abomey-Calavi	Améliorer la production agricole dans un système integer sans intrant	Ongoing
12	ECOWAS		Economic Community of West African States	Ongoing
13	CORAF/WECARD	CORAF/WECARD	Amélioration de la résilience aux changements climatiques des écosystèmes agricoles le long des bassins-versants par le développement participatif de systèmes agroforestiers anti-érosifs et fertilisants dans six pays ouest africains	Ongoing
14	Quantification, modelling and monitoring of dynamics of carbon stocks in forest ecosystems in Benin	European Union – Global Climate Change Alliance	- Quantify the carbon stocks in three forest ecosystems ; - Establish the forest reference level; - Develop volume and biomass models ; - Test the hypothesis that the change in latitude influences the carbon storage of plant communities ; - Establish a system for monitoring the dynamics of carbon sequestered.	Ongoing

Appendix 14: Research Grants in 2013

N°	Title of Grant	Beneficiaries	Status (ongoing or ended)
1	International Foundation for Science (IFS), Sweden, Grant D/5464-1	FANDOHAN Adandé Belarmain	Ongoing
2	2nd IFS (International Foundation for Science) Grant	GOUWAKINNOU Gerard N.	Ongoing
3	Individual IFS research grant on : Assessing local conservation priorities of useful woody species in Wari-Maro forest reserve in Benin (West Africa)	HOUEHANOU Thierry	Ongoing
4	IFS (International Foundation for Science). Research Grant N° D/5448-1. 2013 Assessing the impacts of organs harvesting on population structure and reproductive performance of the wild palm *Borassus aethiopum* Mart. (Arecaceae) in Benin.	SALAKO K. Valère	Ongoing
5	International Foundation for Science (IFS) Individual Research Grant	SINASSON S. K. Gisèle	Ongoing
6	Organization for Women in Science for the Developing World (OWSD) Postgraduate Fellowship and co-supervision in South Africa	SINASSON S. K. Gisèle	Ongoing
7	West Africa Agricultural Productivity Program (WAAPP) - Programme de productivité agricole en Afrique de l'Ouest (PPAAO)/ Bourse de Doctorat	YAOITCHA Alain Sèakpo	Ongoing

N°	Title of Grant	Beneficiaries	Status (ongoing or ended)
8	UNESCO MAB Young Scientists grants	KIKI Martial	Ongoing
9	Third World Academy of Sciences research grants	ASSOGBADJO Achille	Ongoing
10	Robert S. McNamara FellowshipsProgram (RSM)	PADONOU Elie Antoine	Ongoing

Appendix 15: Prizes and nomination in 2013

N°	Title of prize / nomination	Nominee
1	Support Africa International Research Award for Ecology	FANDOHAN Adandé Belarmain
2	Support Africa International Award for Ecology, Germany	GOUWAKINNOU Gerard N.
3	Laureate of 4thedition of Scientifics poster's competition organized by IFB, DNRST, CIRAD and IRD in Benin	ANAGONOU Polynice G. HOUINATO Marcel
4	Laureate of 4thedition of Scientifics poster's competition organized by IFB, DNRST, CIRAD and IRD in Benin	KOURA Ivan HOUINATO Marcel
5	IFB-DNRST (Institut Français du Bénin-Direction Nationale de la Recherche Scientifique et Technique). Mise au point d'une technique d'échantillonnage pour la caractérisation floristique en forêt dense au Bénin. Best scientific poster of the year 2013 in Benin.	SALAKO K. Valère
6	Nomination for the Word Academy of Sciences, Young affiliate	ASSOGBADJO Ac hille
7	Nomination as young outstanding scientist in the field of science & technology in Benin	ASSOGBADJO Ac hille
8	Nomination as International Conferences Committee member for the World Academy of Science, Engineering and Technology	KINDOMIHOU Valentin

Appendix 16: Visitors received in 2013

N°	Full names of visitors	Provenance	Responsibles in LEA	Topics
1	Coert Geldenhuys	South Africa	ASSEDE Emeline P.S.	Vegetation of Biosphere Reserve of Pendjari
2	Prof. Dr. Hartmut Stützel	University of Hanover	DJOSSA Bruno A.	Evaluation visit of Benin fellows of the postdoctoral program "Knowledge for Tomorrow – Cooperative Research Projects in Sub-Saharan Africa"
3	Nyeema Harris	University California Bekerley	SOGBOHOSSOU Etotepe DJAGOUN Sylvestre	Carnivores studies
4	Professor Makoto Maruyama	Department of Advanced Social and International Studies College of Arts and Science, The University of Tokyo, Japan	KINDOMIHOU Valentin	Environmental friendly agriculture based on community resources: A strategy for sustainable development and biodiversity.
5	Dr. Hoi Yee Fu	Department of Advanced Social and International Studies, College of Arts and Science, The University of Tokyo, Japan	KINDOMIHOU Valentin	Environmental friendly agriculture based on community resources: A strategy for sustainable development and biodiversity.
6	Dr Eniola Fabusoro	Department of Agricultural Extension and Rural Development, University of Agriculture, PMB 2240, Abeokuta, Nigeria. Tel: 234-(0)-803-4046179; 234(0)-39-774563.	KINDOMIHOU Valentin	Environmental friendly agriculture based on community resources: A strategy for sustainable development and biodiversity.

9. Abstracts of Publications

1. Analysis of impact of the climatic variability on the agroforestery parks: perception,strategy of adaptation and mitigation of the population in the W Transboundary biosphere reserve in Benin

Adissatou B. Sare*; Laurent G. Houessou; Oscar Teka; Christophe Houssou; Brice Sinsin
* Laboratoire Pierre PAGNEY Climat Eau Ecosystème et Développement, Département de géographie, Faculté des Lettres, Arts et Sciences Humaines, Université d'Abomey Calavi.
*Laboratoire d'Ecologie Appliquée (LEA), Faculté des Sciences Agronomiques (FSA), Département Aménagement et Gestion de l'Environnement, Université d'Abomey Calavi (UAC). Email: adissatous@yahoo.fr
AIC AIChE Journal 59- 9 **(**2013): 458-463

Abstract

This study analyzes farmers' perceptions of climatic variability on agroforestry parks around W Biosphere reserve in Benin. To this end, investigations have been carried out with 220 agricultural households randomly selected in different ethnic groups. Interviews were related to local perception of climate variability, their perceived manifestations and causes as well as endogenous measures used for mitigation and adaptation. Frequency of citation for perceived manifestations, causes and used adaptation measures was assessed. Relationship between informant socio-demographic characteristics and perceived manifestations on one side and adaptation measures on other side were examined. About 99% of the informant opined for climate change variability effect on agroforestry system. Correspondence analysis showed the adaptation measures vary according to socio-demographic characteristics of the informants. Tree plantation, activity shifting, transhumance and the modification of agricultural calendar are the strategies used by the farmers to cope with the effect of climate variability on agroforestry systems. This study highlights the necessity to strengthen the current strategies used by farmers to cope with climate variability and to facilitate access to climatic information by farmers.

Key words: climatic variability, perception, adaptation, W Biosphere Reserve, Agroforestry Park.

2. Distribution of tree species along a gallery forest–savanna gradient: patterns, overlaps and ecological thresholds

Akomian Fortuné Azihou*, Romain Glèlè Kakaï, Ronald Bellefontaine, Brice Sinsin
*Laboratory of Applied Ecology, FSA, UAC, 01 BP 526 Cotonou, Benin. Email: fazihou@gmail.com
Journal of Tropical Ecology 29:1 (2013): 25-37

Abstract

Savannas intermingled with gallery forests are dynamic habitats typical in Africa. This study aims to determine if differences in species traits lead to non-overlapping distribution of gallery-forest and savanna species and abrupt transition between gallery forest and savanna. Tree species densities were measured in 375 plots of 1500 m^2 covering a total sample area of 56.25 ha along forty 3-km transects located at right angles to a riverbed with gallery forest into surrounding savanna. Location, vegetation type, soil physical properties, erosion and fire occurrence were recorded as site factors. Data analysis included the quantification of co-occurrence patterns, threshold indicator taxa analysis and fuzzy set ordination. The gallery forest-savanna gradient predicted floristic composition of plots with a correlation of 0.595 but its accuracy was locally modified by the occurrence of fire and the physical properties of soil that covered more than 30 % of the range of residuals. The distribution of gallery-forest and savanna tree species did not overlap. Along the gallery forest-savanna gradient, savanna species gradually increased in density while gallery-forest species showed a community threshold at 120 m from the river beyond the width of gallery forest. The forest species driving this trend should play an important role in the dynamics of gallery forest-savanna boundaries.

Key words: Africa, Benin, community analysis, ecological thresholds, environmental synthesis, fuzzy set ordination, indicator species, species co-occurrence, vegetation dynamics, woody flora

3. Do isolated gallery-forest trees facilitate recruitment of forest seedlings and saplings in savanna?

Akomian Fortuné Azihou*, Romain Glèlè Kakaï, Brice Sinsin
*Laboratory of Applied Ecology, FSA, UAC, 01 BP 526 Cotonou, Benin. Email: fazihou@gmail.com
Acta Oecologica 53 (2013): 11-18

Abstract

Facilitation is an ecological process that allows some species to establish in environments they can hardly afford in the absence of the process. This study investigated if the subcanopy of gallery-forest trees isolated in savanna is suitable for the early recruitment of forest woody species. We measured tree crown area as well as the density of seedlings and saplings of gallery-forest tree species beneath isolated trees and in the savanna matrix along 50 transects of 5-km long and 600 m wide located along four gallery forests. We then tested the nurse-plant effect and Janzen-Connell hypothesis beneath isolated trees. We also examined the relationships between the crown area and the density of seedlings and saplings. Among the eight identified tree species isolated in savanna, only *Daniellia oliveri* and *Khaya senegalensis* showed nurse-plant effect and promoted a significant, yet low early recruitment with a seedling-to-sapling survival of 0.044 and 0.578, respectively. The suitability of the subcanopy of isolated trees decreased with the recruitment progression and Janzen-Connell effects were absent. Seedlings had neutral association with the crown area of isolated trees which shifted to positive at the sapling stage.

The species of the isolated tree and the crown area explained less than 20 % of total variance, indicating that other predictive factors are important in explaining the nurse-plant effect observed in this study.

Key words: Benin, dispersal, facilitation, early recruitment, Janzen-Connell hypothesis, woody species

4. Importance of functional traits and regional species pool in predicting long-distance dispersal in savanna ecosystems

Akomian Fortuné Azihou*, Romain Glèlè Kakaï, Brice Sinsin

* Laboratory of Applied Ecology, FSA, UAC, 01 BP 526 Cotonou, Benin; Email: fazihou@gmail.com

Plant Ecology (Under review)

Abstract

Long-distance dispersal (LDD) of plants is rare, difficult to measure but disproportionately important for various ecological and evolutionary processes. Dispersal of seeds of gallery forest trees in savanna provides an opportunity for the study of colonization processes and species coexistence driven by LDD. Investigations were carried out on 91 isolated trees along four gallery forests sampled in the Biosphere Reserve of Pendjari, Benin. The abundance of adult trees within nearest gallery forest was combined with functional traits (species maximum height, seed weight, morphological adaptation for dispersal by wind, water, birds and mammals) to explain the floristic composition of forest seedlings and saplings under isolated trees and in savanna. Stepwise negative binomial regression was used to identify the most significant variables explaining abundance of seedlings and saplings beneath isolated trees and in savanna and then derive colonization from seedlings and persistence from saplings. The maximum height of species and seed weight explained the highest proportion of variance in species colonization. Morphological dispersal syndromes by wind and birds had poor explanatory importance. Species rare in gallery forest had higher potential to colonize new environments through LDD while abundant species had higher persistence abilities. Contrary to the predictions of the seedling-size effect, small-seeded species dominated the sapling stage. The findings revealled the strong dependence of LDD and subsequent colonization and persistence processes on species traits specialized for a variety of dispersal vectors. They also suggest that LDD towards isolated trees established far away from gallery forest can be difficult.

Key words: coexistence, colonization, dispersal strategy types, functional traits, local communities, regional species

5. Distribution des habitats de *Dialium guineense* (willd) (Fabaceae: Caesalpinioideae) dans les phytodistricts Est du Sud-Bénin

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Journal of Applied Bioseciences

Résumé

Cette étude sur *Dialium guineense* (willd) (Fabaceae, Caesalpinioideae) est effectuée dans les phytodistricts de Pobé, de Plateau et de la Vallée de l'Ouémé. Elle a pour objectif de connaître les habitats et la distribution géographique de l'espèce dans cette partie du Sud-Bénin. Déterminer les caractéristiques écologiques et structurales en vue de la conservation et la valorisation. A cet effet, des relevés phytosociologiques et dendrométriques ont été faits dans des placeaux de 900 m2 dans les galeries et de 1000 m2 dans les forêts communautaires et forêts denses et semi décidues. La matrice constituée de 157 espèces et de 31 relevés a été soumise à l'Analyse Canonique des Correspondances. Au total Trois groupements végétaux ont été discriminés. Il s'agit du groupement végétal à *D. guineense* et *Sida acuta* (Burm.f.) des champs, jardins de case et formations postculturale ; groupement végétal à *D. guineense* et *Berlinia grandiflora* (Vahl) Hutch. &Dalz des savanes et enfin, de celui à *D. guineense* et *Celtis zenkeri* (Engl) des forêts denses semi-décidues et galeries. L'indice de Shannon varie entre 3,8 et 4,2 bits du groupement végétal à *D. guineense* et *Sida acuta* au groupement végétal à *D. guineense* et *Celtis zenkeri* alors que l'équitabilité de Pielou est comprise entre 0,66 et 0,7. La densité moyenne des populations de *D. guineense* varie entre 5 et 97 arbres / ha. Le volume du houppier des arbres de D. guineense varie 57, 65 m3 à 187,59 m3. Le nombre moyen de branches par arbre croit de 5,20 à 15,33. La structure en diamètre est en J renversé dans les trois groupements végétaux. *D. guineense* est plus conservé dans les forêts que dans les terroirs cultivés et post culturales. Ses graines doivent être collectées dans les zones naturelles rémanentes qui sont confrontées à des menaces pour une conservation *ex situ* dans des arboreta et des jardins botaniques. Encourager les pépinières villageoises des graines de l'espèce.

***Mots-clés**:* Conservation, répartition géographique, Tamarinier noir, black velvet et Bénin

6. Could Sacredness Contribute to Forest Conservation in African Urban Areas?

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Annales des Sciences Agronomiques (under review)

Abstract

Attention is presently paid to forest conservation because of its potential for the sequestration of carbon. More than rural forest, urban forest is of greater utility because of it can serve as a natural low cost laboratory for pedagogic activities of

several schools. Unfortunately, forests are regressing in Benin, even classified forests. The objective of this study is to analyze whether sacredness could help reverse this situation in classified forests. It focused on two urban forests: the classified forest of Abomey (Abomey District) in the centre of Benin, and the classified forest of Kilir (Djougou District) in the northern Benin. The information was collected through a literature review on the administrative status of the forests, a mapping and enumeration of forest species, participant observation of the pressure on the forests, traditional authority interview and focus groups analysis with stakeholders of both forests. The investigation revealed that the size of the two forest decreased drastically, while each of the remaining parts sheltered a sacred space. From respectively a size of 173 ha at the classing in 1941 and a size of 50 ha at the classing in 1949, 43.4 % of the Abomey forest and 70 % of the Kilir forest are occupied illegally. Sacred spaces were completely preserved through time, suggesting that a sufficient recovery of sacred powers could facilitate the sustainable management of urban classified forests in Benin and Africa.
Key words: Sacredness, Urban Forests, Conservation, Benin

7. Les conflits Homme-Girafe dans l'aire centrale de répartition de la girafe (*Giraffa camelopardalis* Peralta Linnaeus 1758) au Niger

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Annales des Sciences Agronomiques 17 (2) : 107-119, 2013 ISSN 1659-5009

Résumé

Les conflits hommes-faune représentent une importante menace à la conservation de la faune de par le monde. Au Niger, l'unique population de girafes d'Afrique de l'Ouest cohabite avec les hommes. L'augmentation de la pression démographique et la croissance quasi-exponentielle de la population de girafes oblige à faire un suivi régulier des conflits homme-girafe pour une meilleure cohabitation des girafes et des hommes en vue de la sauvegarde de l'espèce. Nous avons évalué l'importance et l'évolution des conflits homme-girafe, la perception locale sur la cohabitation avec les girafes et les méthodes de résolution des conflits à travers des enquêtes auprès de 144 ménages dans trois des communes les plus fréquentées par les girafes. Les enquêtés sont essentiellement des agriculteurs dont les récoltes ne suffisent pas souvent à combler leurs besoins alimentaires durant les périodes de soudure. Les principales spéculations attaquées par les girafes sont le niébé (59,7 % des personnes enquêtées) et le manguier (22,9 % des personnes enquêtées). Les conflits, qui touchent annuellement en moyenne 54,2 % de la population de la zone, sont restés stables les cinq dernières années malgré la forte croissance de la population de girafe. Malgré les conflits, les populations trouvent des avantages à la présence des girafes et près de 60 % estiment que les avantages surpassent les inconvénients. Des méthodes d'atténuation utilisées, les plus efficaces sont le creusement de tranchées autour des camps et vergers et le transport des récoltes vers les maisons. Pour limiter les conflits et garantir la survie de la population de girafes au Niger, une approche intégrant le suivi des conflits, l'éducation et le développement d'activités alternatives génératrices de revenus, et la promotion de sources durables d'énergie domestique doit être développée.
Mots clés :*Giraffa camelopardalis* peralta, conflits homme-faune, perception locale, atténuation, Afrique de l'Ouest

8. Survey of *Loxodonta africana* (Elephantidae)-caused bark injury on *Adansonia digitata* (Malvaceae) within Pendjari Biosphere Reserve, Benin

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African Journal of Ecology doi: 10.1111/aje.12131

Abstract

This study assessed the level of bark damage on baobab trees (*Adansonia digitata*) as caused by elephants (*Loxodonta africana*), and the possibility of finding refuges where baobab could escape bark damage within the Pendjari Biosphere Reserve (PBR). Distributions of elephants and baobab trees within the PBR were compared using presence records of both species taken along transect lines. Two sites (National Park vs. hunting zone) that differ in elephant density were compared for intensity of bark damage and correlations between the intensity of bark damage and stem size of the baobab trees and population structure of the baobab trees. Elephants and baobabs showed co-occurrence in PBR suggesting that there is nowhere to hide for baobabs. The intensity of bark damage was positively correlated with elephant density and baobab girth. Baobab population girth classes were not significantly different in areas with and without bark damage. Future studies should test whether there are certain baobab genotypes that can resist elephant damage. It could also be tested whether effective conservation of elephants in the PBR has resulted in a bull-biased population over its carrying capacity.
Key words: bark damage intensity, bio-reserves, distribution, tree girth class distribution, West Africa

9. Small scale farmers' vulnerability to climatic changes in southern Benin: the importance of farmers' perceptions of existing institutions

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Mitigation and Adaptation Strategies for Global Change DOI 10.1007/s11027-013-9468-9

Abstract

Farmers in rural Africa use a number of adaptive strategies to cope with observed climatic changes and their impacts on agriculture. Most studies on adaptive capacity focus on socio-economic parameters (such as poverty or education), and few provide detailed analysis on the role played by different institutions at local level, and the effects of how these institutions are perceived on farmers' adaptation. Semi-structured interviews were conducted among 46 households from seven villages in southern Benin (West Africa), and among representatives of several institutions at the local level. Half the participants were involved in Non-Governmental Organizations (NGOs) development projects and half were independent farmers. Results indicate that independent farmers mostly use non-agricultural coping strategies (loans, work in town) while project farmers mainly use agricultural adaptive strategies (improved seed varieties). Lack of adaptive capacity of independent farmers is linked to weak State institutions at the local level. Due to their lack of efficiency and high corruption rates, local State representatives are mistrusted. NGOs are trusted and seek for help, even by independent farmers. Even if NGOs do not have climate change adaptation in their agendas, they promote activities, which help reduce farmers' vulnerability. Although our results are limited to south-western Benin, they question the way adaptation is promoted today, for instance through the United Nations Framework Convention for Climate Change (through the National Adaptation Programmes of Action).
Key Word: Climate Change: Vulnerability, Perceptions, West Africa. Adaptive strategies, Agriculture.

10. Home gardens: an assessment of their biodiversity and potential contribution to conservation of threatened species and crop wild relatives in Benin

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Genetic Resources and Crop Evolution DOI 10.1007/s10722-013-0035-8

Abstract

Despitegrowingliteraturesupportingtheimportanceofhomegardens (HG) asbiodiversityhotspots,knowledge ofpatternsoftheircontribution toconservation ofthreatenedspeciesandCropWildRelatives(CWR)across climateandcultureinAfricaisstilllimited.Thisinvestigationwasconductedacrossthreeclimaticzonestoassess thefloristicdiversityofhomegardensandtheextenttowhichtheycontributetoconservation ofthreatened speciesandCWR.Overall,240homegardensweresampledandtheir floristic diversity assessed. Theecologicalimportanceof recordedspecieswasdeterminedperclimaticzoneusingtheimportance valueindex(IVI).Aclusteranalysiswas performedtogroupthespeciesaccording totheirIVI-values andaprincipalcomponent analysishelpedto identifythemostimportantspecies.285specieswereinventoried throughout the study area.Home gardenspecies'diversity globally declinedfrom thedriertothewetterzonebutwashighestinthetransitionzone. The average number of species found per HG was 10.1 and varied weakly across zones (9.07, Guineo-Congolean zone; 10.77, Sudano-Guinean zone; and 10.53, Sudanian zone).Themostimportanthomegardensspeciesin theSudanian, theSudano-GuineaandtheGuineo-Congoleanzoneswere respectively:*Abelmoschusesculentus* (L.) Moenchand*Hibiscusasper* Hook.f.;*Solanumlycopersicum*Mill.and*Zeamays* L.;*Ipomoeaaquatica* (L.) Ker-Gawl.,and*Sennaoccidentalis* (L.) Link. They were mainly vegetables and used as food and/or medicinal plant species. Twenty CWRandtwelvethreatenedspecieswererecorded and were also mainly used for food and medicinal purposes. Thorough researchonsocioeconomic factorssupporting possession of HG and choice of managed species as well as indigenous management strategies of HG and dynamic of traditional knowledge related to HG mayhelpto deeply assesshomegardens'effectivenessinbiodiversityconservation.
Keywords: Conservation status; Climatic zones; Floristic inventory; Importance value index; West Africa

11. Impact of climate change on the geographical distribution of suitable areas for cultivation and conservation of underutilized fruit trees: case study of the tamarind tree in Benin

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Biotechnology Agronomy Society and Environment 17(3): 450–462

Abstract

Climate change may limit integration of Underutilized Agroforestry Fruits Trees (UAFT) into formal cropping systems as a strategy to increase rural household income in Africa. The present study analyzed the potential impact of climate change on the geographical distribution of suitable areas for tamarind (*Tamarindusindica* L.), an economically important UAFT species. Presence records of the species were collected and combined with bioclimatic data derived from the Worldclim data base and from soil type data. The Maximum Entropy Modeling principle (MAXENT) was used in combination with a Geographic

Information System (GIS) to forecast current and future (horizon 2050) suitable habitats for the cultivation and conservation of the species. Three different climate models were used for future predictions (the CCCMA, HadCM3 and CSIRO models) under IPCC scenario A2. Under current conditions, 65% of the national area and 87% of the national protected area network were found to be highly suitable for the cultivation and conservation of local tamarind ecotypes, respectively. It is possible that an increase in rainfall (CCCMA and HadCM3 models) will convert the currently highly suitable zones (semi-arid and subhumid dry) into poorly suitable areas at horizon 2050. A decline in precipitation (CSIRO model) could also convert the currently poorly suitable zones (sub-humid humid) into highly suitable zones. In the case of an aridification of the climate (CSIRO), cultivation and conservation of tamarind could become possible all over Benin and/or require the introduction of ecotypes from more arid areas. The predictive capacity of climatic models is constantly improving and it is therefore recommended that such studies be undertaken in order to better inform decision making for the optimum use of UAFT species.

Keywords : adaptation, Benin, climate change, crop modeling, diversification, ecotype, fruit tree, model, *Tamarindus indica*

12. Ecological factors influencing physical soil degradation in the Atacora Mountain range of West Africa

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Mountain Research and Development (MRD-JOURNAL-D-13-00030 (Under review)

Abstract

The West African landscape is characterized by an important mountain chain, the Atacora Mountain range. It is a particular ecosystem because of the orographic effect of the relief. Moreover, it arbors two of Beninese endemic species, *Thunbergia atacorensis* and *Ipomoea beninensis.*The ecosystem is threatened by soil degradation. In this study soil degradation processes and the main ecological factors influencing them were analyzed on the hillsides of this mountain range. Data were collected along line transects from plain to top within 22 plots of 30 m x 30 m. Indicators of physical soil degradation (extent of organic layer, color of topsoil, compactness of soil, cover of rill and occurrence of sheet erosion) and environmental factors (canopy and ground cover, topography, soil humidity and slope) were assessed. Cluster analysis was computed on the five indicators of physical soil degradation. Four soil degradation classes were identified: light, moderate, high and extreme, representing a gradient of increasing degradation. Canopy and ground cover were the two main ecological drivers of soil degradation identified by a Discriminant Analysis (DA) in combination with a Multivariate Variance Analysis (MANOVA). The variations in canopy and ground cover showed that plant, litter and stone cover decrease along the gradient of increasing soil degradation. Moreover we were able to conclude that the hilly parts (high topographic position and high value of slope) of Atacora Mountain are less degraded than areas with low slope values. The latest are found mostly on area easily accessible to human activities (plains and valleys).

Key words: Soil degradation, degradation classes, ecological factors, Atacora Mountain, West Africa.

13. How far does physical soil degradation influence plant communities: Study case of Atacora Mountain range (West AFrica)

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African Journal of Ecology (Manuscript ID AFJE-13-234/Under review)

Abstract

Atacora Mountain range is a particular ecosystem of West Africa where soil degradation occurs. The present study assessed the impacts of soil degradation processes on plant communities in the Beninese portion of this mountain chain. Phytosociological relevés were carried out within 22 plots along line transects from plain to top. Floristic structure of each plant community was determined and plots were classified according to soil degradation level. Plant communities (floristic composition, species cover data and biodiversity indicators) of soil degradation classes were compared by calculating the similarity index of Jaccard and performing Multi-Response Permutation Procedures and Discriminant Analysis. We found that there was no similarity between the floristic lists and vegetation physiognomy of the different soil degradation classes. In addition, species richness, species diversity, and the number of regional species, phanerophytes and sarcochores decreased along the gradient of increasing degradation but the number of species with wide distribution, therophytes and sclerochory followed a contrary trend. We concluded that soil degradation induced a gradient of disturbance of plant communities. The complexity of the vegetation patterns found on the different soil degradation classes is a response to the availability of soil resources as explain by resource allocation model.

Key words: Soil degradation, plant communities, resource allocation model, Atacora Mountains, West Africa.

14. Caractérisations phytoécologique et structurale des groupements végétaux abritant *Chrysophyllum albidum* (G. Don) sur le plateau d'Allada au Sud-Benin

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Afrique SCIENCE 09(3) (2013) 147 – 158

Résumé

Le présent travail a été réalisé pour fournir des données de base pour une meilleure conservation de *Chrysophyllum albidum* G. Don sur le plateau d'Allada au Sud-Bénin. Il vise à identifier les différents groupements végétaux au sein desquels évoluent l'espèce, à connaître leur diversité floristique et la structure diamétrique de leurs peuplements ligneux. Les inventaires forestiers ont été réalisés à l'intérieur de 104 placeaux de 50m * 50m installé dans des formations végétales homogènes. Ces inventaires ont permis de discriminer cinq groupements végétaux avec 67 espèces réparties en 7 familles. Les Rubiaceae (50 %), Sterculiaceae (49,2 %) Bignoniaceae (45 %) étaient les familles dominantes. L'indice de Shannon des groupements végétaux varie de 1,31 et 2,99 bits. Les coefficients de Skewness des classes de diamètres pour les différents groupements végétaux ont donné des valeurs supérieures à 1. Le vieillissement, l'urbanisation et le caractère sacré de l'espèce sont les principaux facteurs qui accentuent sa disparition sur le plateau d'Allada.

Mots-clés : relevé floristique, structure diamétrique, Pomme Etoile Blanche, plateau d'Allada, Benin.

15. Influence des changements climatiques sur la distribution géographique de *Chrysophyllum albidum* G. Don (Sapotaceae) au Benin

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Int. J. Biol. Chem. Sci. 7(5): 2007-2018. 2013

Résumé

La présente étude a pour objectif principal d'évaluer l'influence des changements climatiques sur la distribution spatiale de *Chrysophyllum albidum*, une espèce prioritaire et menacée au Bénin. La modélisation de la distribution géographique actuelle et future de l'espèce est basée sur le principe d'entropie maximale (MaxEnt). Elle a été faite à partir des variables bioclimatiques et des points de présence de l'espèce. Deux modèles climatiques ont été utilisés sous le scenario A2 pour la prédiction de la distribution de l'espèce à l'horizon 2050 (les modèles HadCM3 et CSIRO). Les habitats actuellement très favorables à *Chrysophyllum albidum* correspondent à la zone guinéenne regroupant les phytodistricts de Pobè, du Plateau et de la Vallée de l'Ouémé. Le modèle CSIRO prédit une augmentation considérable de près de 76, 02% environ des aires actuellement très favorables à l'espèce vers le centre du pays. Par contre, le modèle HadCM3 prédit en 2050 une légère augmentation (16,27%) des habitats actuellement très favorables à l'espèce. Ces résultats révèlent que l'habitat favorable de l'espèce est peu menacé par les changements climatiques au Bénin. Ainsi l'espèce a de forte chance de survivre face aux changements climatiques. Ceci représente une opportunité majeure pour sa conservation à long terme.

Mots clés : Changement climatique, modélisation, scénario A2, *Chrysophyllum albidum*, habitat favorable, Bénin.

16. Using niche modeling to plan conservation of an indigenous tree species under changing climate: example of *Sclerocarya birrea* in Benin, West Africa

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Research and Development in Sub-Saharian Africa (5) 1-8

Abstract

Climate envelope modeling techniques implemented in Maxent combined with GIS was used to forecast the current and future distribution (horizon 2050) of *Sclerocarya birrea*, a local fruit tree species native to semi-arid zones of Africa under present and three future climate models. The species presence data were gathered from fieldworks and herbarium records. Environmental variables were derived from monthly temperature and rainfall obtained from WordClim database. The most characteristics and least correlated were selected for the modeling after a colinearity analysis. Results showed that the current suitable range of the species remains restricted to the dry sudanian zone of the country encompassing the two main protected areas. Under future climate, results differed with the climate model with two of them predicting a reduction in the suitable habitat of the species. The suitable range is projected to shift from the two main protected areas suggesting failure of reserves to conserve the species in the future. Conservation in agricultural systems stands as a most plausible mitigation action under change in climate.

Keywords: Climate change; protected area; gap analysis; MaxEnt; Herbarium records; Tree genetic resources; Benin.

17. Change in the woody floristic composition, diversity and structure from protected to unprotected savannas in Pendjari Biosphere Reserve (Benin, West Africa)

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African Journal of Ecology,51 (2013): 358–365

Abstract

Savannas are widespread vegetation type in Sudanian zone of Africa. Since protected areas are often assumed to be the best way to conserve biodiversity, we assessed the effectiveness of the Pendjari Biosphere Reserve in Benin, for maintaining savanna woody species composition, diversity and structure. Square plots of 900 m^2 were randomly established in protected and surrounding unprotected savannas and all woody species (dbh ≥ 1 cm) were recorded and identified. Species composition, Importance Value Index, densities, basal area and diversity indexes were assessed in relation to conservation status. The results showed that DCA based on presence/absence species data did not separate clearly protected savannas from unprotected ones. However, some species were prominent in unprotected savannas while others showed the same scheme in protected ones. Diversity indexes indicated a good distribution of species in the two savanna types. The woody density showed a higher value in protected than unprotected savanna at shrub layer level. The basal area was significantly higher in the protected savanna than unprotected one at the two woody layer levels. It can be concluded that biodiversity conservation in surrounding unprotected areas should be of great importance to increase biodiversity conservation by protected area whether specific actions were implemented.

Key words: Savanna, Woody species, Structure, Diversity, Conservation.

18. How far a protected area contributes to conserve habitat species composition and population structure of endangered African tree species (Benin, West Africa)

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Ecological Complexity,13 (2013): 60-68.

Abstract

The Pendjari Biosphere Reserve located in the Sudanian zone of Bénin, is a protected area well managed, but mainly aimed at wild animal conservation. This study assessed its effectiveness to conserve habitat species composition and population structure of three endangered African tree species: *Afzelia africana* Sm., *Pterocarpus erinaceus* Poir. and*Khaya senegalensis* (Desv.) A. Juss. We randomly sampled 120 plots in the protected and surrounding unprotected habitats by inventorying plant species. For the three target species, we estimated adult and juvenile densities and recorded size classes. According to floristic composition four habitats groups were recognized in relation to human disturbance, vegetation type, and moisture. These were protected savannas, unprotected savannas, old fallows and gallery forests. The estimated adult densities of *A. africana* were similar between protected (14 ± 1.2 tree/ha) and unprotected savannas (17 ± 0.9 tree/ha) while for *P. erinaceus* the adult density was significantly higher in protected (12 ± 3.7 tree/ha) than in unprotected savannas (5±1.9 tree/ha). Estimated adult density of *K. senegalensis* was also significantly higher in protected gallery forest (40 ± 5.8 tree/ha) than in unprotected one (29 ± 4.8 tree/ha). Juvenile densities of *A. africana,K. senegalensis* and *P. erinaceus* were higher in protected habitats than in unprotected ones but the difference was not significant. Skewness coefficient indicated that populations of investigated trees were declining in their protected habitats. However, in the case of *A. africana* and *K. senegalensis* populations seemed to be mostly threatened in the protected area. We concluded that although the studied protected area is effective to conserve some habitats species compositions, protection is not sufficient to guarantee future conservation of some threatened tree species.

Key words: *Afzelia africana*, *Pterocarpus erinaceus*, *Khaya senegalensis*, Species composition, Population structure, Conservation.

19. Efficiency of inventory plot patterns in quantitative analysis of vegetation: a case study of tropical woodland and dense forest in Benin

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Southern Forests 2013, 75(3): 137–143

Abstract

The main issue in forest inventory is the reliability of data collected, which depends on the shape and size of inventoried plots. There is also a need for harmonisation of inventoried plot patterns in West Africa. This study focused on the impact of plot patterns on the quantitative analysis of two vegetation types of West Africa based on case studies from Benin. Twenty and fifteen plots of 1 ha each were demarcated in dense forest and woodland, respectively. Each 1 ha plot was divided into 100 quadrats of 100 m^2 each and diameter at breast height (dbh) of trees was recorded in each quadrat. The required time to measuring trees diameter in each 1 ha plot was also recorded to compute the mean inventory effort. From the 100 quadrats in each 1 ha plot, 14 subplots of different shapes and sizes were considered by grouping together adjacent quadrats. The basal area of each subplot was computed and the relationship between estimation bias of the basal area and the size of subplots was modeled using Smith's Law (Smith 1938). The mean absolute error of the shape parameter *c* of Weibull distribution was computed for each of the subplot shape, size and direction. The direction and shape of subplots did not influence significantly ($P > 0.05$) the precision of the quantitative analysis of vegetation. However, square subplots were suitable in practice. On the contrary, plot size was significantly ($P < 0.05$) and inversely correlated to estimation efficiency. The optimal plot size for quantitative analysis of vegetation was 1 800 and 2 000 m2 with an inventory effort of 0.51 and 0.85 man-days per subplot in woodland and dense forest, respectively. It is concluded that use of standard sample sizes will help to harmonise a forestry database and to carry out comparisons at regional level.

Keywords: efficiency, forest inventory, plot patterns, structure, tropical vegetation types

20. Variation of Loranthaceae impact on *Vitellaria paradoxa* C. F. Gaertn. Fruit yield in contrasting habitats and implications for its conservation.

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Fruits, vol. 68 (2): 109-120

Abstract

Shea tree (*V. paradoxa* C.F. Gaertn.), a species endemic to the Sudanian savanna woodlands, is dominant in the parklands of West Africa where it is of great socioeconomic importance. However, shea tree has been reported in recent decades to be threatened by plant parasites, Loranthaceae. Our study aimed to assess possible variation of the impact of these parasites on shea tree fruit yield in two contrasting habitats. Materials and methods. We selected 41 weakly and 41 heavily infected shea tree individuals, of similar size, in a protected area as well as in its adjacent parklands. Shea tree traits such as diameter at breast height, canopy diameter, tree height, canopy height, number of fruit yielded, number of parasite stumps per tree and an impact index ratio were assessed on each shea tree individual. Two-way ANOVA was performed to compare parasite impact on shea tree fruit yield in relation to habitat. Hierarchical cluster, canonical discriminant and one-way ANOVA analyses were used to show quantitative traits that characterize shea tree groups from habitats. Results. Loranthaceae did not reduce fruit yield significantly either in the parklands or in the protected area. Quantitative traits tended to discriminate all pooled shea trees in relation to habitats. Shea tree individuals in parklands were characterized mostly by the highest value of number of infected stumps per tree and of the impact index ratio, suggesting that many shea tree individuals in parklands were sensitive to Loranthaceae impact on their fruit yield. Conclusion. These findings were helpful for implementing some shea tree conservation plans.

Keywords : Benin / *Vitellaria paradoxa* / fruits / yield / Loranthaceae / parasitism / colonizing ability / habitats

21. Effet de l'âge et de l'intensité de pâture sur le développement des touffes et la production de biomasse de *Panicum maximum* var. C1 dans les pâturages artificiels en zone soudanienne et subéquatoriale

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Résumé

L'objectif de l'étude est d'évaluer l'effet du mode d'exploitation sur le développement des organes de régénération des graminées vivaces et leur productivité dans les pâturages artificiels des fermes d'élevage de Kpinnou, de Samiondji et de

l'Okpara au Bénin. Les données ont été collectées sur les trois fermes au pic de biomasse au cours du mois d'octobre. Les mesures de densité de touffes et de la surface des plateaux de tallage ainsi que la récolte de biomasse ont été réalisées dans 27 parcelles de *Panicum maximum* var. C1 âgées de 2 ans, 5 ans et 10 ans en prenant en compte les parcelles fauchées, les parcelles moyennement pâturées et les parcelles fortement pâturées. Les résultats ont montré que le nombre moyen de touffes par m² est plus élevé pour tous les pâturages en condition de surpâturage qu'en condition de non pâture. La moyenne était de 15,68 touffes.m^{-2} dans les zones surpâturées contre 6,00 touffes.m^{-2} dans les zones fauchées. La densité moyenne des touffes dans les pâturages en condition de pâture moyenne était de 8,76 touffes.m^{-2}. La surface des plateaux de tallage et la production de biomasse ont évolué inversement à la densité des touffes, en fonction de l'âge et de l'intensité de pâture. La surface moyenne couverte par les plateaux de tallage en condition de fauche était 336,29 $cm^2.m^{-2}$ contre 219,61 $cm^2.m^{-2}$ en condition de surpâture. La surface moyenne couverte au sol dans les zones d'exploitation moyenne était de 251,97 $cm^2.m^{-2}$. Ceci confirme que la pâture a des impacts très évidents sur les pâturages artificiels exploités par le bétail.

Mots clés : Groupements végétaux artificiels, pâture, plateaux de tallage, densité de touffes.

22. Influence of vegetative and seed establishment methods on seed yield and quality of *Arachis pintoi* CIAT 17434 in Sudanian region of Benin

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Abstract

Arachis pintoi is a valuable forage legume in tropical savannas. However, seeds are expensive, so that, vegetative planting is an option particularly for smallholder farmers. During 3-year, *A. pintoi* CIAT 17434 seed yield and quality were studied in northern Benin (West Africa). Two treatments (establishment from stolons and from seeds) were tested under a randomised bloc design with 4 replications per treatment. Mean annual rainfall was 1,200 mm with mean annual temperature of 27 °C. Seed yield/ha, 100 pods and 100 kernels weight, pod and kernel length and wide, pod distribution in soil profile, seed germination percentage and germination speed were parameters assessed. Mean value of each treatment were compared using the Least Squares Mean method. Plants established by seeds produced significantly ($p<0.01$) more pod (309-407 kg/ha) than those established from stolons (125-181 kg/ha). 1000 pods weight varied from 12.2 to 15.8 g and 100 kernel weight varied from 8.8 to 10.9 g. Both, pod and kernel weights were influenced by establishment methods. Most of the seeds were produced in 0-6 cm soil layer but plants established from seeds showed a higher pod depth than plants established by stolons. Harvested seeds had higher germination percentage for both treatments (75-92%) which decreased quickly 6 months after storage to nil before 9 months after harvesting. High correlations ($r = -0.97$; $p < 0.01$) were found between seed germination percentage and storage duration which can be used to predict seed germinative quality.

Key words: Forage peanut, pod, germination, West Africa.

23. Variety and environmental effects on crude protein concentration and mineral composition of *Arachis pintoi* (Kaprovickas & Gregory) in Benin (West Africa)

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Abstract

In tropical regions of West Africa, low crude protein and mineral concentrations of forages are often reported as the most constraints for livestock nutrition. Forage legumes have generally better crude protein and mineral concentrations than grasses. Three year trials were conducted in Benin on four Arachis pintoi varieties (CIAT 17434, CIAT 18744, CIAT 22160 and AFT 495) in two ecological regions (humid and subhumid). The objective was to identify their crude protein content and mineral concentrations in order to make recommendations for their use in ruminant production systems. Varieties were established through randomised complete block design arranged in a split-block where regions were main plots and varieties were subplots replicated four times per variety. Plant forages were harvest five months after establishment, dried and analysed for crude protein and mineral nutrient contents. Data were analysed with GLM model. Results showed that year had no significant influence on crude protein nor mineral contents of forages, but region and variety had both significant influence ($P<0.05$) on crude protein and mineral concentrations (Ca, K, Mg, P, Na, S, Cl, Zn Cu, Fe, Mn, Se, Co, Mo and Cr). Region×variety interaction was also significant. In humid region and for crude protein content, varieties ranked in CIAT 18744 (20.43%) = AFT 495 (19.66%) >CIAT 22160 (18.03%) = CIAT 17434 (17.77%) and in subhumid region the ranking was : CIAT 18744(19.72%) > CIAT 22160 (18.61%) >CIAT 17434(17.89%) = and AFT 495 (17.50%). Variety CIAT 18744 showed generally the highest concentrations in Ca (1.60%) and P(0.21%).

Key words*: Arachis pintoi*, crudeprotein, mineral contents,Benin

24. Influence de l'écartement et de la fertilisation azotée sur le rendement et la qualité des semences de *Brachiaria ruziziensis* en climat tropical sub humide

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Fourrages (2013) 216, 339-345

Résumé

L'expérimentation conduite au nord du Bénin (pendant 3 ans) a comparé 3 écartements entre les lignes (20, 40 et 80 cm) de Brachiaria ruziziensis et 4 niveaux de fertilisation azotée (0, 50, 100 et 200 unités N/ha). Le rendement en semences varie de 26 à 114 kg/ha, la fertilité des diaspores de 45 à 93 %. Au vu des résultats, l'installation des plants à un écartement de 40 cm est recommandée. L'influence de la fertilisation sur le rendement et la qualité des semences est variable suivant l'année de mesure : un apport de 50 kg N/ha la première année de culture et de 100 kg les 2 années suivantes donne les meilleurs résultats pour la production semencière. Une récolte de fourrage de qualité médiocre est envisageable après celle des semences mais en veillant à fertiliser correctement la culture.

Mots clés: Afrique de l'ouest, Bénin, *Brachiaria ruziziensis*, fertilisation azotée, graminée, production de semences, production fourragère, semence fourragère, semis, *Urochloa ruziziensis*, zone sub-humide, zone tropicale.

25. Growth and Forage Production of Four *Arachis pintoi* (Kaprovickas & Gregory) Genotypes in Two Contrasting Ecological Regions of Benin (West Africa)

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International Journal of Agriculture Innovations and Research, 2(2), ISSN (Online) 2319-1473

Abstract

The agronomic performance of plants is influenced by their genetic potential and the interactions of complex ecophysical factors, as well as by management practices. A 3-year field experiment was set up in order to examine the adaptability of four *Arachis pintoi* varieties (CIAT 17434, CIAT 18744, CIAT 22160 and AFT 495) in two different ecological sites (humid and subhumid zones) of Benin in West Africa. *A. pintoi* varieties were planted at three sowing densities (9, 18 and 36 plants/m^2). The objective of the trial was to identify the most interesting variety and sowing density which could be used in agricultural system in those regions. Twelve treatments (2 sites × 4 varieties × 3 densities) with four replicates per treatment arranged in a split-block design with randomized complete block where varieties were main plot and sowing densities were subplots. Data Stolon number (SN), stolon density (SD), dry matter production (DM), soil coverage (SC) and plant dry season survival (SS) were monitored for 3 years after establishment and were analyzed with the General Linear Model procedure of SAS. Data indicated that plant (SN) and (SD) varied from 8 to 512 units/m^2 and from 3 to 110 m/m2, respectively. The proportion of the plants that remained green after the 3-year trial varied from 10 to 80%. (DM) varied from 9 to 3153 kg/ha. For (SN), (SD), (DM), (SC) and (SS), there was a significant difference between sites, varieties, densities and years with a significant site×variety interaction ($P<0.01$). In general, under humid conditions, varieties ranged in the following order: CIAT 17434 = CIAT 18744 > CIAT 22160 > ATF 495. Under subhumid conditions the ranking was: CIAT 22160 > CIAT 18744 > CIAT 17434 > ATF 495. Sowing density of 36 plants/m^2 gave higher (SC) and (DM). Sowing density had no influence on plant dry season survival.

Keywords: Cover, Density, Dry Matter, Peanut, Stolon

26. Medicinal forage present in the natural pasture in Benin: Review article

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*Journal of Animal Production Advances*2013, 3(11): 301-310

Abstract

There was great opportunity of studying some underutilized forage in the natural pasture which had therapeutic properties. When crossing the natural pasture's species list with African medicinal plants one, we had five plants which could be used as forage and which had strong therapeutic properties. *Boerhavia diffusa* leafy stems and leaves were be cut as a fodder for sheep and also used as medicinal plant in Asia and in Africa. *Bridelia ferruginea* was well known for its pharmacological properties. It's also used as forage for sheep. In many parts of Africa and Asia the medicinal properties of *Chamaecrista absus* were used. In the Sahel and in Nigeria it is well liked by livestock, used to make silage and favor growth. In veterinary medicine *Detarium microcarpum*'s leaves and roots were used to treat diarrhea in cattle in southern Mali, and in Benin to treat constipation and fever in Niger. *Khaya senegalensis* was used in veterinary medicine. Its leaves were also used as fodder

with low nutritional value. This article chosen to present those five forages, their use and their properties in the goal to offer a strategy to completely solve the problem of poor feeding ruminant livestock.
Keywords: Therapeutics plants; Animal nutrition; Ruminants; Benin.

27. Supplementing *Panicum maximum* with two medicinal forages in the diet of Djallonke sheep at Benin national sheep center

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Scientific journal of animal Science(2013) 2(11) 284-295

Abstract

Ensuring a better integration of natural resources in the animal feeds remains the main challenge that farmers face most of the time. The present study, conducted in the breeding farm of Betecourou, deals with the nutritional value of two plant species both forage and anthelmintic, notably the *Khaya senegalensis* (desr.) A. Juss and the *Boerhavia diffusa* L. the feeding experiments lasted 120 days and were conducted on seventy-two (72) youg sheep Djallonké, 9.00 ± 0,25 month age, with an initial weight of 19,32±0,45 kg. For both the dry rainy seasons' experiments, the sheep were arranged in a Fisher block-like of three batches of twelve animals each. Lot 1: -green leaves of *Panicum maximum* C1 from pasture +800 g of green leaves of *B. diffusa* for each sheep. Lot 2:- green leaves of *K. senegalensis* per animal. Lot 3:- represents the control group fed only with forage *Panicum maximum* C1. For tre dry season, animals Average Daily Gain (ADG) for Lots 1 &2 are higher than those of the control group (0, 13 kg/d for the control group). Experiments during the rainy season yielded higher ADG ($p<0.05$) even though the feed intake for *B. diffusa* is the lowest. ADG and total weight gain induced are respectively 0.18 kg / d and 20.94 kg feeding with *B. diffusa* versus 0.17 kg/d and 20.0 kg for *K. senegalensis* and 0.12 kg/d and 14.25 kg for the control group) *B. difusa* and *K.senegalensis* can be used in the formulation of an intensive sheep fattening ration.
Key words: ADG, *Boerhavia diffusa*, fattening, N digestibility, *Khaya senegalensis*

28. Adaptation of peri-urban cattle production systems to environmental changes: Feeding strategies of herdsmen in southern Benin

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*Journal of Sustainable Agriculture (*Under review*)*

Abstract

This study aimed at a characterization of the diversity of peri-urban cattle production systems in southern Benin and at a better understanding of herders' strategies and perspectives in meeting their herd's feeding requirements. One hundred and twelve (112) farms were surveyed using a semi-structured questionnaire. The information collected included the socio-economic characteristics of the farms, feeding and herding practices, herders' perceptions of changes in feed resources' availability and of their driving forces. Categorical Principal Component Analysis and Two-Step Cluster Analysis were performed to classify the surveyed farms into more homogeneous groups of farms reflecting different farming systems. Subsequently, the logistic regression technique was used to predict the adaptive strategy of a given farm in function of its socioeconomic characteristics. Four distinct types of cattle farms were identified as follows: large integrated agro-silvopastoral farms (LAS, 17%); small agro-silvopastoral farms (SAP, 28%); non-integrated farms (NIN, 30%) and silvopastoral farms (SIP, 25%). These groups of cattle farms differed significantly ($p<0.001$) according to several characteristics of the farm, including land sizes, source of labor, feeding practices and constraints. Herdsmen perceptions of feeding constraints differ from one farm type to another. However, the low availability of pasture (94 %) and the difficult access to pasture (100 %) were commonly shared by all herders and were perceived as resulting from increased crop and vegetable farming (77 %), urbanization (25 %) and climate variability (40 %). Herdsmen current coping strategies included the use of lowlands pastoral resources (78 %) and exploring new grazing routes (60 %). Their future coping strategies in case of worsened environmental conditions include *inter alia* moving animals from the periurban area to rural locations (43 %) and this choice significantly depends ($p <0.001$) on the farm type and the distance to urban centers.
Keywords: cattle farming, typology, urban fringes, environmental changes, feeding strategies

29. Importance and vulnerability of ligneous medicinal plants used in Benin and its surroundings countries in Africa: literature review and quantitative approach

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Abstract

This study aims at: (i) identifing the most important ligneous species used frequently in traditional medicine in Benin and its surrounding countries for human as well as animal ailment treatment; (ii) assessing how harvesting of ligneous medicinal plant part is affecting their survival. The ethnobotany studies implemented in Benin were most focused on ligneous species and the ethnopharmacology ones reported in addition many other ligneous species; thus, this review aims to find out those plants need the in depth study. A total of 38 published articles carried out in Benin and Central and Western Africa were exploited and had permitted to compute the relative importance (RI) and the plant part used value (PUV) for each ligneous plant. Both index allowed at identifying the most employed medicinal plants according to the medicinal proprieties of their parts harvested. The number of ligneous medicinal plant used in Benin and in its surrounding stood at 263 species belonging to 193 genera and 61 families. Beninese country and its surrounding used commonly 99 ligneous species as medicinal plants. All the ligneous were used for 146 medicinal proprieties categorized into the 17 groups and occurred in all the parts of ligneous: leaves (66.92%), barks (42.21%), roots (39.54%), stem (28.14%) and fruit/seed (19.77%). The most important values of relative importance (RI) where obtained at 14 principal medicinal plants that were majority subjected to ethnobotanical studies in depth. The highest values of the plant part used (PUV) were also obtained at the ligneous plant with high relative importance value and expressed the impact of plant part harvest for various ailment treatments, on the species survival. This review shows that the many ligneous plant were mostly and commonly used as soon as in Benin and in its surrounding countries. Some ligneous plant as *Morinda lucida* and *Zanthoxylum zanthoxyloides* had most widely used. According to medicinal proprieties attributed particularly to their roots, those plants are seriously vulnerable and worth studying in depth in perspective for their conservation in Benin.

Keywords*:* Literature survey, Medicinal plant, plant part used value, Benin, Central and Western Africa

30. Indentification et caractérisation des formations végétales exploitées par l'éléphant *Loxodonta africana* dans la Réserve de Biosphère de la Pendjari au Nord-Ouest de la République du Bénin

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*Pachyderm*No. 52 July–December 2012

Résumé

Les formations végétales de la Réserve de Biosphère de la Pendjari (RBP) sont soumises à une utilisation permanente par la population des éléphants. Ces formations représentent une importante source d'alimentation pour la faune en général et en particulier pour les éléphants mais aussi une source d'approvisionnement en viande de gibier et autres produits forestiers non ligneux pour les populations riveraines. Peu de données scientifiques existent sur les relations entre les formations végétales exploitées par les éléphants et les éléphants dans la RBP. Les objectifs de l'étude sont les suivants: identifier les différentes zones exploitées par les éléphants ; caractériser les différentes formations végétales exploitées par les éléphants ; et évaluer les dégâts occasionnés par les éléphants sur ces formations. La méthode de Braun-Blanquet a été utilisée pour les relevés phytosociologiques. Les matrices des données collectées à partir des relevés ont été traitées avec le logiciel STATISTICA. Le dendrogramme a été obtenu à l'aide du logiciel STATISTICA par la méthode de Ward sur la base des distances euclidiennes pour définir les groupements végétaux. La surface terrière, la structure verticale et la structure horizontale ont été les paramètres dendrométriques calculés. L'ensemble des données a été soumis au test de Monté Carlo pour analyser les corrélations entre les facteurs environnementaux et les différentes phytocénoses exploitées par les éléphants dans le but d'évaluer l'impact des éléphants sur les formations végétales. Les résultats ont montré que les zones de Porga et d'Arly étaient des zones de forte concentration en éléphants, tandis que celles de Batia et Konkombri étaient des zones de faible concentration en éléphants. Sur les 61 relevés x 183 espèces effectués sur l'ensemble des zones identifiées, le dendrogramme a fait ressortir 5 groupements végétaux discriminés suivants les facteurs type de formations végétales, niveau de dégradation due à la densité en éléphants et la superficie des zones abritant ces groupements. La structure verticale observée était une distribution s'ajustant dans l'ensemble à une distribution en cloche de Gauss. La structure horizontale était en J renversé et traduisant une formation naturelle. La présence des chablis étaient fortement corrélés avec les zones de forte concentration en éléphants. En somme, la caractérisation dendrométrique faite souligne que la végétation de la RBP demeure en bon état de conservation malgré son caractère giboyeux dans la sous région de l'Afrique de l'ouest.

Mots clés: phytosociologie, dendrométrie, Chablis, régénération

31. Home gardens: an assessment of their biodiversity and potential contribution to conservation of threatened species and crop wild relatives in Benin

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Abstract

Despite growing literature supporting the importance of home gardens (HG) as biodiversity hotspots, knowledge of patterns of their contribution to conservation of threatened species and crop wild relatives (CWR) across climate and culture in Africa is still limited. This investigation was conducted across three climatic zones to assess the floristic diversity of home gardens and the extent to which they contribute to conservation of threatened species and CWR. Overall, 240 home gardens were sampled and their floristic diversity assessed. The ecological importance of recorded species was determined per climatic zone using the importance value index (IVI). A cluster analysis was performed to group the species according to their IVI-values and a principal component analysis helped to identify the most important species. 285 species were inventoried throughout the study area. Home garden species' diversity globally declined from the drier to the wetter zone but was highest in the transition zone. The average number of species found per HG was 10.1 and varied weakly across zones (9.07, Guineo-Congolean zone; 10.77, Sudano-Guinean zone; and 10.53, Sudanian zone). The most important home gardens species in the Sudanian, the Sudano-Guinean and the Guineo-Congolean zones were respectively: *Abelmoschus esculentus* (L.) Moench and *Hibiscusasper*Hook.f.;*Solanum lycpersicum* L. and *Zea mays* L.; *Ipomoea aquatic*a Forssk. and Senna occidentalis (L.) Link. They were mainly vegetables and used as food and/or medicinal plant species. Twenty CWR and twelve threatened species were recorded and were also mainly used for food and medicinal purposes. Thorough research on socioeconomic factors supporting possession of HG and choice of managed species as well as indigenous management strategies of HG and dynamic of traditional knowledge related to HG may help to deeply assess home gardens' effectiveness in biodiversity conservation.

Keywords: Conservation status –Climatic zones - Floristic inventory-Importance value-index -West Africa

32. Soil factors affecting density of three giant land snail species in different habitats of Dassa-Zoumè district (Central Benin)

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Abstract

This study examined the environmental factors affecting the density of the exploited giant land snail species, *Archachatinamarginata*, *Achatinafulica* and *Limicolariaflammea* in Dassa Zoumè district (Benin). Thirty plots of 30 m X 30 m were laid out, within four vegetation types (fallows, forest, woodlands and wood savannah). Inside each plot the numbers of each giant land snail species were counted, and soil characteristics were measured. ANOVA and generalized linear models (GLMs) with Poisson distribution were used to examine the influence of soil factors on the giant land snails. *A. fulica* has the highest mean density (507 snails/ha) while *A. marginata* has the lowest density (110 snails/ha). ANOVA showed no significant difference in density among habitat types for any species. The most parsimonious GLM model showed that the abundance of *A. fulica* was positively associated to the fine sands, fine silts and pH while the interactions were negatively associated with the abundance of the species. The abundance of *L. flammea* was negatively associated to the fine sands, fine silts and pH while the interactions were positively associated to the abundance of the species. As for *A. marginata*, the abundance was negatively associated to the fine silts, pH and litter while the interactions were positively associated to the abundance of the species. The abundance pattern of forest molluscs is likely to be affected by different processes. Exploitation of these giant snails will affect their density, and further research is needed to establish appropriate levels of harvesting and habitat management.

Key words: Benin-habitat-land snail- soils parameters.

33. Is the crocodile the heart of the water? a frame analysis of human-crocodile relationships in agro-pastoral dams in Northern Benin

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International Journal of Agricultural sustainability (IJAS) on 5 December 2013 (in press)

Abstract

Crocodiles, a protected species, make themselves at home in agro-pastoral dams in Northern Benin where they share ecosystem services with the local communities. This study aimed to sharpen our understanding of the way stakeholders frame the presence of crocodiles, and the institutions (formal and informal) people use for coping with crocodiles. A comparative case study was carried out in three villages in northern Benin, using a framing perspective to understand stakeholders' perceptions and practices related to the presence of crocodiles. Stakeholders in the villages of Nikki and Sakabansi expressed their discontent because their activities were hampered by crocodiles. The formal rules for protecting crocodiles were framed as not sufficiently taking into account human livelihoods. By constructing specific informal institutions, the non-compliance with the formal rules was justified, allowing them to kill crocodiles. However, stakeholders in the village of Fombawi, although experiencing the same damages, reacted in a different way. Instead of blaming the crocodiles for being aggressive, they constructed informal rules that support to live in peace with crocodiles. We suggest to regularly organizing encounters among stakeholders of the different villages for exchanging experiences and expectations that may stimulate mutual learning and sustain the livelihoods provided by the dam agro-ecosystems.

Keywords: water resources management, multi-stakeholder, framing, formal and informal rules, competing claims on natural resources

34. An assessment of climate variation risks on agricultural production: Perceptions and adaptation options in Benin

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International Journal of Climate Change Strategies and Management: 5: 2 (2013): 166-180

Abstract

Purpose – The purpose of this paper is to assess the local communities' perception of climate variation effects on crop production and the adopted strategies by farmers in order to cope with the negative effects of climate on the agriculture in the coastal zone of Benin. **Design/methodology/approach** – A total of 290 agricultural households were sampled and surveyed through structured interviews. The principal component analysis (PCA) was performed on the relative frequencies citation of perceived climate variation indication in order to describe the relationship between risk perceptions according to socio-demographic characteristics. The relative frequency of citation was calculated according to age, gender, ethnic group and agro-ecological region. **Findings** – Results showed that almost 83 per cent of the respondents already perceived the climate change risks through several indications. Climate variation perception varied with respect to age. Respondents' opinion regarding climate variation causes depended generally on their age, religion and level of education. As far as climate variation risks impact on crop production is concerned, the respondents' opinions diverged. **Originality/value** – The assessment of local communities' perception is important to design participatory and sustainable measures to cope with harmful effects of climate variation on crop production.

Keywords: Climate variation, Crop production, Perception, Adaptation, Tradition, Benin

35. Ethnobotanical study of medicinal plants used for the treatment of malaria in plateau of Allada, Benin (West Africa)

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Journal of Ethnopharmacology 146 (2013): 154-163

Abstract

Background: Malaria remains one of the most important illnesses in sub-Saharan Africa. In Benin, it constitutes a major public health preoccupation particularly for children and pregnant women. Until now, population still mostly relies on herbal medicine for malaria healing. Hence this study was carried out to document the medicinal plants used in the plateau of Allada in Benin and to assess local knowledge on traditional medicine in the management of malaria and related symptoms. Materials and methods: Data were collected from 53 informants composed of 23 traditional healers and 30 medicinal plants sellers using a structured questionnaire. Results: A total of 82 plants species belonging to 78 genera in 43 plant families were recorded as antimalarial in the study area. The families of Rubiaceae and Caesalpiniaceae were the most represented with seven species each. High informant consensus factor (ICF) was recorded in the treatment of malaria (ICF¼0.90). High fidelity level (FL=100%) was also recorded for 45.67% of the species used as antimalarial. *Dichapetalum madagascariense* was the species of high relative frequency of citation (RFC¼0.81). The dominant plant parts used in the preparation of

remedies were leaves (68%). The decoction (79%) was the main mode of preparation, while oral route (92%) was the principal route of remedies administration. Conclusion: This study provides plant species used in the plateau of Allada for malaria and related symptoms treatment. We hope that this study could be important for the conservation of traditional knowledge on the antimalarial plants and the improvement of malaria management. However, several plant species used as antimalarial by the traditional medicine practitioners in the study area need to be screened in order to identify the species having antiplasmodial activity.

Keywords: Informant consensus factor, Fidelity level, Medicinal plants, Ethnobotany, Rubiaceae

36. Land Use and Land-cover change at "W" Biosphere Reserve and its surroundings areas in Benin Republic (West Africa)

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Environment and Natural Resources Research 3:2 (2013): 88-101.

Abstract

Biosphere Reserves stand as the worldwide strategy of biological conservation. However, the current global land use change involves extensive loss of vegetation cover around the reserves and increase their vulnerability and their ecological isolation. The overall objective of this study was to assess the trends of land covers change in and outside the "W" Biosphere Reserve (WBR) in Benin as well as the driving forces of land cover change in order to provide tools for its sustainable management. For this purpose, two serial times of maps from Landsat images TM 1995 and ETM+ 2006 were used to assess the rates and trends of the different land cover units from 1995 to 2006. Socioeconomic surveys based on structured interviews were conducted with 240 households in 8 villages around the reserve. Land clearing, tree logging, settlement and grazing were frequently quoted by the households as main driver forces inducing land cover change around WBR. Probability transition matrices of land cover displayed high probabilities (>0.6) in the southern part of WBR and moderate probabilities (0.3 to 0.5) in the northern part of WBR for woodland and savanna vegetation to be changed into cropland outside the reserve showing the persistence of vegetation degradation around WBR in the coming years. Our study revealed the urgent necessity of the development of conservation action planning to stop the agricultural frontline progression toward the reserve.

Keywords: Deforestation rate, land use and land cover change, probability transition matrices, temporal maps, W National Park

37. Transboundary protected areas management: experiences from W-Arly-Pendjari parks in West Africa

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*Parks*19:2 (2013): 95-105

Abstract

This paper presents the experiences of W-Arly-Pendjari (WAP) parks in West Africa to improve conservation strategies with the support of partners within a transboundary management system. The W Regional Park and WAP complex conservation, funded respectively by the European Union and the Global Environment Facility (GEF) projects since 2001, has allowed the development of a technical basis for the transboundary approach and enhanced the effectiveness of protected areas management. This paper outlines the results of these projects including the harmonization of management strategies and the establishment of the regional patrol and biodiversity survey systems which have strengthened threat reduction. An important tool developed through the cooperative management is the establishment and implementation of a regional coordination system that brings together the three countries and all stakeholders involved in WAP protected areas management. A GEF small grant system was also implemented to support rural activities that contribute to biodiversity conservation and improve riparian communities' livelihoods in the WAP complex. The transboundary management of the complex is an experience which provides excellent lessons and deserves to be supported by natural resource funding to ensure the main management objective - the long-term conservation of biodiversity.

Keywords: Transboundary, Park, WAP, Projects, funding.

38. Current floristic composition, life form and productivity of the grasslands in the Hunting Zone of Djona (Benin)

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Biogeoscience (Under review)

Abstract

Objectives: This paper addressed temporal changes in floristic composition, plant communities' structures and productivity of grasslands. The study was conducted in the Hunting zone of Djona in the Transboundary Biosphere Reserve of W (TBRW)

Benin. *Methodology and Results*: For these purpose 30 plots of 900m² were used and "phytosociological relevés" were done following ecological uniformity, floristic homogeneity and samples representativeness to established plants communities. For biomass estimation, 30 plots of 100 m² were used. Results showed that the greatest productivity value (8320 ± 0.21 kg DM/ha) was observed in *Andropogon gayanus-Schizachyrium sanguineum* grassland. The dominant life forms in all plants communities of the study area are the phanerophytes followed by therophytes. For chorological types, all plants communities are dominated by the species of the Sudanian base element and species with broad distribution. *Conclusions and application of findings:* The identified life forms and chorological types showed an evolution of the post farming pastures to woodlands and savannas vegetation, which explains the current floristic composition of the area. Moreover, it will be possible to model the impact of grasslands exploitation on the viability of the protected area particularly in the context of climate change and for this, it's important to undertake a long-term study in order to take into account all variations and all causes of these variations.

Key-words: Grasslands, productivity, floristic composition, protected area, Benin.

39. Contribution to efforts to protect the Transboundary Biosphere Reserve in the rangeland vegetation dynamic

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Acta Botanica Galica (Under review)

Abstract

Rangeland vegetation before protective measures intensification (2002) was compared to rangeland vegetation 10 years after (2012). To reach our objectives, 32 phytosociologiques plots were considered in Transboundary Biosphere Reserve according to Braun blanquet method. Data were collected in 2002 and in 2012. Linear releves were also done according to Daget and Poissonnet methods. An NMS (Nonmetric Multidimensional Scaling) perfomed on the two survey matrices allowed us three plants groups: *Andropogon pseudapricus* and *Isoberlinia doka* of woodlands, *Hyparrhenia involucrata* and *Stereospermum kunthianum* of herbaceous savannahs and *Hyparrhenia involucrata* and *Grewia cissoides* (2002). *Loxodera ledermannii* and *Isoberlinia doka, Hyparrhenia involucrata* and *Combretum glutinosum* and *Andropogon gayanus*et*Combretum glutinosum* in 2012. With linear releves data pastoral value were calculated for the two periods. Life form and chorological type spectrum were done and analysis. This analysis revealed the predominance of phanerophytes in 2012 and can be explained by reduction of anthropic pressures on rangeland vegetationsince intensification of protection measures. We also remarked that the dominance of Sudanian base element species and testify the adherence of our data zone to the sudanian area. The high pastoral value observed in 2012 showed a better quality of forage in the rangeland. All diachronic analysis proved that a decrease of anthropogenic pressure and also proved the progressive evolution of rangeland vegetation of Transboundary Biosphere Reserve of W.

Key-words: grasslands, protection, dynamics, indicators values

40. How farmers perceive and cope with bowalization: a case study from West Africa

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*Land Use Policy*36 (2014) 461– 467

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.
K**eywords**: Bowal, Bowé, Perception, Coping strategies, Climate zones, Benin.

41. Differences in germination capacity and seedling growth between different seed morphotypes of *Afzelia africana* Sm. in Benin (West Africa)

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Journal of Horticultural Science & Biotechnology (2013) 88 (6) 679–684

Abstract

Afzelia africana is a multi-purpose woody species threatened by a lack of natural regeneration in the wild. In the present study, differences in seed germination capacity and seedling growth between morphotypes of the seeds of *A. africana* Sm. were evaluated. A total of 600 seeds were collected in the Sudanian and Guinean climatic zones of Africa and their lengths, widths, thicknesses, and weights were recorded. A hierarchical classification and canonical discriminant analysis were applied to the above traits of seeds from the different climatic zones. An analysis of variance with repeated measures was applied to seed morphotypes identified by hierarchical classification to test for the effect of these morphotypes on seed germination and seedling growth. Hierarchical classification helped to identify three seed morphotypes. Canonical discriminant analysis performed on these morphotypes revealed highly significant differences. Morphotype 1 consisted of seeds from the Guinean zone, while seeds from the Sudanian zone were clustered in morphotypes 2 and 3. Morphotype 1 had the longest and heaviest seeds, while the shortest and lightest seeds were from morphotype 3. Morphotype 1 and morphotype 3 seeds showed rapid germination, while only morphotype 1 seedlings displayed rapid growth. Morphotype 1, consisting of large seeds, was superior in terms of its germination ability and seedling growth, and represents the best choice for species restoration purposes.

42. Natural variation in fruit characteristics and seed germination of *Jatropha curcas*, West Africa

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Journal of Horticultural Science & Biotechnology(2014) 89 (1) 69-73

Abstract

An investigation was conducted in the ten phytodistricts of Benin, West Africa in order to assess the level of variation in *Jatropha curcas* seed and their germination potential. Hierarchical classification of the morphological traits of the seeds identified five morphotypes using 54% of the overall morphological information. Canonical discriminant analysis performed on the five morphotypes revealed highly significant differences. Morphotype 1 included seeds from the phytodistricts of Côtier, Pobè, Ouémé Valley and Plateau. Morphotype 2 and morphotype 5 were from the phytodistricts of Bassila, Zou, and Borgou-Sud; while morphotype 3 and morphotype 4 were from the phytodistricts of Borgou-Nord, Atacora Chains, and the Mekrou-Pendjari. There was significant morphological variation within the seed that was consequence of genetic make-up or environmental effects. Seed from Mekrou-Pendjari and the Atacora Chains were black, smooth, light (0.67 g seed-1) and small (1.76 cm-long and 1.15 cm-wide). Seed from Plateau, Côtier, the Ouémé Valley and the Pobè zone were brown, rough, heavy (0.84 g seed-1) and large (1.97cm-long, 1.2 cm-wide). All Seed germination started 4 d after sowing and ended between day 7 and day 8. Seed germination varied significantly with morphotypes.

43. Using species distribution models to select climate change resistant species for ecological restoration of bowé in West Africa

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Restoration ecology(under review)

Abstract

Bowalization is a particular form of land degradation and leads to lateral expansion of ferricrete horizons. The process occurs only in tropical regions. In this study the most adapted and resistant species towards climate change were identified on bowé. The 15 most common bowé species of the sub-humid and semiarid climate zones of Benin were submitted together with significant environmental variables (elevation, current bioclimatic variables, soil types) to the ecological niche modeling program Maxent (version 3.3.3). For future prediction (2050) IPCC4/CIAT climate data were applied. *Asparagus africanus*,

Andropogon pseudapricus and *Combretum nigricans* were identified as the most resistant species for ecological restoration of bowé in the semiarid climate zone and *Asparagus africanus*, *Detarium microcarpum* and *Lannea microcarpa* in the sub-humid climate zone.

Keywords: Benin, Bowé, climate change, ecological restoration, resistant species, sub-humid and semiarid climate zones.

44. Determination of the role of bowé in plant distribution patterns in West Africa

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Acta botanica gallica(under review)

Abstract

Bowalization, a particular form of land degradation is a lateral expansion of ferricrete horizons. This study investigated the impact of bowé on vegetation patterns, life forms, chorotypes and plant families in the semiarid and sub-humid climate zones in Benin. In both climate zones, bowé sites were characterized by tree and shrub savannas. The woody species were more diversified on bowé in sub-humid (51%) than in semiarid (44%), while the opposite was found for herb species. Hemicryptophyte and phanerophyte life forms were more frequent on bowé in the sub-humid than in the semiarid climate zone. The occurrence of chamephytes was more frequent on bowé sites in the semiarid. The occurrences of hemicryptophytes and therophytes were significantly related to bowé, while phanerophytes were highly significantly related to woodland. The Sudano-Guinean, Pan-Tropical, Paleo-Tropical, Pluri regional African, Afro-Malgache Afro-American plant chorological types were significantly bound to the occurrence of bowé, while the Sudano-Zambesian, Guineo-Congolian and Paleo-Tropical types were more frequently observed in woodland than on bowé. Amaranthaceae, Zingiberaceae, Chrysobalanaceae, Connaraceae, Loganiaceae, Moraceae and Ochnaceae were exclusively found on bowé in the sub-humid climate zone, while Convolvulaceae, Loganiaceae, Rhamnaceae, Sterculiaceae, Araceae, Bombaceae, Colchicaceae, Cucurbitaceae, Olacaceae, Pedaliaceae, Amaranthaceae, Cyperaceae and Tiliaceae were exclusively found on bowé in semiarid zone.

Keywords: bowé; sub-humid climate zone; semiarid climate zone; life forms; chorological types; vegetation patterns; plant families; Benin; West Africa.

45. Spatial distribution of bowal and differences in physicochemical characteristics between bowal and woodland areas in Benin, West Africa

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CATENA(under review)

Abstract

Bowalization, a particular form of land degradation, is a lateral expansion of ferricrete horizons. This study aims at assessing the spatial distribution of bowé in Benin and at analyzing the physicochemical characteristics of bowé soils in comparison to woodland soils. Bowé sites were identified during field exploration in Benin and their geographic coordinates were stored. Soil samples were taken on the bowé sites and nearby woodland. Mann-Whitney test was applied to analyze the different physicochemical characteristics of bowé and woodland sites. The results show that bowal was directly related to ferruginous soils and precipitation patterns. Bowal showed significantly lower values of electrical conductivity, organic matter, extractable phosphorus, silt and total nitrogen than woodland soils, while its potassium exchangeability was higher. The conversion of woodland to bowé occurring in area with ferruginous soil and unimodal rainfall regime induced lower physicochemical characteristics on bowé. Bowalization can be expected wherever ferruginous soil is observed in unimodal rainfall regime condition. Thus prevention strategies can be developed where it does not yet occurred and the observed bowé sites can be restored based on the difference found in comparison to woodland.

Keywords: Bowal; bowé; ferruginous soil; physicochemical soil characteristics; phytogeographical district; Benin.

46. Effect of inventory plot patterns in the floristic analysis of tropical woodland and dense forest

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African Journal of Ecology(in press)

Abstract

This study was set up to examine the effect of plot patterns on the accuracy of phytosociological characterization of tropical vegetation. Fifteen and twenty square plots of 1 ha were demarcated, respectively, in woodland and dense forest in Bénin. Each 1 ha plot was divided into 100 quadrats of one 100 m^2. Species of trees in each quadrat were identified and recorded. The cost in terms of time required to record tree species in each 1 ha plot and five random quadrats in a 1 ha plot were also

recorded to compute the mean inventory effort for a team of three foresters. From the 100 quadrats in a 1 ha plot, fourteen independent subplots of square and rectangular plots with different sizes were considered by grouping together adjacent quadrats of 100 m^2. Eigenanalysis was carried out to compare the subplots. Moreover, the relationship between the relative loss of accuracy (RLA) and the size of subplots was modelled. Plot size highly influenced the RLA ($P < 0.05$). Findings indicated that the square plots of 1500 and 1000 m^2 with an inventory effort of 0.35 and 0.20 man-days per subplot, respectively in tropical dense forests and woodlands appeared to be the most efficient in the phytosociological characterization of woody vegetation.

Key words: Bénin, efficiency, eigenanalysis, floristic analysis, inventory plot, vegetation

47. Efficiency of inventory plot patterns in quantitative analysis of vegetation: a case study of tropical woodland and dense forest in Benin

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*Southern Forests*2013, 75(3): 137–143

Abstract

The main issue in forest inventory is the reliability of data collected, which depends on the shape and size of inventoried plots. There is also a need for harmonisation of inventoried plot patterns in West Africa. This study focused on the impact of plot patterns on the quantitative analysis of two vegetation types of West Africa based on case studies from Benin. Twenty and fifteen plots of 1 ha each were demarcated in dense forest and woodland, respectively. Each 1 ha plot was divided into 100 quadrats of 100 m 2 each and diameter at breast height (dbh) of trees was recorded in each quadrat. The required time to measuring trees diameter in each 1 ha plot was also recorded to compute the mean inventory effort. From the 100 quadrats in each 1 ha plot, 14 subplots of different shapes and sizes were considered by grouping together adjacent quadrats. The basal area of each subplot was computed and the relationship between estimation bias of the basal area and the size of subplots was modeled using Smith's Law (Smith 1938). The mean absolute error of the shape parameter c of Weibull distribution was computed for each of the subplot shape, size and direction. The direction and shape of subplots did not influence significantly ($P > 0.05$) the precision of the quantitative analysis of vegetation. However, square subplots were suitable in practice. On the contrary, plot size was significantly ($P < 0.05$) and inversely correlated to estimation efficiency. The optimal plot size for quantitative analysis of vegetation was 1 800 and 2 000 m 2 with an inventory effort of 0.51 and 0.85 man-days per subplot in woodland and dense forest, respectively. It is concluded that use of standard sample sizes will help to harmonize a forestry database and to carry out comparisons at regional level.

Keywords: efficiency, forest inventory, plot patterns, structure, tropical vegetation types

48. On The Empirical Performance Of Non-Metric Multidimensional Scaling In Vegetation Studies

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*International Journal of Applied Mathematics and Statistics*36 (6): 54-67.

Abstract

Non-metric multidimensional scaling (NMDS) is a widely and routinely used ordination methods in vegetation studies. Its use in statistical software often requires the choice of several options on which the accuracy of results will depend. This study focused on the combined effect of sample size, similarity/dissimilarity indexes, data standardization and type of data matrix (abundance and binary) on NMDS efficiency based on real data from the Lama Forest Reserve in Southern-Bénin. Efficiency was assessed with the Spearman rank correlation and the s-stress value. All the four factors were shown to influence the efficiency of the NMDS. Among standardizations, samples (plots) standardization to equal totals gave the best results. Similarity/dissimilarity indexes of Jaccard and Sorensen performed equally whatever the nature of the matrix. However, with binary matrices, similarity index of Sokal & Michener performed better. A quadratic relationship was noted between s-stress and sample size. The optimal sample size was lower (75 plots) for the binary matrices than for the abundance ones (90 plots).

Keywords: Non-metric multidimensional scaling, efficiency, vegetation studies.

49. Return of aboveground nutrients by switchgrass into surrounding soil during senescence

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*Biofuels*4(2): (2013): 169-183.

Abstract

Switchgrass (*Panicum virgatum* L.) is a crop that holds promise for cellulosic biofuel production. To minimize fertilizer costs, farmers prefer to reduce crop removal of nutrients from the soil when biomass is harvested. The objective of this study was to monitor, from May 2008–November 2009 at Portageville (MO, USA), the nutrient concentration in the soil, switchgrass roots and rhizomes in a 20-year-old switchgrass field. Soil and tissue samples were collected to determine the sink of the nutrients lost in the aboveground biomass during senescence of the plant. **Results:** Nutrient concentration in switchgrass biomass decreased from July to the end of the season. In general, as switchgrass senesced, the nutrient

concentration of the roots did not significantly change, whereas that of the rhizomes increased. Soil test results varied depending on where samples were collected relative to switchgrass root clumps. Generally, soil samples collected from the clump showed the highest evidence of nutrients returning to the soil from the aboveground biomass; however, some of this could be due to root breakage during sampling. Soil ammonium acetate extracted K in the clumps and averaged 218 kg K kg^{-1} soil in October, compared with 302 mg K kg^{-1} soil in November. Soil NO_3-N content in the clumps in November was 5.5 mg kg^{-1} soil, compared with 1.5 mg kg^{-1} soil in October. **Conclusion:** This study provided evidence of nutrient recycling in the field by switchgrass plants and supports the concept of a reverse flow of nutrients to soil at the end of the season. The harvest of switchgrass late in November will help minimize the nutrient removal and maximize biomass yield.

Key words: Switchgrass, biomass, nutrient concentration, biofuel, senescence, USA.

50. Diagnosis and recommendation integrated system (DRIS) model establishment for diagnosing Sorghum (*Sorghum bicolor*) nutrient status in Benin (West Africa)

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*Scientific Research and Essays*8(32): (2013): 1562-1569.

Abstract

The Diagnosis and Recommendation Integrated System (DRIS) is a potential method for interpreting plant foliar nutrient composition. It provides a reliable means of linking leaf nutrient concentrations to the yield of sorghum, and has been developed for this crop using experimental data from organic and inorganic trials carried out in the Upper Catchment of Benin. Grain yield and leaf nutrient concentration were used to establish DRIS norms for N, P, K, Mg, Ca, S and Zn and statistical parameters for sorghum. The DRIS norms provided by this study were N/P: 6.5, K/N: 0.7, N/Ca: 4.6, S/N: 0.1, N/Zn: 712.2, K/P: 4.7, P/Ca: 0.7, S/P: 0.4, Zn/P: 0.01, K/Ca: 3.3, S/K: 0.1, K/Zn: 510.1, S/Zn: 39.0, Ca/Zn: 164.0, and S/Ca: 0.3. Although the database was relatively small, the norms derived for nutrient ratios of key biological significance that is, N/S and K/N, were within the expected narrow ranges for higher plants, giving credibility to both the database and the DRIS model. Data from future surveys and field experiments may subsequently be used to enlarge the database allowing the refinement of model parameters and hopefully an expansion of the diagnostic scope such as to include other micro-nutrients. As it stands, this preliminary DRIS model for sorghum offers a good diagnostic tool for evaluating the N, P, K, Ca, S and Zn status of sorghum crops in Benin.

Keywords: DRIS norms, grain yield, sorghum, Benin.

51. Plant species utilization and technical restoration of erosion areas (dongas) in the W Park and its periphery in Karimama (North Benin)

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*Journal of Applied Biosciences*69: (2013): 5496 – 5509

Abstract

Objective: This study examines the best plant species and soil and water conservation management techniques for restoring degraded ecosystems in northern Benin. Methodology and Results: A multifactorial experiment using a Split Plot design with 3 factors was conducted in Karimama during 105 days: 5 species (*Khaya senegalensis* (African mahogany), *Jatropha curcas* (Purging nut), *Moringa oleifera* (drumstick tree), *Parkia biglobosa* (stink bean), *Balanites aegyptiaca* (desert date) selected following their economic and socio cultural values. These were cultivated under 3 techniques (Zai, half moon and control) on 2 sites (donga and versant). Parameters such as mortality, diameter and height were recorded during fourteen weeks to evaluate the plant growth. Survival rates were high on the slopes (77.4 % versus 74.8 %). *Balanites aegyptiaca* showed the highest value (88.9%) on the slumpfaction and the lowest (68.5%) on the slopes where *Jatropha curcas* expressed the highest value (88.9%). The growth in diameter was the lowest with *Parkia biglobosa* and the highest with *Jatropha curcas* (0.34 versus 1.62 mm $week^{-1}$). The growth in the height ranged from 1.69 to 4.51 mm. $week^{-1}$, and was the highest with *Balanites aegyptiaca* (4.51 mm $week^{-1}$). Conclusions and applications: *Jatropha curcas* and *Balanites aegyptiaca* grew more quickly in diameter and height at the juvenile stage in the half-moons and the Zai as well on the dongas on slope. Among the techniques of water and soil management and conservation tested, only the zai is easily used at farmer level. These bioenergy and wild fruit plants already domesticated for their substantial contributions to farmers' income and sociocultural well being would be adequate in a large extent to the development of sustainable strategies for restoration of degraded Sudano-Sahelian areas. However, data from dry season will help to conclude definitively in the long term.

Keywords: woody species, erosion, slumpfaction, zaï, half-moon, W National Park.

52. Evaluation of biomass production and nutritive value of nine *Panicum maximum* ecotypes in Central Benin

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*African Journal of Agricultural Research*8(17): (2013): 1661-1668.

Abstract

The grassland resource could be better managed if the effect of different defoliation regimes on the amount of the dry matter and nutritive value was known. Consequently, 9 ecotypes of *Panicum maximum* were evaluated in central region of Benin with an average 1100 mm annual rainfall during 3 years for ley pasture without any fertiliser input. Three cutting regimes (3-10-3, 5-6-5 and 6-4-6-week) were tested for dry matter production (DM), crude protein (CP) content, CP production and mineral (Ca, Mg, P, K, Na, Zn, Mn, Cu and Co) contents. Significant differences were observed between ecotypes ($p<0.001$), cutting regimes ($p<0.001$) and years ($p<0.001$) for DM and CP production. Ecotype and cutting regime influenced significantly CP content ($p<0.05$) but year had no influence. Forage harvested from 310-3-week regime produced significantly ($p<0.05$) more DM (4742 kg $DMha^{-1}$) than 5-6-5-week (3635 kg DMha-1) or 6-4-6-week cutting regime (3789 kg DMha-1). But the reverse effect was observed for CP content as 3-10-3-week regime (5.68 gkg-1 DM) had significantly ($p<0.05$) lower CP than those of 5-6-5week (8.55 gkg-1 DM) or 6-4-6-week cutting regimes (7.15 gkg-1 DM). Mineral concentrations varied between ecotypes but not by cutting regimes and years. Three ecotypes (n° 1, 4 and 5) consistently outproduced than others and can be harvested through 5-6-5-week cutting regime. P, Na, Zn and Cu deficiencies were the most common detected in the cropped forages.

Keywords: Guinea grass, ecotypes, yield, crude protein, mineral contents, Benin.

53. Growth and Yield of Three Indigenous Vegetables (*Amaranthus caudatus, Celosia argentea L., Corchorus olitorius L.*)Grown in Soil Supplemented with Poultry Manure

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*Nigerian Society for Experimental Biology Journal*13(1&2): (2013): 13-18.

Abstract

This study tests the hypothesis that sustainable indigenous vegetable production can be achieved through organic fertilization. To that end, three tropical indigenous vegetable (*Amaranthus caudatus, Celosia argentea, Corchorus olitorius*) croppings were subjected to poultry manure fertilization in order to appreciate the plant's response observed using some growth traits and yield variations. The experiment was carried out at the organic farm of Federal University of Agriculture, Abeokuta in Nigeria. A split plot arrangement fitted into a randomized complete block design considered 3 species x 2 treatments (10t/ha manure and control) x 3 replicates. Plants that were marked were each measured weekly from the third week after planting for their height, leaf number, leaf area, root length, fresh mass and dry mass. Yield values range from 2.03t/ha to 10.07t/ha depending on species and treatments. The highest yield results were from *A. caudatus* and the lowest from *C. olitorius*. The poultry manure application caused significant increases in the height of *A. caudatus* and *C. argentea* height ($p<0.05$) and compared to the controls. However, this did not affect the leaf number and area. Poultry manure induced higher yields 1.9 times of the control (5.33 t/ha) for *Amaranthus caudatus*. However, *Celosia argentea* and *Corchorus olitorius* gave decreased yields of 5.21% and 12.9% respectively. Indigenous species responded differently to the poultry manure. Further studies are needed to test the response abilities of more indigenous vegetables to organic fertilizers.

Keywords: indigenous vegetables, poultry manure, growth.

54. Environmentally induced variation in germination percentage and energy of naked caryopses *of Loxodera ledermannii* (Pilger) W.D. Clayton ex Launert in subhumid Benin (West Africa)

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*Advances in Environmental Biology*7(2): (2013): 320-329, 2013

Abstract

This study investigated the conditions for maximizing germination of *Loxodera ledermannii*, an earlier and nutritional tropical fodder grass species. We examined the correlation of percentage germination with seed container, substrate, sowing depth, methods and date of sowing. Naked caryopses of *L. ledermannii* were subjected to various growth conditions. Results showed that percentage germination depended on growth conditions ($P = 0.001$) and energy of germination ($P = 0.0001$). Effects of the seed container, substrate, sowing depth, methods and sowing period were significant ($P < 0.05$). Refining of the substrate improved the percentage germination. Seed container coverage and sowing depth substrates increased the energy of germination ($P = 0.000$); their magnitudes were dependent on substrate types, being average for sterilized soil (56%) and higher with blotting paper (84.9%) and refined soil (121%). Highest germination energy was recorded for covered and deeper seed containers (< 5 days). Tamping increases notably the caryopses germination and the plant density through the growth period. Further studies are needed to well characterize constitutive variation of these traits.

Keywords: Germination percentage, energy, caryopses, *Loxodera ledermannii*, growth conditions.

55. Palm oil mill wastes production systems in Southern Benin

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African Journal of Agricultural Research(In press)

Abstract

While the waste management is given more care for protecting the environment and human health, agro industrial wastes are still a concern, in developing countries. This study quantitatively assesses the palm oil wastes generated by mills and describes their management in southern Benin. Twenty four out of 335 regional palm oil mills were randomly selected and assessed for waste quantities generated during the oil production season. From 1 ton of Full Fruit Bunches (FFB), each palm oil mill produces an average of 712.1 kg of fruits, 254.7 kg of Empty Fruit Bunches (EFB), and 399.8 kg of Palm kernel cake, 114.9 kg of fibre, 240.4 of Palm Oil Mills Effluents (POME) and 152.3 of crude palm oil. Numeric classification analyses result in four groups of palm oil mills following production factors and wastes quantities: small, medium, large and big mills. These groups produced yearly on average respectively 12.4 T; 31.3 T ; 132.7 T ; 800.7 T of EFB ; 5.6 T, 13.6 T, 135.2 T, 637 T of Fibre and 15.1 T, 40.9 T, 233.4 T, 572.6 T of POME. They differed in nature, plantations area and capacity to employ people. About 80% are small producers. Only the use of POME, depend on waste quantity produced.
Keywords: Palm oil mills, Wastes, Production System, Benin.

56. Influence of *Panicum maximum* ecotypes on plant root growth and soil chemical characteristics after 3-year study in Sudanian region of West Africa

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*Archives of Agronomy and Soil Science***,** DOI:10.1080/03650340.2013.770146.

Abstract

A study was carried out to compare the influence of four Guinea grass ecotypes (Panicum maximum) differing in their morphological, physiological, and agronomical traits on soil fertility in Soudanian region of West Africa. Plants were sown in a randomized complete block design with four replicates and cultivated during three successive years under a cut-and-carry regime without any fertiliser use. A natural fallow served as the control. Soil samples were collected before and after cultivation, and analyzed for pH, organic carbon, nitrogen, available P, and exchangeable cation contents. Aerial plant production was quantified and analyzed for N, P, and K content to estimate the uptake of these nutrients. Root biomass, depth, and distribution were also measured. Data were analyzed through ANOVA. After 3 years of cultivation, soil pH under plants did not vary but C and N concentrations declined from the initial levels. Owing to their deep rooting systems, two ecotypes can recycle nutrients apparently from deeper soil layers. While these ecotypes could be used for ley pastures in savannah regions of West Africa, maintenance fertiliser applications would be required to prevent nutrient depletion under a cut-and-carry regime. Further studies to test the efficacy of farmyard manure in providing these nutrients seem warranted.
Keywords: Guinea grass; soil fertility; roots.

57. Effets des variétés de niébé à buts multiples comme précédent cultural sur le rendement du maïs cultivé sur terres de barre dégradées au Sud-Bénin

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Bulletin de la Recherche Agronomique du Bénin Numéro spécial Fertilité du maïs – Janvier 2013

Abstract

Sept variétés améliorées de niébé ont été évaluées en milieu paysan sur des terres de barre dégradées dans les localités d'Adingnigon et de Zakpota dans la région centrale de la République du Bénin à fortes infestations de *Striga gesnerioides* pour leur aptitude à contribuer à l'amélioration du rendement du maïs. Il s'agissait des variétés IT99K-491-7, IT98K-506-1, IT99K- 409-8, IT98K-1034-92, IT98K-390-2, IT97K-499-35 et IT95K-193-12. La variété de niébé locale du milieu d'étude, dénommée Kpodji, a servi de témoin. Le niébé était cultivé durant la première saison des pluies et le maïs, variété 99 SYNEE-W à cycle court, était cultivé durant la deuxième saison des pluies après l'enfouissement des fanes du niébé. A la récolte, les taux d'infestation de *S. gesnerioides* variaient entre 0 et 57,85% en fonction de la localité. Indépendamment de la localité, les taux de défoliation des variétés améliorées de niébé à la récolte étaient compris entre 5,00 et 31,67% alors qu'ils étaient de 73,33% pour la variété locale Kpodji. En général les rendements moyens en grains les plus élevés étaient obtenus avec la variété améliorée IT95K- 193-12. Toutefois, le niveau de rendement était variable selon les localités. A Adingnigon, le rendement moyen était de 824 kg/ha contre 630 kg/ha pour le témoin tandis qu'à Zakpota, le rendement moyen obtenu était de 1.036 kg/ha contre 726 kg/ha pour le témoin. Les rendements moyens en fanes de niébé à la récolte les plus élevés étaient obtenus dans les deux localités avec la variété améliorée de niébé IT99K-491-7. Le rendement moyen du maïs a augmenté à Adingnigon et à Zakpota respectivement de 31,64 et 77,59% sur les parcelles ayant abrité la variété IT99K-491-7

comparativement au rendement moyen du maïs sur les parcelles ayant abrité la variété de niébe Kpodji. L'étude démontre que les variétés de niébé à buts multiples peuvent être utilisées dans l'amélioration des rendements du maïs sur les terres de barre dégradées du Sud-Bénin.

Mots clés: Fertilité, systèmes de cultures, *Vigna unguiculata*, *Zea mays*, Zou.

58. Effet de l'âge et de l'intensité de pâture sur le développement des touffes et la production de biomasse de *Panicum maximum* var. C1 dans les pâturages artificiels en zone soudanienne et subéquatoriale

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Abstract

L'objectif de l'étude est d'évaluer l'effet du mode d'exploitation sur le développement des organes de régénération des graminées vivaces et leur productivité dans les pâturages artificiels des fermes d'élevage de Kpinnou, de Samiondji et de l'Okpara au Bénin. Les données ont été collectées sur les trois fermes au pic de biomasse au cours du mois d'octobre. Les mesures de densité de touffes et de la surface des plateaux de tallage ainsi que la récolte de biomasse ont été réalisées dans 27 parcelles de *Panicum maximum* var. C1 âgées de 2 ans, 5 ans et 10 ans en prenant en compte les parcelles fauchées, les parcelles moyennement pâturées et les parcelles fortement pâturées. Les résultats ont montré que le nombre moyen de touffes par m² est plus élevé pour tous les pâturages en condition de surpâturage qu'en condition de non pâture. La moyenne était de 15,68 touffes/m^{-2} dans les zones surpâturées contre 6,00 touffes/m^{-2} dans les zones fauchées. La densité moyenne des touffes dans les pâturages en condition de pâture moyenne était de 8,76 touffes/m^{-2}. La surface des plateaux de tallage et la production de biomasse ont évolué inversement à la densité des touffes, en fonction de l'âge et de l'intensité de pâture. La surface moyenne couverte par les plateaux de tallage en condition de fauche était 336,29 $cm^2.m^{-2}$ contre 219,61 $cm^2.m^{-2}$ en condition de surpâture. La surface moyenne couverte au sol dans les zones d'exploitation moyenne était de 251,97 $cm^2.m^{-2}$. Ceci confirme que la pâture a des impacts très évidents sur les pâturages artificiels exploités par le bétail.

Mots clés : Groupements végétaux artificiels, pâture, plateaux de tallage, densité de touffes.

59. Composition chimique, dégradabilité in sacco et produits de fermentation in vitro de la fétuque élevée (*Festuca arundinacea)*

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Journal of Applied Biosciences, 2013, 7: *5173-5182*.

Abstract

Objectifs : En vue d'une sélection pour une utilisation comme aliment pour bétail, vingt-quatre écotypes de fétuque élevée (*Festuca arundinacea*) provenant du milieu naturel du nord de la Belgique ont été étudiés afin d'en déterminer la valeur nutritionnelle. Méthodologie et Résultats : La composition chimique, la dégradabilité in sacco et les incubations in vitro ont été réalisés. Un mouton adulte fistulé au niveau du rumen a été utilisé pour la détermination de la dégradabilité in sacco des écotypes et les incubations in vitro. La teneur moyenne en MAT (8,0% MS) des 24 écotypes étudiés est faible. Les écotypes de *Festuca arundinacea* présentent en moyenne une meilleure dégradabilité potentielle (a + b) (82,7%) que les fourrages tropicaux *Pennisetum purpureum* (64,9%) et *Tripsacum laxum* (66,8%) mais moindre que les fourrages tempérés (*Lolium perenne* : 90,5%). *Festuca arundinacea* a présenté une production élevée de propionate (234.7 Gmol/mmol AGV totaux). Conclusion : Les meilleurs de la collection de 24 écotypes de *F. arundinacea* ont été identifiés pour une utilisation comme aliment pour bétail. Les teneurs en MAT trouvées pour la fétuque élevée sont comparables à celles des fourrages tropicaux qui sont généralement plus pauvres en protéine que les fourrages tempérés ; ce qui représente un handicap pour leur ingestion volontaire. Ces résultats impliquent d'une part qu'il faut une supplémentation en azote pour les pâturages de *Festuca arundinacea* et d'autre part l'exploitation des pâturages à la fétuque élevée au stade avant frutification. Par ailleurs, la culture en association de fétuque élevée et légumineuses est également une solution envisageable. Une variabilité a été notée entre les écotypes de *Festuca arundinacea* qui en moyenne présentent une meilleure dégradabilité que les fourrages tropicaux, mais moindres que les fourrages tempérés. Cet avantage de la fétuque élevée sur les fourrages tropicaux se consolide par une production élevée d'acide propionique et faible d'acide acétique comparables à celles des fourrages tempérés ; ce qui est très intéressant car le propionate peut générer du glucose, un des facteurs limitant pour la production laitière.

Mots clés:*Festuca arundinacea*, écotype, azote ammoniacal, dégradabilité in sacco, méthane, acides gras volatiles.

60. Effect of graded levels of dry pineapple peel on digestibility and growth performance of rabbit

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Abstract

A feeding trial was conducted to investigate the effect of the inclusion levels of sun dried pineapple peel (PP) in the diets, on the digestibility and growth performance of rabbits. Methodology and Results: Diets R0 (control), R20, R30 and R40 were formulated by including 0, 20, 30 and 40% of PP. *Panicum maximum* C1 fodder supplemented the diet of each rabbit. Twenty-four growing rabbits, of 40 to 55 days old, with initial weight 765 ± 128g were used for 70-day trial. Faecal apparent digestibility of dry matter was measured in 12 rabbits during 7 days. The intake of the diets based on PP was similar ($p>0.05$) to that in the control diet. Total feed intake ranged from 66 to 72 g DM/kg. The average dry matter digestibility (67.5%) was similar ($p>0.05$) in rabbits fed diet containing 20% PP and control diet. Average daily weight gain (15.5 to 16.7 g) and feed conversion ratio (5.48 to 6.08) were better in rabbits fed R0, R20 and R30 diets.

Conclusions and application of findings: Results from this study show that weaned rabbits are good consumers of dried PP. This study demonstrated that, the dried PP is a suitable feedstuff for rabbits. It can be included in rabbits' diets up to 20% without a significant adverse effect on feed intake, dry matter digestibility and growth performance. The PP meal is biologically efficient and environmentally sustainable. It successfully enhanced the rabbit's growth performance. To get optimum performance of rabbit, famers may not exceed 20% inclusion level in dietary. However, the present technologies do not take into account other equal practices or more important, in farm conditions. Therefore, it is important to include the economic viability aspect in the technologies during on farm research before starting its dissemination.

Keywords: pineapple peel, chemical composition, intake, live weight gain, feed conversion ratio

61. Implications de l'utilisation des ligneux comme bois-énergie dans la Commune d'Abomey

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Résumé

Cette recherche vise à déterminer les impacts de l'utilisation abusive des bois pour la production de l'énergie domestique et de l'importance de la préservation de ces ressources dans la Commune d'Abomey. L'approche méthodologique développée est axée autour de la recherche documentaire, de la collecte des données sur le terrain, de leur traitement et de l'analyse des résultats. L'analyse diachronique a permis d'apprécier l'évolution des différentes unités d'occupation du sol, et la matrice de Léopold a été utilisée pour l'identification des impacts. Les résultats montrent que les besoins en bois-énergie augmentent de façon exponentielle dans le secteur d'étude ce qui explique le déboisement intensif des forêts et savanes surtout dans les localités qui ravitaillent les grands centres urbains. Aussi, les forêts reliques dans la Commune d'Abomey qui, pendant longtemps assuraient l'approvisionnement en énergie domestique dans les grandes villes du Sud se sont épuisées sous la pression d'une population en perpétuelle augmentation. Alors devant celle-ci régressent des formations ligneuses dans les zones d'approvisionnement.

Mots-clés : Abomey, bois de chauffe, énergie domestique, impacts négatifs

62. Hunting affects dry season habitat selection by several Bovid species in Northern Benin.

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Wildlife Biology (under review)

Abstract

Multiple land uses including tourism, hunting, and agriculture around protected areas can be a serious complication for wildlife management. We calculated habitat selection indices (Manly's alpha) for 10 bovid species in the Pendjari Biosphere Reserve in Benin, West Africa, to assess if habitat use differed in each bovid species between hunting and non-hunting zones. Presence/absence data was used in resource-selection functions based on a Generalized Linear Mixed effect Model to examine factors that explained bovid species distribution. We observed stronger avoidance of open habitat types in the hunting zone than in the non-hunting zone for the hartebeest (*Alcelaphus buselaphus*), oribi (*Ourebia ourebi*), roan (*Hippotragus equines*), kob (*Kobus kob*), waterbuck (*Kobus ellipsiprymnus defassa*) and reedbuck (*Redunca redunca*). In contrast, in grey duiker (*Sylvicapra grimmia*), red-flanked duiker (*Cephalophus rufilatus*), bushbuck (*Tragelaphus scriptus*) and buffalo (*Syncerus caffer brachyceros*) we found no differences in habitat use between hunted and non-hunted areas. This may indicate that the latter species show more pronounced ecological and behavioural plasticity. Further, resource selection

of bovid species on a small scale was influenced by other factors such as habitat structure, landscape characteristics, and human disturbance. This preliminary assessment of bovid habitat relationships in West Africa suggests that human hunting activities may cause species to alter their habitat selection. We therefore suggest habitat models may need to incorporate this source of variation if they are to accurately predict habitat use or distribution of a species.
Key words: Resource selection; human disturbance; hunting vs. non hunting; ungulates

63. Stable carbon isotope analysis of the diets of West African bovids in Pendjari Biosphere Reserve (Northern Benin)

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* 01 BP 526, Cotonou-Bénin/ Email: dchabi@gmail.com
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Abstract

Bovid diets have been studied for decades, but debate still exists about habitat-related variation in the diets of many species. In this study we used stable carbon isotope analyses of faeces to explore the seasonal dietary preferences of 11 bovid species from a West African savanna, the Pendjari Biosphere Reserve (PBR), along the browser/grazer (or C3/C4) continuum. We compared our carbon isotope values with those for Eastern and Southern African bovids, as well as with dietary predictions based on continent-wide averages derived from field studies. Oribi and reedbuck, expected to be grazers were found to be predominantly browsers in the PBR. Bushbuck, common duiker and red-flanked duiker consumed more grass than reported in previous studies. When comparing wet and dry season diets, kob, roan and oribi showed the least variation in C3 and C4 plant consumed proportions, while red-flanked duiker, bushbuck, reedbuck and waterbuck showed the most marked shifts. This study shows that animals in the better-studied Eastern and Southern African savannas do not exhibit the full range of possible dietary adaptations and African bovid species intended to make the point that studying a little-known region such as West Africa can change our overall picture of bovid isotopic ecology.
Key words: diet; bovid; graze; browse; savanna.

64. Stable isotope analysis provides evidence that low density bovid population can result in non-structured herbivore communities

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Abstract

Understanding the mechanisms of species coexistence within local assemblages can play a crucial role in conservation of a species. There is little understanding of how large mammalian bovid species from West Africa partition diet resources, and vary their diet and habitat selection seasonally in order to coexist. Here we studied an assemblage of eleven bovid species in Pendjari Biosphere Reserve, West Africa and tested two nutritional hypotheses for the ecological diversity of ungulates, the browser/grazer (diet type) and diet quality models. We used stable carbon isotope ratios of faeces to reconstruct diet of each species at seasonal scale and collected data from literature regarding the species body mass. These data are combined with proxies for diet quality (percent nitrogen) from faeces to track changes in diet quality. Results show that, contrary to many predictions, body mass and diet type are not related, but these data confirm predictions that diet quality decreases with increasing body size, both in dry and wet seasons. Our findings also show numerous patterns in resource partitioning amongst the 11 bovid species studied, suggesting that different species used different dietary resources in contrasting ways. In practice, actual resource competition between bovid species is difficult to demonstrate, but there exists much overlap in diet along the stable carbon isotope axis for most of the studied species. However we conclude that in our study area, due to abundant resources and low herbivore densities, especially in the wet season, niche breadth and diet overlap remain large, because there is no need for herbivores to specialize, to avoid competition over scarce resources.
Key words: body mass, carbon isotopes, per cent nitrogen, bovid, coexisting.

65. Seasonal habitat and diet partitioning between two sympatric bovid species in Pendjari Biosphere Reserve (Northern Benin): waterbuck and western kob

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Abstract

Niche theory suggests differential use of shared resources which facilitates co-existence of species in a community. In this study we used the faecal stable isotope analysis with observations along line transects perpendicular to the Pendjari River. This was to examine seasonal habitat features and diet partitioning between two sympatric bovid species waterbuck (*Kobus ellipsiprymnus*) and western kob (*Kobus kob*) in the Pendjari Biosphere Reserve. In support of niche partition hypothesis, diets of western kob and waterbuck differed significantly along both faecal selection axis (δ13C and δ15N) during the resource limited period of dry season as opposed to wet season when there is resource abundance. Western kob and

waterbuck resource partitioning does not occur only on the basis of diet segregation but also some habitat variables play an important role in their co-existing system. Findings support the niche partition hypothesis, where morphologically, ecologically and closely related sympatric species segregate at least in one of the niche dimensions to allow coexistence. The two bovid species were observed to diverge largely along distance to water source gradient. The results provided empirical evidence that habitat features acts as an additional dimension over which herbivores partition resources.
Key words: Niche overlap, Habitat selection, *K. ellipsiprymnus, K. kob*, Coexistence.

66. Vigilance efficiency and behaviour of Bohor reedbuck *Reduncaredunca* (Pallas 1767) in a savanna environment of Pendjari Biosphere Reserve (Northern Benin)

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*Mammal Study*38:81-89

Abstract

This study was performed to gain more knowledge about the Bohor reedbuck time budget and vigilance in a savanna habitat. Detailed data on the time-budget were collected through focal animal observation technique to determine whether the time budget activities of Bohor reedbuck was affected by vegetation cover and to test if herd size, position in herd, the age and sex affect vigilance efficiency. We used generalized linear mixed-effect models to assess how herd size, sex, animal position in the herd and age affected individual time allocation to vigilance behaviour. The most parsimonious model averaging clearly showed how vigilance behaviour among Bohor reedbuck was strongly, affected by age, sex, the total herd size and animal position in the herd accounting for the lowest Δ value of Akaike Information Criterion (AIC). Vigilance and feeding behaviour occupied the largest percent of Bohor reedbuck daylight time budget. Herd size effects were significant on different behaviour categories only when the Bohor reedbuck was observed in sympatric association. Our findings support the herd size effect hypothesis only in sympatric grouping system. However, further study is needed to investigate the possible sex-specific functions and targets of vigilance behaviour with respect to the herd direction in the field.
Key words: Vigilance, herd effect, time budget, behaviour, sympatric ungulate.

10. Abstracts of Doctorate thesis

1. Ecology of isolated trees in tropical savannas: modelling of plant species distribution and colonization of new habitats through long-distance dispersal and facilitation

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Abstract

Savannas occupy a fifth of the earth's land surface and are one of the most sensitive ecosystems to future changes in land use and climate. In tropical Africa, most savannas are intermingled with gallery forests along waterways. A thorough understanding of factors that structure savanna communities is urgently required to guide management effort. The current research aims to (i) predict spatial isolation of tree species from the distribution of tree species along a gallery forest–savanna gradient; (ii) assess the efficiency of isolated gallery-forest trees established in savanna to facilitate the germination and growth of forest woody species beneath their canopies; (iii) analyse the relative importance of morphological traits, dispersal, microhabitat amelioration and biotic interactions in predicting the recruitment of forest species under the crown area of gallery-forest trees isolated in savanna; (iv) assess the importance of functional traits and regional species pool in predicting long-distance dispersal in savanna ecosystems; and (v) predict spatial isolation and colonisation process from spatial patterns of trees, saplings and seedlings in gregarious stands.

The introduction presents a general overview on savanna ecology with emphasis on theories of facilitation and long-distance dispersal in plant communities, and describes the objectives of the study and the organisation of the thesis. Chapter 1 describes the Biosphere Reserve of Pendjari, the study area of the five scientific investigations that form the main body of the dissertation.

In chapter 2, Thresholds Indicator Taxa Analysis (TITAN) was applied to identify abrupt changes in the distribution of tree species and detect the existence of isolated trees at gallery forest – savanna boundaries. The gallery forest-savanna gradient predicted floristic composition of plots with a correlation of 0.595 but its accuracy was locally modified by the occurrence of fire and the physical properties of soil that covered more than 30 % of the range of residuals. The distribution of gallery-forest and savanna tree species did not overlap. Along the gallery forest-savanna gradient, savanna species gradually increased in density while gallery-forest species showed a community threshold at 120 m from the river beyond the width of gallery forest. The forest species driving this trend should have isolated trees that play an important role in the dynamics of gallery forest-savanna boundaries.

Chapter 3 focused on the identification of gallery-forest trees isolated in savanna. It tested the nurse-plant effect and Janzen-Connell hypothesis beneath isolated trees and also examined the relationships between the crown area and the density of seedlings and saplings. Among the eight identified tree species isolated in savanna, only Daniellia oliveri and Khaya senegalensis showed nurse-plant effect and promoted a significant, yet low early recruitment with a seedling-to-sapling survival of 0.044 and 0.578, respectively. The suitability of the subcanopy of isolated trees decreased with the recruitment progression and Janzen-Connell effects were absent. Seedlings had neutral association with the crown area of isolated trees which shifted to positive at the sapling stage. The species of the isolated tree and the crown area explained less than 20 % of total variance, indicating that other predictive factors are important in explaining the nurse-plant effect observed in this study.

In chapter 4, various regression models were fitted to identify the best candidate for predicting positive plant-plant interactions between isolated trees and their protégés. The number of seedlings and saplings of gallery-forest tree species was recorded beneath 91 isolated trees. Predictor variables included: diameter at breast height, total height and crown area of isolated trees, height of vegetation surrounding the isolated tree, distance between the isolated tree and the nearest river, height and basal area of termite mounds, C4 grass cover, and number of savanna trees, gallery-forest juveniles, savanna saplings and savanna seedlings under the isolated tree. Negative binomial regression was used for data analysis and model selection was based on Akaike-information-criterion. Abundance of savanna saplings, height of termite mounds and height of isolated tree were important explanatory variables for the abundance of gallery forest seedlings and saplings. Abundance of savanna seedlings and distance to the nearest river were important in predicting abundance of conspecific seedlings and heterospecific seedlings under isolated trees. Abundance of savanna saplings was also significant indicator of microhabitat amelioration. Abiotic and biotic mechanisms which allow early establishment (seedling) also favour persistence (sapling). Both conspecific and heterospecific seedlings and saplings showed similar responses to dispersal, microhabitat amelioration by termites and interaction effects with savanna woody species. Enhanced recruitment of saplings beneath isolated trees will therefore lead to remote forest communities. However, the previous modelling exercise does not give any information on the prediction of the floristic composition of seedling and sapling community beneath isolated trees.

Chapter 5 assesses the importance of functional traits and regional species pool in predicting long-distance dispersal (LDD) from gallery-forest towards isolated trees. It tests theories of coexistence in plant communities; particularly how the inference/dispersal trade-off could explain species assemblages in savanna ecosystems. The maximum height of species explained the highest proportion of variance in species colonization. Morphological dispersal syndromes by wind and birds

had poor explanatory importance. Species rare in gallery forest had higher potential to colonize new environments through LDD while abundant species had higher persistence abilities. Contrary to the predictions of the seedling-size effect, small-seeded species dominated the sapling stage. For both colonization and persistence, increasing dispersal distance is likely to reduce the probability that seeds will reach a suitable habitat beneath isolated trees. The findings reveal the strong dependence of LDD and subsequent colonization and persistence processes on species traits specialized for a variety of dispersal vectors.

Chapters 3 to 5 deals with dicotyledonous isolated trees identified from ecological thresholds in chapter 2. Chapter 6 focuses on *Borassus aethiopum*, the only one monocotyledon and dioecious species reported to have isolated trees in chapter 2. It investigates the spatial patterns of *B. aethiopum* and potential convergence between spatial processes in stands and spatial isolation of individual palm adults. We collected map data for palm individuals in three different life history stages, taking into account the sex of adults; other tree species and termite mounds in savanna have been also considered. Spatial analyses were based on the pair correlation function. Juveniles of *B. aethiopum* were scarce in stands, suggesting the existence of a recruitment bottleneck for the seedling-to-juvenile transition. Seedlings showed an aggregative distribution, while adults had a random pattern or a clumped distribution. All development stages were spatially independent from nutrient-rich patches and spatial segregation of the sex was absent. Seedlings showed spatial patterns independent from female adults; suggesting the prevalence of mammals-mediated dispersal which may explain the existence of isolated trees. Both sexes were equally represented among isolated trees; but seedlings mostly occur in the vicinity of isolated female palms. From these results, we propose a parsimonious scenario explaining spatial isolation of palm trees. Long-distance dispersal of seeds by elephants and baboons increase the probability that heavy seeds bridge long distance and establish adult palms far from stands. The demographic bottleneck at the juvenile stage explains the failure of isolated palms including females to reconstitute small stands around them. Further studies using molecular marker analysis and assignment tests are required to test if seedlings occurring around isolated male palms are a case of 'rescue effect'.

The last section of this work discusses the major findings and their relevance to literature, implications for conservation and perspectives for future researches. Nurse plants and dispersal from regional species pool could be used to increase establishment of target plant and reduce time required for restoration. Applied nucleation is a promising restoration strategy that can accelerate forest recovery to a similar degree as plantation-style restoration but is more economical. Further researches must go beyond demonstration of the existence of facilitation by investigating evolutionary impacts of facilitation in African savannas. It requires integrating long-term data with spatial data as well as using new methods (molecular marker, stable isotopes, and fluorescent colours) to measure LDD and its implications for metapopulation and metacommunity theories.

Keywords: tropical savannah, plant distribution, modelling, colonization, dispersion

2. Feeding ecology and habitat use of bovid species in Pendjari Biosphere Reserve, Benin (West Africa)

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Abstract

This thesis endeavours to understand how grazing and browsing herbivores co-exist, with special emphasis on understanding the mechanisms of competition and facilitation over temporal and spatial scales. We focused on feeding ecology and habitat use study of the free ranging bovid species of Pendjari Biosphere Reserve in North western Benin. Here we used stable light isotope analysis of faeces to identify, as well as quantify bovid food selection, diet niche segregation and habitat selection indices (Manly's alpha) were calculated for each bovid species to assess if habitat use differed in each species across hunting and non-hunting zones. While presence/absence data were used in resource-selection functions based on Generalized Linear Mixed effect Model to examine how bovid species distribution were related to habitat structure and composition, landscape structure and human disturbance. Additionally, detailed data on the time-budget were collected through focal animal observation technique to determine whether the time budget activities of Bohor reedbuck, living in sympatric system was affected by vegetation cover and to test if herd size, position in herd, the age and sex affect vigilance efficiency. Chapter 1 dealt with the background, starting research objectives, research questions and the thesis structure while chapter 2 dealt with the study area and study animal. In Chapter 3, we analyzed bovid species habitat use and distribution with respect to habitat structure (micro and macro-habitat), landscape characteristics, and human disturbance factors in West Africa, a semi arid landscape, where bovid occupy the Biosphere Reserve characterized by different managed areas. We observed a clearly stronger avoidance towards opened habitats in the hunting zone than in the non hunting zone for the hartebeest, oribi, roan, kob, waterbuck and reedbuck, while the ecological and behavioural plasticity was most pronounced in the grey duiker, red-flanked duiker, bushbuck and buffalo which didn't show any shift in habitat use across the managed areas. Besides habitat preferences attributed to each bovid species at landscape level, bovid species' resource selection was influenced on a small scale by other factors such as habitat structure, landscape characteristics, and human disturbance factors suggesting that bovid species are influenced by a range of factors operating at different scales. Chapter 4, analyzed the proportions of C_3

browse:C_4grass in the diets of 11 bovid species in Pendjari Biosphere Reserve, Benin, West Africa. Of these, eight were expected to be grazers (buffalo, reedbuck, waterbuck, hartebeest, kob, oribi, roan and topi), and three browsers (red-flanked duiker, bushbuck and common duiker). Carbon isotope results from faeces of PBR bovids implied that only six species (buffalo, waterbuck, hartebeest, kob, roan and topi) had primarily C4 grass-dominated diets, whereas five species focused largely on C3 vegetation, i.e. browse (reedbuck, oribi, red-flanked duiker, bushbuck and common duiker). Given the discrepancies in % C4 in the diets of bovids from PBR compared with literature for other parts of Africa, it is clear that there is spatio-temporal dietary flux in many bovid species. Bovid diets are, to some extent, habitat-specific and averaging of % monocots in diet from continent-wide field studies does not adequately represent dietary diversity among African bovid species. Chapter 5 studied an assemblage of eleven bovid species in Pendjari Biosphere Reserve and tested two nutritional hypotheses for the ecological diversity of ungulates, the browser/grazer (diet type) and diet quality models. Results show that, contrary to many predictions, body mass and diet type are not related, but these data confirm predictions that the diet quality decreases with increase in body size, both in dry and wet season. Our findings also show numerous patterns in resource partitioning amongst the 11 bovid species studied, suggesting that different species used different dietary resource in contrasting ways. We concluded that in our study area, due to abundant resources and low herbivore densities, especially in the wet season, niche breadth and diet overlap remain large, because there is no need for herbivores to specialize and to avoid competition over scarce resources. Chapter 6, examined seasonal habitat features and diet partitioning in sympatric bovid species using waterbuck (*Kobus ellipsiprymnus*) and western kob (Kobus kob) as model species. In support of niche partition hypothesis, diets of western kob and waterbuck differed significantly along both faecal selection axis (δ13C and δ15N) during the resource scarcity period of dry season as opposed to wet season when there is resource abundance. Western kob and waterbuck resource partitioning does not occur only on the basis of diet segregation but also some habitat variables play an important role in the co-existing system with “distance to water” emerging as most important discriminatory variable.
Chapter 7 provided a valuable contribution to our knowledge on how coexistence in sympatric African mammal herbivores affect behaviour and vigilance of ungulate using Bohor reedbuck as model species. Our study adds to the large amount of evidence demonstrating the herd-size effect on ungulate vigilance, and it also adds the importance of sympatric grouping system in Bohor reedbuck behaviour and vigilance efficiency. In addition, habitat type and grass height did not affect the vigilance behaviour of the Bohor reedbuck. Our study has also shown that within-herd spatial position is an important factor to be taken into account in the study of vigilance behaviour. However, further study is needed to investigate the possible sex-specific functions and targets of vigilance behaviour and the effect of within-herd spatial position with respect to the herd direction in the field. The last chapter (Chapter 8) presented a general discussion and conclusions on issues tackled in this thesis. Although each part of the study was approached independently, the various elements combined well providing an indication of the factors driving coexistence in bovid community of Pendjari Biosphere Reserve.
Key words: Bovid, diet, habitat use, coexistence, Pendjari, niche segregation, seasonality, Benin

3. Assessing land use impact and biodiversity indicators in W Biosphere Reserve and its bordering areas in Benin (West Africa)

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Abstract

During the last century, the rapid population growth has led to an increasing demand of natural resources for human requirements. As a result, one has assisted to an accelerated loss of biological resources. To cope with the uncontrolled use of biological resource and its degradation, nations over the world have committed themselves to a significant reduction of biodiversity loss through the Convention on Biological Diversity (CBD). Hence the assessment of progress accomplished in the biodiversity conservation has become a challenge for the scientists, resources managers and policy-makers. Since biodiversity is too complex to be fully quantified, the use of indicators appears relevant to follow-up and to provide information on the trend of biodiversity. There are considerable experiences over the world in biodiversity indicators development for the sustainable use of natural biological resources. However, the effectiveness of the most developed indicators in measuring biodiversity remains questionable. Moreover, the defined indicators in a given place cannot be systematically transferred to another place since the driving forces and ongoing ecological processes can differ. This work represents a case study of indicators for sustainable conservation development based on the driving forces and ongoing ecological processes in the W Biosphere Reserve (WBR) in Benin. The overall objective of this study is to assess the impacts of land use on biodiversity conservation and to define a set of effective indicators in order to provide park managers and policy-makers with decision support tools for a long term monitoring and sustainable management of biological diversity in WBR and surrounding areas. The specific objectives are to assess (i) the land cover and land use change at W Biosphere Reserve, (ii) the change in plant community composition, diversity and traits along land use gradient park → buffer zone → communal lands, (iii) the grasslands state characteristics along land use gradient to protected area, (iv) the effectiveness of hemicryptophyte plant species as indicators of grassland state, (v) the land use and pruning impacts on population structures of four woody fodder species, and (vi) the effective indicators for sustainable management of WBR. This thesis begins by the introduction which presents the relevance of the study and the objectives to be achieved.

The chapter 1 briefly describes the study area. First, we present the general characteristics of Benin and after the specifics characteristics of the W Biosphere Reserve and surroundings areas.

The chapter 2 analyzes the land use/land cover change within two (02) sampled areas including the protected area and unprotected area in the northern as well as in the southern of the WBR. We have assessed the main drivers of land covers change around the reserve. Land clearing for crops production, tree logging, settlement and grazing are quoted by the surveyed households as main driving forces inducing land cover change around the reserve. Using the logit model, results show that household active population growth and land fertility are the main factors which significantly impact land clearing around the WBR. Temporal maps analysis within the periods 1995 and 2006 shows that the forest cover is progressively converted into farmlands at a deforestation rate of 15.1% outside the reserve while the forest cover has increased for 0.7% inside the reserve at the southern part. For the same period of time, the deforestation rate is about 7.6% outside the reserve while the forest cover has increased for 0.05% inside the reserve at the northern part. Probability transition matrix of land cover shows high probabilities of woodland and savanna vegetation to be converted into cropland outside the reserve highlighting the persistence of vegetation degradation around the reserve in the coming years.

The chapter 3 of this thesis analyses how far land use affects plant communities traits and their diversity in order to highlight plant species and plant communities' attributes which are sensitive to disturbance. For this purpose, 120 stratified random plots are set out along transects crossing communal land, buffer zone and park. Non-metric multidimensional scaling (NMS) is used to assess plant community patterns. Results show that species richness and Shannon index of plant communities display no clear pattern along the land use gradient while Pielou evenness is sensitive to disturbance. Therophytes abundance is significantly higher in the communal land while hemicryptophytes abundance is significantly higher in the protected area. Wide-distributed species abundance is significantly higher in the communal lands whilst Sudanian species show significantly higher abundance in the protected area. This chapter outlines the relevance of Pielou evenness, life forms traits and chorotypes composition of plant communities as indicators which can be used by managers for phytodiversity monitoring and sustainable conservation.

In the chapter 4, we have quantified and compared the grassland characteristics between park, buffer zone and communal lands. A total of 36 biomass plots (10 m X 10 m) are randomly laid out along the transect from communal land, through buffer zone to the park. Biomass harvesting and point quadrat relevés are performed in the park, buffer zone as well as in the communal lands. Results show that the average grassland primary production is significantly different between park, buffer zone and communal lands. The grazing value of grassland decreases significantly along land use gradient from the protected area to the communal land In contrast, the rate of unpalatable plant species increases significantly from protected area to the communal lands. A negative correlation is found between grasses biomass production and the rate of unpalatable plant species in all grassland types. Species richness of grasses species is positively correlated with the grasses biomass production in the protected area. Species richness of grasses, rate of unpalatable plant species and grazing value are found to be relevant indicators for determining grassland state.
In the chapter 5, we have discussed the reliability of the use of hemicryptophytes traits as indicators of grassland state in the WBR and surrounding areas. Results show that hemicryptopyte traits vary significantly with the land use types. Hemicryptophyte biovolume and hemicryptophyte contribution for biomass production are strongly correlated, respectively, with the total biomass production and the grazing value. The study higlights the relevance of hemicryptophytes as indicators of grassland state that can be used by managers for the monitoring, restoration and sustainable use of grasslands.
In the chapter 6, we have analyzed the use of woody fodder plant species by cattle breeders. Through structured interviews, we have inventoried a total of eighteen woody species as woody fodders used by cattle breeders around the reserve. *Afzelia africana, Pterocarpus erinaceus, Khaya senegalensis*, and *Stereospermum kunthianum*, respectively are the four most use woody fodder in the area by cattle breeders. We have assessed the impacts of pruning and land use type on the population of the four most frequently used woody fodder species. The Weibull distribution is used to fit the diameter size class distributions (SCDs) of the four studied species. In the protected area, the SCDs have displayed right asymmetric distributions for all four plant species indicating populations with relatively few young individuals. In communal lands, the SCDs have displayed left asymmetric distribution indicating populations with very few young individuals for A. africana and *K. senegalensis*. Populations of *S. kunthianum* and *P. erinaceus*, however, have displayed right asymmetric distribution in the communal lands. *Afzelia africana, Pterocarpus erinaceus, Khaya senegalensis* are found to be in a critical state and deserve high priority for conservation around the WBR in order to prevent from decline in communal lands. Moreover, this chapter shows that the use of population tree density and height as indicators is questionable at local scale.
Finally, we have highlighted key results from this study and discussed the relevance of the methods used to identify the indicators. Synthesis of the effective indicators to be used by managers of WBR for biodiversity monitoring is presented at species, habitat and landscape level. Based on the findings from this study, perspectives for further researches are made and recommendations are formulated toward managers for effective monitoring of biodiversity and sustainable management of the reserve.
Keywords: biodiversity indicator; biosphere reserve, hemicryptophyte;

4. Areas of occurrence and eco-ethology of the colobus Geoffroy (*Colobus vellerosus*) and the olive colobus (*Procolobus verus*) in Benin

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Abstract

In Benin, due to Habitat disturbances induced by strong anthropogenic pressures, some primates 'species have become vulnerable or even threatened as it is the case of the Colobus monkeys. Thus, the problem of conservation of wild fauna, especially primates becomes worrying. The general objective of the study is to determine biogeographic and eco-Ethological characteristics of *Colobus vellerosus* and *Procolobus verus* in Benin. The study addressed the diachronic analysis of occurrenceareas, abundance, forms of threats, the activities budget and mode of the habitats use by these primates. The method which enabled the biogeographic data collection is based on surveys followed by forest surveys and visits to markets where are sold organs of animals. Methods of linear transects and direct counting in the natural environment associated with the results of investigations allowed to enjoy the abundance of the colobus monkeys on various sites of occurrence. Finally, observations of groups of monkeys by the scan sampling and ad libitum methods associated with floristic survey, helped in describing the activities budget and modes of the habitats use by the colobus monkeys. The results showed that once across the three zones chorologic, *Colobus vellerosus* and red colobus *Procolobus verus*'s current areas of occurrence are limited to Guineo-Congolese and Guineo-Sudanian zones covering respectively 20.506 km^2 and 25.403 km^2.

The main threats to these monkeys included disturbances of Habitat, deforestation and poaching. Numbers of populations of*Colobus vellerosus* and *Procolobus verus* in Beninwere estimated respectively at 543 and 574 individuals and distributed on several sites of occurrence. In the classified forest of Lama, *Colobus vellerosus* average meeting rate of 0.60 contact/km, *Procolobus verus* was 0, 11contact/km and reached 0.49 contact/km in the forest community of Dome. The activities of the *Colobus vellerosus* budget has shown that rest, food, travel, social relations and other activities respectively occupied 56.64%, 26.31%, 13,04% and 3.31% and 0.70% of the time. As far as plants consumed are concerned, the colobus monkeys showed flexibility in their diet because some thirty species were consumed. In addition, sites dormitories had characteristics conducive to the avoidance of predators and were close to food resources. Finally, strategies and actions need to be developed to reverse the trend towards the decline of populations of primates in particular those of the colobus monkeys.

Key words: biogeography, abundance, threats, habitat use and budget activities, Benin.

5. Ethnobotanical and ethno-pharmacological studies of plants used in traditional treatments of high blood pressure disease in central Benin

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Abstract

High blood pressure also called the "silent killer" is a major risk factor for cardiovascular diseases, and according to statistics, one in two adults will suffer of hypertension by 2025. Although the African people have used traditional herbs to heal themselves, very little information exists on species that show antihypertensive properties. This worktherefore aimsto contribute tothe study of theantihypertensive propertiesofplants used intraditional treatmentof hypertensionin the departmentsof Zou andCollines.The ethnobotanical study conducted among 27 herbalists and 174 traditional healers, helped to identify 160 plant species used in the treatment of hypertension in central Benin. These plants belong to 139 genus and 64 botanical families. From the most representative species, the aqueous extracts of leafy stems and roots of *Heliotropium indicum* and leaves of *Crateva adansonii* were selected for the antihypertensive, toxicity and phytochemical studies. The phytochemical study revealed the presence of flavonoids, tannins, coumarins, lignans, saponins, terpenes, anthocyanin pigments and triterpenes. Only the roots of *H. indicum* revealed alkaloids. The administration of decoction of each extracts did not induce any signs of toxicity in Wistar rats. We evaluated the effect of our extracts in animal model of hypertension induced by N(G)-nitro-L-arginine-methyl-ester (L- NAME) and they showed a significant decrease in blood pressure.These preliminary results are pharmacological arguments for the use of our plants in the traditional treatment of hypertension. Thus,extensive researchofmechanisms of action ofextracts of*H. indicum* and*C.adansonii*in loweringblood pressurecould bea pathway towardsthe discovery of newactive moleculeswhoseantihypertensive propertiesare certain.

Keywords: Medicinal plants, L-NAME, ethnobotany, antihypertensive, central Benin, *Heliotropium indicum*, *Crateva adansonii*.

6. Contribution to the ethno-botanical and pharmacological study of plants used in traditional treatment of the high blood pressure disease in Atlantic and Littoral departments

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Abstract

According to the WHO, the prevalence of high blood pressure disease in 2000 was estimated at 26.4% for adult population. In Benin, it increases rapidly from 20.03% in 2001 to 27.5% in 2008. The modern treatments to this disease are inaccessible to people of developing countries due to its high cost and lead them to traditional medicine. Our ethnobotanical survey made in the departments of Atlantic andLittoral helped to identifythe plants used in traditional medicine to treat this pathology. Preparation methods and parts used were also identified. A hundred and ten traditional healers, thirty-six herbalists and eight resource persons were interviewed. Ninety-one species belongings to forty-three families were identified. *Morinda lucida* is one of the most significant. *Morinda lucida* leaves and roots' extracts at the single dose of 2000mg/kg body weight showed no evidence of toxicity. The phytochemical analysis by TLC (Thin Layer Chromatography) of those extracts showed the presence both in leaves and roots of coumarins, flavonoids, bitter ingredients, lignans, naphtoquinone aglycone and cardiac glycoside. For the pharmacological study, the doses of 500mg/kg body weight and 1000mg/kg body weight were tested for the leaves and the dose of 500mg/kg body weight for the roots on arterial high blood pressure disease induced in the rat WISTAR by L-NAME. At those different doses, arterial blood pressure was found to have declined significantly. The dose of the leaves extracts at 1000mg/kg body weight leads to the arterial blood pressure normalization. These results explain why the species is largely used in traditional medicine.

Keys words: Hypertension, *Morinda lucida*, Atlantique, Littoral, folk medecine, L-NAME.

7. Assessments of ethnobotany and effects of plants presumed to fight the high blood pressure disease in the lower Valley of Oueme (Benin)

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Abstract

Despite the efforts in curbing the progress of cardiovascular diseases, the prevalence of the high blood pressure disease in Benin rose to 27.9% in 2008. Due to the high cost of modern treatments, lack of accessibility to the poor who often use poorly studied medicinal plants, this study aims to determine the plants that are used in fighting the high blood pressure disease, the effect of the leaves and roots of *Carissa edulis*, a mostly used plant species in the Oueme lower Valley through its efficiency and its non-toxicity.To that end, an ethno-botanical survey was carried out, followed by the selection of a relevant plant, the preparation of the plant aqueous extract, the phytochemical study of the acute toxicity according to the OECD, the collected bodies histological study and evaluation of the anti-HTA activity excerpts.As results, on the 59 plants listed, *Carissa edulis* has been taken. Its leaves'phytochemical analyses revealed the presence of coumarins glycosiles, flavonoids glycosiles, anthocyanin pigments, Lignans, saponins, derivatives anthracene, bitter principles (terpene derivatives and sesquiterpene) and cardiac glycosides. In the roots, we noted the additional presence of alkaloids and terpenes glycosiles, then the absence of anthracene derivatives and bitter principles.The administration of leaves and roots decoctions caused no toxic signs in the Wistar rat. *Carissa edulis* has proven significantly efficient against the high blood pressure disease on this rat. But these results provide a pharmacological important argument for the valorization of this plant against the high blood pressure disease. Better targeted studies of the mechanisms of action and the determination of *Carissa edulis* could develop new remedies against the high blood pressure disease which must be more accessible to our populations.

Key words: high blood pressure disease, *Carissa edulis*, L-NAME, traditional medicine, treatment.